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HILLSIDE AGRICULTURE SUB-PROJECT (HASP)

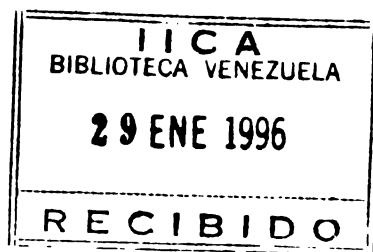
On-Farm Trial of Traditionally Grown
Cacao, (*Theobroma cacao* L.)
Comparing Farmers Cultural Practices.

IICA-CIDIA

C.Reid, E. Stone, E. Pinnock, Z. Annakie
Jamaica, W.I.

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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 TRIAL OF TRADITIONALLY GROWN
CACAO, *Theobroma cacao* L., COMPARING FARMERS
CULTURAL PRACTICES TO THE COCOA INDUSTRY BOARD (CIB)
RECOMMENDED COMPLETE PACKAGE OF CULTURAL PRACTICES
AS PERTAINS TO CACAO POD AND WET BEAN PRODUCTION**

By

**Charles Reid, HASP Technical & Administrative Coordinator
E. Stone, E. Pinnock, Z. Annakie, Agronomists**

November, 1993

This report gives a description, analysis and comparison of cacao grown and managed under traditional methods compared to traditionally grown cacao managed using the cultural practices of the Cocoa Industry Board at 15 locations in the Parish of St. Catherine, Jamaica. A paired comparison test was used to find differences in the CIB recommended package of cultural practices and the farmers method of managing cacao. The treatments were:

Treatment 1, (CIB recommended cultural practice)

1. Weeding twice per year,
2. Pruning cacao trees once a year between crops to correct tree shape and other defects, and thereafter every two months to remove gormandizers; and pruning overhead shade trees to less than 50% shade for cacao plants with continuous canopy,
3. Application of 1 lb. of 13-11-19 or similar fertilizer per tree before the onset of both the ring and autumn rains,

Treatment 2. (traditional management practice),

1. weeding once a year,
2. light pruning once a year with partial removal of black pod.

Information was collected on trunk diameter, height. nearest shade tree, soil composition, the loss of pods from cherelle wilt, soft pod disease, black pod disease, and rat damage. Analysis of data included ANOVA, Paired Comparison, Repeated Measures Analysis and Covariate Analysis, and Modified Stability Analysis. A Regression Analysis of the various pod results was performed against different cacao tree trunk sizes.

Data for the winter harvest was being compiled at the time of this report but was not available in sufficient quantity to analyze. The researchers will continue to collect and analyze the data as it is gathered.

The researchers urge that data continue to be collected and analyzed for another two seasons in order to get a better understanding of the response of cacao one year after pruning.

INTRODUCTION

Cacao plants were introduced into Jamaica by the Spaniards in 1646 and cocoa was among the first major export crops (Miller and Topper, 1986). The Parish of St. Mary in the region around Richmond traditionally produced the most cocoa in Jamaica. Important adjacent cacao growing areas included northern St. Catherine, St. Ann, upper Clarendon, Portland, St. Thomas, and southern and western St. Andrew. Cacao was also grown on a lesser scale in the eastern parishes in southern St. James and Hanover, northern Westmoreland and St. Elizabeth (Topper, 1993, personal communication). In 1991/92 deliveries of wet cocoa to fermentaries totalled 6,194 tones, an increase of 41.6% over the 1990/91 crop year (Planning Institute of Jamaica, 1993).

Fagan (1984) reported that small farmers produced 76% of the country's cocoa crop. In 1988, there were 24,000 registered farmers on 8,498 ha growing cacao on land ranging from 0.2 ha to 4.0 ha in size (Atkins, 1988). Williams (1993) found in case studies in the Rio Cobra Watershed (n=4) that an average of 20 additional plant species were intercropped in cacao fields giving rise to four canopy strata with 68% of the plants occurring in the lower canopy (between two and six meters). Of the 68% of the plants in the lower canopy, 46% were cacao, 27% were banana, *Musa* (AAA Group), and 20% were renta yam, *Dioscorea alata* L. var. *renta*. Of the 23% of the plants occurring in the ground cover strata (less than two meters), 49% were cacao and 21% were cocoyam, *Colocasia esculenta* (L.) Schott. There was a total of 4,174 plants per ha, nearly three times the 1,493 plants recommended by Wood and Lass for cacao plantings (1987).

Reason for Cacao Trials

In an analysis of data gathered from the Informal Survey conducted by MINAG/IICA Farming Systems Sub-Project of the Hillside Agriculture Project of 1989-1990, Todd-Bockarie and Williams (1991a) found less than half (47%) of the cocoa farmers pruned their trees and even fewer (11.7%) fertilized. Development of a cacao farmer typology from a combination of the Baseline Survey and a Rapid Rural Appraisal Exercise (Bockarie and Williams, 1991b) suggested that farmers could be categorized according to:

1. Farmers not harvesting nor applying cultural practices (weeding, pruning, fertilizer, and rat control) to their cocoa fields,
2. Farmers that harvest cocoa, but do not utilize cultural practices,
3. Farmers who use some cultural practices some of the time,
4. Farmers using all cultural practices.

This information suggests that many farmer are not following the complete recommendations from the Cocoa Industry Board for cultural practices which include:

1. Planting at a spacing of 3 x 3 or 3.6 x 3.6 m for cuttings and hybrid seedlings, respectively,
2. Weeding,
3. Pruning cacao trees once a year between crops to correct tree shape and other defects, and thereafter every two months to remove gormandizers; and pruning overhead shade trees to less than 50% shade for cacao plants with continuous canopy,
4. Application of .45 kg of 13-11-19 or similar fertilizer per tree before the onset of both the spring and autumn rains,
5. The setting of 0.11 kg of rat poison per 30 trees checked and replaced when needed every three days until damage is stopped (Topper, 1992).

Objective and Justification

The objective of this trial was to compare the response of cacao pod production of traditionally grown cacao trees grown under CIB recommended package of cultural practices to that of the farmers method. Traditional cacao fields were defined as mixed with planted and volunteer cacao of largely undetermined and assorted varieties of diverse ages and sizes intercropped with assorted plant species of diverse sizes and densities. The study was intended to provide information to extensionist and small farmers on the response of traditionally grown cacao under the CIB recommended package of cultural practices compared to the farmers method.

METHODOLOGY

Research Design

A paired comparison test design was used to compare the effect of the CIB recommended package of cultural practices and the farmers method of cultural practices for cacao. The CIB treatment was:

1. Weeding twice per year,
2. Pruning cacao trees once a year between crops to correct tree shape and other defects, and thereafter every two months to remove gormandizers; and pruning overhead shade trees to less than 50% shade for cacao plants with continuous canopy,
3. Application of 0.45 kg of 13-11-19 or similar fertilizer per tree before the onset of both the spring and autumn rains.

The farmers traditional practice was:

1. weeding once a year,
2. light pruning yearly with partial removal of black pod.

Fifteen sites each contained one block made up of two plots. Plots were randomly assigned treatments. Nine plants were assigned to each plot for a total of 18 plants per block.

Data Recording

The height and diameter of each tree in the study was recorded in September and October, 1993. The standard measurement of diameter at breast height (dbh = 1.3 m from ground level) was taken using a diameter tape. The height of each tree was taken using a bamboo pole marked in meters. The distance and species of the plant providing the major source of shade for each cacao tree was recorded. Cacao pods rendered useless by cherelle wilt, black pod, soft rot and rat damage were removed from the study trees in September and October, 1993. Thereafter, the number of pods destroyed from these pests were recorded at two week intervals. The number of pods harvested and the wet weight of the seed was recorded for each tree every two weeks during the harvest season.

Analysis

Analysis included ANOVA, Paired Comparison, Repeated Measures Analysis, Covariate Analysis and Modified Stability Analysis of:

- 1) diameter and height,
- 2) sub-species production (criollo vs. forastero),
- 3) number of rat-cut,
- 4) number of cherelle wilt,
- 5) number of black pod,
- 6) number of soft rot

Genetic Material

The genetic material was not determined experiment initiation. The test fields were a mix of *Theobroma cacao* cv.'s *criollo*, *forastero*, and some *trinitario*. An attempt was made to identify the cultivars in the experiment from the characteristics listed by the Cocoa Industry Board.

Criollo trees were characterized by pods being high-shouldered, long and pointed, warty with thin pod walls with mature pods usually green in color. The beans from criollo pods were reported as being large and plump with a white interior. If the pod was pollinated by a forastero tree then the seeds could be light purple in color.

The forastero pods were characterized as being smooth with thick walls of a calabash shape. The color varied from green to red or some color combination. The beans were flatsided and smaller than the criollo with the bean interior being a deep reddish-purple.

The trinitario pods were characterized as being high shouldered or bottle necked with either long or short points. The skin was only slightly warty.

Site Management

Fields were cleaned and pruned by the farmers between June and August, 1993, under the supervision of IICA\MINAG agronomist working to maintain uniformity in pruning techniques based on CIB recommendations. Dead, dying and diseased limbs were removed. Further pruning resulted in the removal of gormandizers to a height manageable by the farmers ie., facilitating pod harvest. The subsequent pruning of cacao limbs and other shade material in the site was done between the harvest periods before leaf flushing and flowering.

The first application of the CIB recommended N-P-K fertilizer 16-9-18 at the rate of 0.45 kg per plant was begun in August, 1993 and was scheduled to be applied at the onset of each rainy season.

Two weeks before harvesting, rat bait was applied to all sites at a rate of 0.11 kg per 35 trees. Every three days the bait was replaced if eaten. Rat control was maintained as long as rat damage was present.

RESULTS

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 30.9⁰ C. February was the coolest month with a mean minimum daily temperature of 18.3⁰ C (Figure 2).

Prior to the trials all sites were managed as traditional cacao-intercropping systems. Management practices included weeding and pruning once a year between January and March. After March the sites were generally not weeded to allow the young renta yam (*Dioscorea alata* L. var. *renta*) to grow into the canopy. The sites were generally heavily intercropped traditional crops including banana (*Musa* (AAA and AAB Groups), cocoyam (*Colocasia esculenta* (L.) Schott), pear (*Persea americana* Mill.), coconut (*Cocos nucifera* L.), apple (*Eugenia malaccensis* L.), pimento (*Pimenta jamaicensis* (Britton & Harris) Proctor), breadfruit (*Artocarpus altilis* (S. Parkinson) Fosberg), cedar (*Cedrela odorata* L.), sugarcane (*Saccharum officinarum* L.). Other site characteristics recorded included soil type, pH, altitude, % slope, and aspect (Table 1).

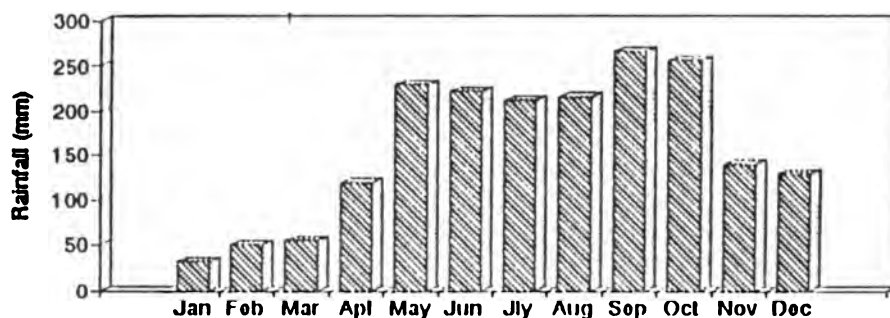


Figure 1. Rainfall records for the Riversdale, St. Catherine between 1950-1980 shown as mm\mo reached or exceeded 75% each year. Rainfall equalled or exceeded 1,552 mm per year 75% of the time. There were two wetter periods, May to June and September to October while January to March was a drier period.

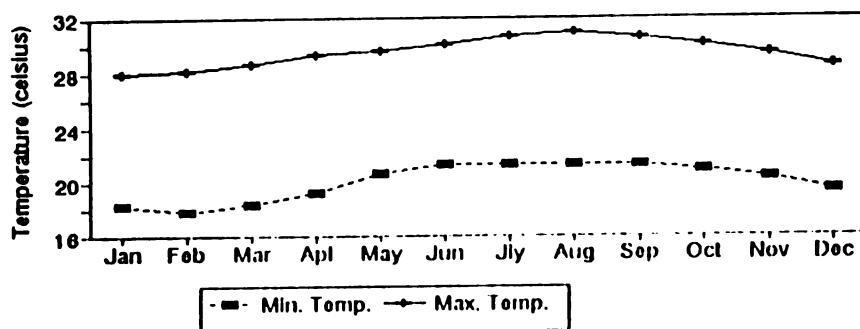


Figure 2. Mean minimum and maximum temperatures for Riversdale between 1950-1980. For Riversdale, August was the warmest month with a mean maximum daily temperature of 30.9°C and February was the coolest month with a mean minimum daily temperature of 18.3 °C.

Table 1. Selected sites characteristics of the complete package trial compared to the farmers traditional method of producing cocoa.

SITE (Location)	SOIL TYPE (Jamaican Series)	pH (H₂O)	Elev. (m)	SLOPE (%)	ASPECT
1. Jubilee	Diamond clay loam	6-7	457	50-60	200- 270⁰ SW
2.					
3.					
4.					
5.					
6. Top Mount.	Bonnygate clay loam	6	450	20	160 SE- 240⁰ SW
7. Top Mount.	Bonnygate clay loam	6	450	35	
8. Top Mount.	Bonnygate clay loam	6	450	35	
9. Bagbie	Flint Riv. sandy loam	7	305		
10. Stapleton	Harewood silty clay loam	6	305		
11. Hampshire	Harewood silty clay loam	6	230		
12. Hampshire	Harewood silty clay loam	6	230		
13. Hampshire	Harewood silty clay loam	6	230		
14. Hampshire	Harewood silty clay loam	6	230		
15. Hampshire	Harewood silty clay loam	6	230		

SUMMARY AND DISCUSSION

The winter season for harvesting cacao arrived late in 1993. Harvest projections from field personnel indicate that the cocoa harvest would be low because of a prolonged wet period during and after summer flowering. This wet period was blamed for low levels of pollination and increased levels of cherrelle wilt and black pod, all of which resulted in decreased yields in the trial region. Further decrease in yields within the trial plots were to be attributed to the effect of pruning. In general, lower yields during the following season after severe pruning can be expected (Wood and Lass, 1987). However, cacao generally responds with increased yields the second season after drastic pruning.

Data for the winter harvest was being compiled at the time of this report but was not available in sufficient quantity for analyses. The researchers will continue to collect and analyse the data as it is gathered.

The researchers urge that data continue to be collected and analysed for another two seasons in order to get a better understanding of the response of cacao one year after pruning.

APPENDIX A

COCOA DATA

TRT/PLOT 1: FERTILIZER + PRUNING + BAD POD REMOVAL = CIB

TRT/PLOT 2: NO FERTILIZER UNDER TRADITIONAL MANAGEMENT

CODES

NSP = nearest plant species
BLACK = phytophthora (black pod)
SOFT = Soft pod rot
RAT = Rat damage, destroyed
VAR = Foresterio or Creolla

ADMIN. AREA

1-5= PINNOCK
6-10= STONE
11-15= ANNAKIE

DATE BASELINE: Sept. 7, 93

TREAT/						
SITE	PLOT	NO.	DIA(cm)	HT(m)	NSP (m)	SPECIES
1	1					
1	1	95	29.2	5	3	11
1	1	94	23.8	6	8	11
1	1	93	13.8	6	4	13
1	1	97	10	4	6	24
1	1	96	11	4	4	5
1	1	76	10.5	4	4	13
1	1	98	12.9	4	4	3
1	1	100	7.7	5	10	25
1	2	1	9.4	4	7	3
1	2	2	6.7	3	9	4
1	2	3	10.1	6	2	4
1	2	4	7.3	4	3	4
1	2	5	11.6	5	14	4
1	2	6	7.8	4	10	1
1	2	7	14.9	4	3	1
1	2	8	18.5	4	15	4
1	2	9	7.4	4	10	4
SITE	PLOT	NO.	DIA(cm)	HT(m)	NSP (m)	SPECIES
12	1	19	8.5	6	1	13
12	1	20	28.1	6	5	13
12	1	21	11.5	4	6	5
12	1	22	7.2	4	6	13
12	1	23	11	6	4	13
12	1	24	10.7	3	9	13
12	1	25	7.2	5	14	13
12	1	26	14	4	11	5
12	2	28	12.1	6	2	8
12	2	29	11	6	8	13
12	2	30	23.9	6	11	13
12	2	31	8.5	6	6	13
12	2	32	10.3	6	6	13
12	2	33	6	4	3	17
12	2	34	10	6	5	17
12	2	35	30.9	6	7	17
12	2	36	9.3	5	5	17

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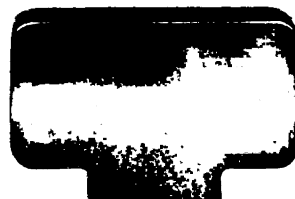
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Autor

Título	grown cacao ...
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Nombre del solicitante



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