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HILLSIDE AGRICULTURE SUB-PROJECT (HASP)

On-Farm Fertilizer Trials of Ackee
Blighia sapida Koenig,
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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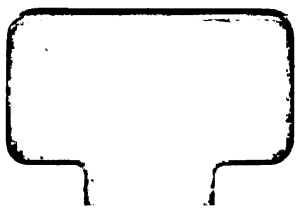

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Abstract of Research Presented to the Hillside Agriculture Project (HAP) in Partial Fulfillment of Requirements for the Hillside Agriculture Sub-Project (HASP).

ON-FARM FERTILIZER TRIAL OF ACKEE, Blighia sapida Koenig, WITH SMALL HILLSIDE FARMERS IN THE PARISH OF ST. CATHERINE, JAMAICA

By

Charles Reid, HASP Technical & Administative Coordinator,
Z. Annakie and J. Mayne, Agronomist

November, 1993

This report provides a description and analysis of an on-farm fertilizer trial of ackee, *Blighia sapida* Koenig, out-planted in October, 1992, at an elevation of 290 m above sea level in the community of Hampshire, Parish of St. Catherine, Jamaica. A randomized complete block design was used to control variability in out-planting conditions. The three treatments tested were:

A. No fertilization,
B. Fertilization with 56 grams of 8-21-32,
C. Fertilization with 112 grams of 8-21-32.

Data collected was to include: 1) diameter growth, 2) the time to flowering, and 3) pod production. An analysis of variance (ANOVA) was used to determine the difference between treatments.

An analysis of the rate of change in diameter between treatments indicated a significant difference ($p = 0.11$). The treatment utilizing 56 g of 8-21-32 gave the greatest rate of change (1.40 cm) while the treatment utilizing 112 g of fertilizer had the next largest rate of change (1.10 cm). The nonfertilized plants gave the smallest rate of change (0.99). When considering the expected classical, bell curve, response of plants to fertilizer application, the ackee fertilizer trail indicated that similar responses may possibly be expected. However, the experiment was replicated three times at one site only and further testing is necessary. Data concerned with date to flowering and production had not been collected due to the immaturity of the plants.

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 farming systems, manage soil erosion and fertility, protect the environment and to improve the living standards in rural farming 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 some local farming constraints.

Reason for Ackee Investigation

A rapid rural appraisal of the project area by the HASP team revealed that some farmers had an interest in growing export quality ackee (*Blighia sapida* C. Koenig). However, many farmers felt they had inadequate knowledge of how to grow and produce ackee profitably.

Investigating ackee cultivation was attractive to the project personnel because it potentially satisfied several stated objectives of the HAP. First, ackee trees provided soil protection with a dense leaf canopy, ground litter cover, and anchored soil with a combined deep and shallow root system (Purseglove, 1981). Secondly, ackee had a history of intercropping in the traditional systems of the local farmers. Finally, ackee establishment and maintenance was thought to be relatively easy, inexpensive with good potential for economic returns.

Ackee History in Jamaica

Ackee occurred wild in West Africa and was introduced to Jamaica in the 1778 where it naturalized (Mintz, 1984). In Jamaica ackee was found on a wide range of soils and climatic conditions ranging from just above sea level to

near 1,200 m (Robins, 1992). It was generally recognized that ackee grew and produced best in moderately dry climates at lower elevations.

Ackee cooked with salted fish became a national dish of Jamaica. As a result ackee has been processed and exported to Canada and England for nearly 30 years (Jarrett, P., personal communication, 1993). The unopened fruit of ackee has long been associated with the illness known as Jamaican Vomiting Sickness (Robins, 1992). Because the aril and unopened fruit contain the peptides, hypoglycine A and B, care must be taken to use only naturally opened fruit and to remove the pink raphe from the aril before processing (Rhem and Espig, 1991). Since 1972, the USA Food and Drug Administration imposed a ban on ackee importation due to concern over hypoglycine in the fruit (Robins, 1992). However, the demand for ackee by processors remained to be satisfied particularly for ackee produced during the off-season (Jarett, P, personal communication, 1993).

Ackee was rarely planted. When volunteer seedlings occurred in locations acceptable to land-users, the tree was allowed to grow. No recognized management strategy has been associated with the growing of ackee. The researchers have observed that many families grow ackee to support their demand, often only one tree. Commercial cultivation of ackee was not practiced and the export industry was dependant on middle-men who traveled through regions gathering small amounts of ackee from numerous sources to obtain profitable quantities to sell to the processors (Jarett, P., personal communication, 1993).

Two types of ackee fruit were commonly recognized and were known locally as the 'butter' and 'cheese' varieties of ackee. The cheese variety was lighter in color having a rigid texture favored for canning (Robins, 1992). Stair and Sidrak (1992) reported considerable variability in ackee germplasm which manifest in: 1) tree conformation and size, 2) color, size and shape of capsules, 3) quality of arils, and 4) yield, time, frequency and magnitude of flowering. Stair and Sidrak further reported that the variability in yield during one year for 19 trees ranged from 117 to 3,157 fruits with the six top producers giving between 1,149 to 3,157 fruits/tree/year.

Literature on the cultural practices for ackee production was sparse. However, Stair and Sidrak (1992) performed several propagation trials and reported a 100% success in rooting ackee from stem cuttings in 9.5 mm gravel media. They reported no success with grafting or budding. However, the Ewarton Nursery supervisor reported that the nursery practices

top-grafting of ackee to provide superior trees and to encourage early fruiting (Ffrench, E., personal communication, 1993).

No farmers growing and managing ackee as a major cash crop were identified. The lack of management directed toward ackee cultivation in a orchard or intercropping system, the potential for economic profits, and the mandate of the HAP encouraging sustainability in agriculture were major factors in investigating the response of ackee to two fertilizer regimes.

Objective

To compare the effect of two fertilizer treatments on early growth and pod production to unfertilized ackee.

Justification

To provide information to farmers, extensionist, and researchers on the response of ackee to early fertilization.

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 for inclusion in the trials were that farmers: 1) had to be active members of the local FACT organization, 2) had to have land on a slope, 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

A researcher managed, on-farm trial was established at a single site. A randomized complete block design was used to control variability in outplanting conditions (Appendix A). The site consisted of three adjacent blocks arranged along the land contour. Each block contained three plots. Each plot was randomly assigned one of three treatments. The three treatments being tested included:

A. No fertilization,
B. Fertilization with 56 grams of 8-21-32,
C. Fertilization with 112 grams of 8-21-32.

Four plants were assigned to each treatment for a total of 12 plants per block. One guard row was established above and below the trial and was subjected to the pertinent treatment. The plants were spaced 7.6 m apart using a square formation adopted from the Coconut Industry Board recommendation for spacing coconut. The N-P-K fertilizer 8-21-32 which was widely available was used by virtue of being recommended by the Coffee Industry Board for bearing coffee.

The height and diameter of each tree (seedling) was recorded in December, 1992. Each tree was marked with paint at the soil line which served as a permanent guideline for measurements. Diameter measurements were taken with a caliper. Height measurements were taken with a measuring tape. Pods were to be counted and weighed as they were reaped from the tree.

Analysis

An analysis of variance (ANOVA) was used to determine the difference in diameter, height, flowering, and production between treatments. Early analysis found a strong correlation between diameter and height and a decision was made to procure only diameter data thereafter.

Planting Material

Ackee seedlings for the experiment were procured from Suttons Nursery, Clarendon. Variety, potting medium, management practice, and age of selling were unknown variables.

Out-planting

In September, 1992, a 0.30 ha site was cleaned using machetes but was not burned. In October, 1992, a pick-axe was used to dig holes approximately 30 cm in diameter and depth. During the same day the fertilizer treatments were incorporated into the planting holes and the ackee seedlings were planted. Thereafter, the fertilizer treatments were applied in a band around the outer leaf area of each plant twice a year during the onset of the rainy season. In early 1993, block three of the ackee trial was fenced and horses corralled in the area resulting in the loss of the block.

RESULTS

Site Characteristics

The site is located at approximately three km N from the township of Riversdale in the community of Hampshire in the NE corner of the Parish of St. Catherine at the approximate latitude 18_0 11' N and longitudes 76_0 58-57' W at an altitude of 290 m on an east facing hillside with a slope of 10%. All trees were removed during previous cultivations leaving no shade within the site. However, the site was surrounded with secondary growth forest.

Between 1988 and 1990, the site was used to grow scotch bonnet pepper, *Capsicum frutescens* L. From 1989 to 1992, the site was in a fallow/pasturage dominated by guinea grass, *Panicum maximum*.

Rainfall records for Riversdale, St. Catherine between 1950 and 1980 show that for 75% of this time rainfall equalled or exceeded 1,552 mm yearly. There were two moist periods, May to June and September to October with a dry period between January and March (Figure 1).

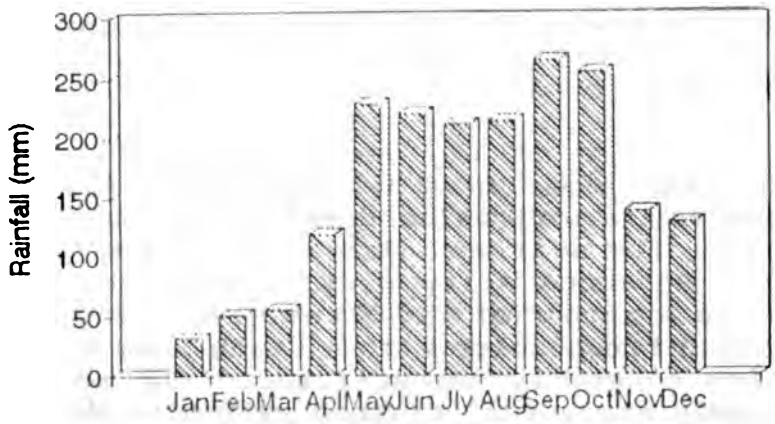

Figure 1. Rainfall records for the Riversdale, St. Catherine between 1950-1980 shown as mm\mo. reached or exceeded 75% each year. Rainfall equalled or exceeded 1,552 mm per year 75% of the time. There were two wetter periods, May to June and September to October while January to March was the dry period.

The mean minimum and maximum temperatures for Riversdale between 1950-1980 indicate that August was 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).

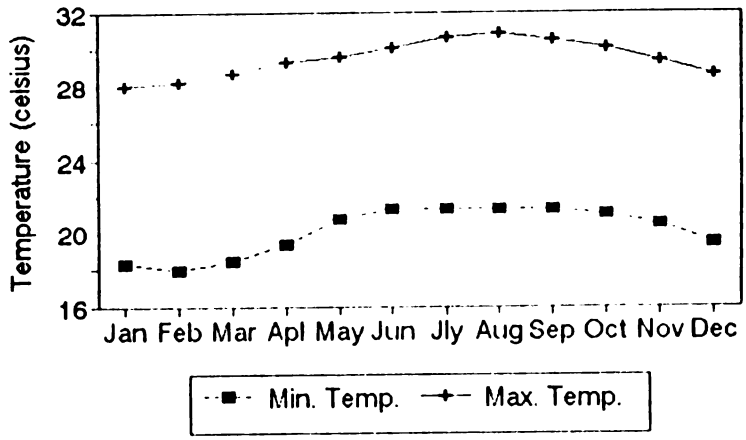

Figure 2. Mean minimum and maximum temperatures for Riversdale between 1950-1980. For Riversdale, August was the warmest month with a mean maximum daily temperature of 30.9^{0}C and February was the coolest month with a mean minimum daily temperature of 18.3 ^{0}C.

The soil was classified in the USDA Soil Order as a Typic Troporthents, a soil which developed over granodiorite parent material. The soil was classified under the Jamaican Soil Order as a Harewood silty clay loam having a pH of 6, formally known as a member of the Flint River sandy loam. The soil had a reddish brown color with a depth from 30-80 cm with root penetration generally unrestricted. The soil was of a fine texture, moderately well drained with a moderate erosion hazard. These soils are generally characterized as low in natural fertility.

Diameter Differences

The analysis in December, 1992, indicated a significant difference between treatment diameters ($p = 0.025$). Fertilization using 56 grams of 8-21-32 showed the largest mean diameter (0.83 cm) followed by fertilization with 112 grams of 8-21-32 (0.75 cm), with the nonfertilized trees showing the smallest mean diameter (0.73) (Figure 3).

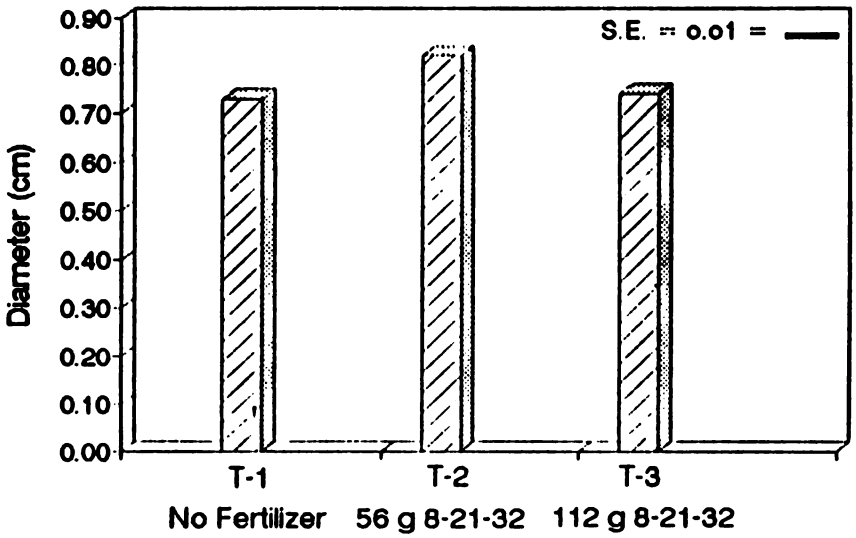

Figure 3. The ANOVA showed a significant difference between treatment diameters three months after planting (p = 0.025). Plants receiving 56 g of 8-21-32 had the largest diameters (0.82 cm) while plants receiving 112 g of 8-21-32 had the next largest diameter (0.74 cm). The unfertilized plants had the smallest diameter (0.73 cm).

The analysis of diameters in March, 1993, showed a significant difference between treatments following the same pattern as December, 1992 (p = 0.16). Treatment diameter means for plants receiving 56 grams of 8-21-32 showed the largest diameters (1.14 cm), while 112 grams of fertilizer gave the next largest mean diameter (0.99 cm) and no fertilizer gave the smallest diameter (0.94 cm) (Figure 4).

In August, 1993, there was no significant difference between treatment diameters. In November, 1993, there was not enough plants surviving landscape manipulation with a bulldozer to determine differences in the treatments.

An analysis of the rate of change in diameter between treatments for one year indicated a significant difference (p = 0.11). The treatment utilizing 56 g of 8-21-32 had the greatest rate of change (1.40 cm) while the treatment with 112 g of fertilizer had the next greatest rate of change (1.10 cm). The nonfertilized plants gave the smallest rate of change (0.99) (Figure 5). Significant differences in the rate of change began to manifest by the third month and seemed to continue even though not significantly at times throughout the experiment (Figure 6).

Time to Flowering and Pod Production

Data concerned with these parameters had not been collected due to the immaturity of the plants.

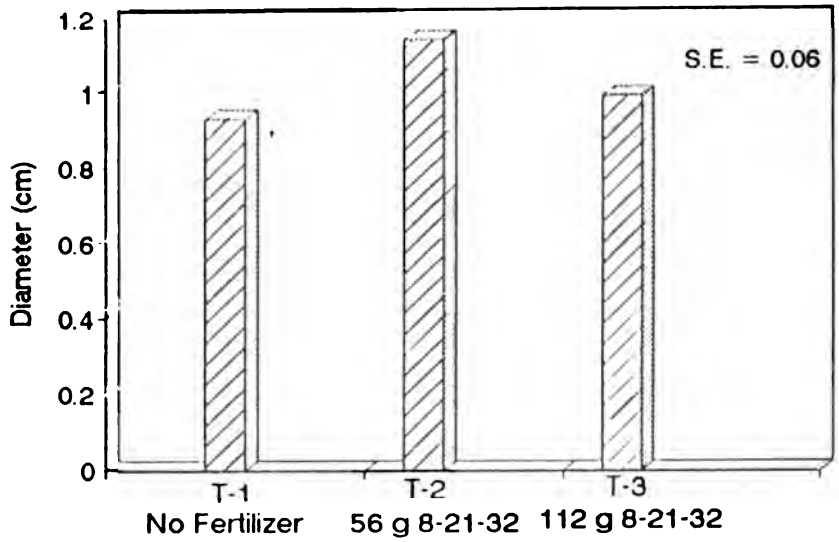

Figure 4. The ANOVA showed a significant difference between treatment diameters six months after planting (p = 0.16). Plants receiving 56 g of 8-21-32 had the largest diameters (1.14 cm) while plants receiving 112 g of 8-21-32 had the next largest diameter (0.99 cm). The unfertilized plants had the smallest diameter (0.93 cm).

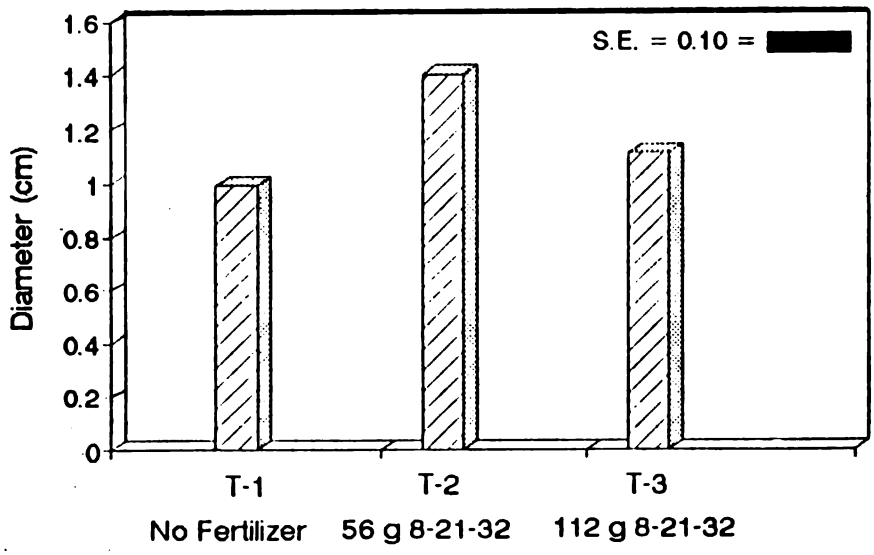

Figure 5. The ANOVA showed a significant difference between the rate of change for treatment diameters during he 11 months after planting (p = 0.11). Plants receiving 56 g of 8-21-32 had the greatest rate of change in diameters (1.4 cm) while plants receiving 1,12 g of 8-21-32 had the next largest diameter (1.1 cm). The unfertilized plants had the smallest diameter (0.99 cm).

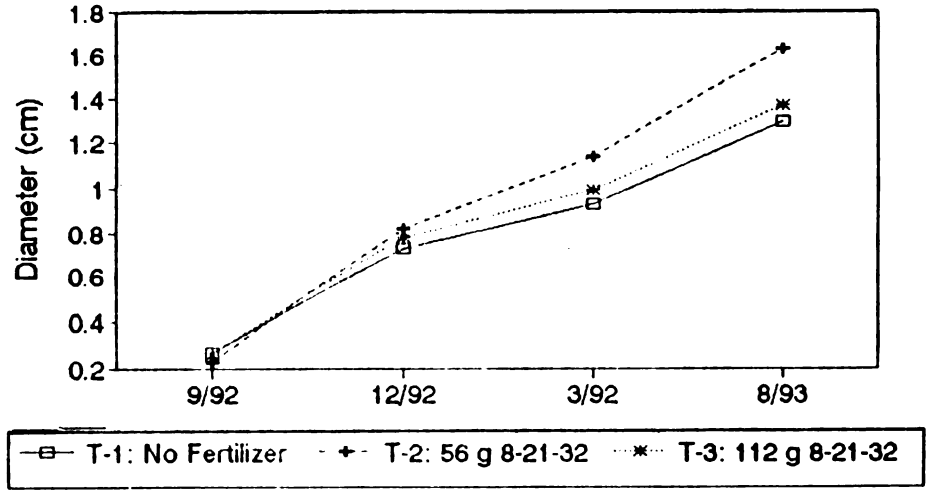

Figure 6. The change of diameter for each treatment over a one year period.

DISCUSSION

The ackee trial was a small experiment replicated three times on one site only. During the course of the trial one replication was lost leaving only two blocks to analyze. Because of the small number of plots at one site this was an imprecise experiment. At the time of the fifth measurement major portions of the remaining blocks were damaged by a bulldozer making it impossible to continue analysis.

The nature of on-farm experimentation should be considered when reviewing these 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 site.

When considering the expected classical, bell curve, response of plants to fertilizer application, the ackee fertilizer trail indicated that similar responses possibly could be expected. Ackee fertilized with 56 g of 8-21-32 gave the greater response for early diameter growth during the first year after planting.

Further Research

Ackee varieties and cultivars with desirable characteristics need to be identified and propagated. The nutrient demand of ackee needs to be studied with the objective of formulating fertilizer which satisfies requirements resulting in more and larger fruit productivity. Furthermore, ackee fertilizer trials need to be replicated on different sites. Establishment trials also need to include spacing, intercropping, weeding, and pruning. Fertilizer and general management trials (pruning, weeding, and intercropping) performed on older trees would be valuable for farmers to aid with increasing production with existing trees.

APPENDIX A
BLOCK AND PLOT LAYOUT

SITE: Hampshire

TREATMENTS: T1= No fertilizer,
T2= 58 g of 8-21-32 per plant,
T3= 112 g of 8-21-32 per plant.

Block 2						Block 1					
45	41	37	25	29	25	21	17	13	9	5	1
46	42	38	34	30	26	22	18	14	10	6	2
47	43	39	35	31	27	23	19	15	11	7	3
48	44	40	36	32	28	24	20	16	12	8	4
T1		T3		T2		T1		T2		T3	

APPENDIX B

ACKEE FERTILIZER TRIAL DATA

			DATE:		DATE: 28/12/92	
BLOCK	TREAT.	LOCAT.	BASE DIA.(cm)	BASE HT(cm)	2ND DIA.	2ND HEIGHT
1	3	2	0.29	19.00	0.76	19.50
1	3	3	0.31	23.10	0.74	26.00
1	3	6	0.34	19.00	0.82	27.50
1	3	7	0.29	24.50	0.70	25.00
1	2	10	0.27	22.40	0.78	23.00
1	2	11	0.03	20.20	0.84	20.00
1	2	14	0.29	23.30	0.85	24.60
1	2	15	0.03	21.90	0.85	24.20
1	1	18	0.31	18.00	0.68	17.20
1	1	19	0.29	21.10	0.82	25.50
1	1	22	0.03	22.00	0.76	23.70
1	1	23	0.35	19.50	0.75	20.50
2	2	26	0.36	24.90	1.07	20.70
2	2	27	0.34	19.20	0.73	21.20
2	2	30	0.26	22.30	0.79	25.40
2	2	31	0.28	17.50	0.72	21.10
2	3	34	0.27	18.50	0.64	21.30
2	3	35	0.29	23.30	0.75	25.80
2	3	38	0.03	20.70	0.75	22.10
2	3	39	0.28	26.30	0.82	26.50
2	1	42	0.29	20.70	0.72	24.00
2	1	43	0.35	19.40	0.76	19.20
2	1	46	0.28	17.00	0.66	16.50
2	1	47	0.29	18.00	0.73	20.00

			DATE: 24/3/93		DATE: 5/8/93	
BLOCK	TREAT.	LOCAT.	3RD DIA.	3RD HEIGHT	4TH DIA.	4TH HEIGHT
1	3	2	0.92	19.00	1.45	59.00
1	3	3	0.92	28.20	1.37	62.90
1	3	6	0.98	27.00	1.19	34.20
1	3	7	0.88	23.50	1.53	48.00
1	2	10	1.02	26.50	1.47	54.30
1	2	11	0.93	19.50	1.33	43.40
1	2	14	1.16	30.00	1.66	43.60
1	2	15	1.30	18.90	1.68	51.30
1	1	18	0.81	14.00	1.20	35.60
1	1	19	1.00	29.30	1.34	55.10
1	1	22	0.89	29.80	0.00	0.00
1	1	23	1.13	28.50	1.70	48.20
2	2	26	1.37	32.20	1.91	71.20
2	2	27	1.05	23.40	1.46	41.50
2	2	30	1.09	25.30	1.60	43.80
2	2	31	1.23	29.70	1.95	74.00
2	3	34	1.12	26.20	1.22	22.10
2	3	35	0.97	26.10	1.66	36.20
2	3	38	1.00	27.60	1.12	30.70
2	3	39	1.17	25.60	1.47	31.10
2	1	42	0.91	26.40	1.22	37.20
2	1	43	0.90	18.60	1.22	
2	1	46	1.02	21.30	1.15	19.80
2	1	47	0.83	17.40	1.21	24.47

DATE:
1/11/93

BLOCK	TREAT.	LOCAT.	5TH DIA.
1	3	2	1.71
1	3	3	1.81
1	3	6	1.90
1	3	7	0.00
1	2	10	1.87
1	2	11	0.00
1	2	14	0.00
1	2	15	0.00
1	1	18	1.63
1	1	19	0.00
1	1	22	0.00
1	1	23	2.27
2	2	26	2.22
2	2	27	0.00
2	2	30	1.67
2	2	31	1.79
2	3	34	1.24
2	3	35	1.61
2	3	38	0.00
2	3	39	1.55
2	1	42	1.30
2	1	43	0.00
2	1	46	0.00
2	1	47	0.00

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