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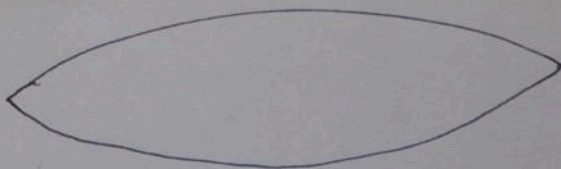
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#### *About the Institute*

The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.



- maximum width of apical third of lobe - max width of median third.
- maximum depth of indentations in 3 term. lobes.
- no of clearly percept. indentations in all 3 term lobes.

pubescence

only at base of blade  
 " " " " + along mid ribs of lobes  
 " " " " " " " " " " + secondary  
 " " " " " " " " " " " " + blade

18-19-20

Undulation 1-2-3

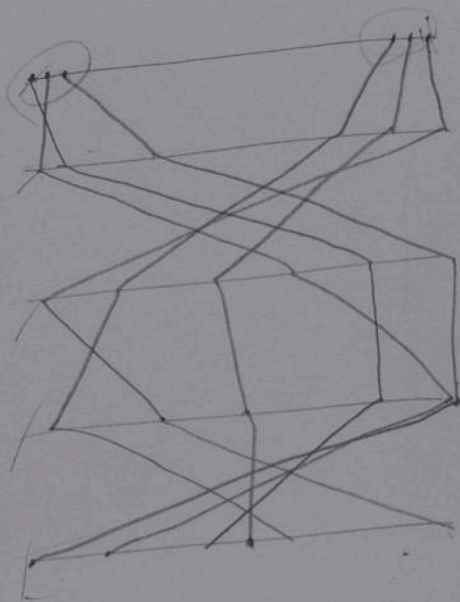
[obs. size of leaf]

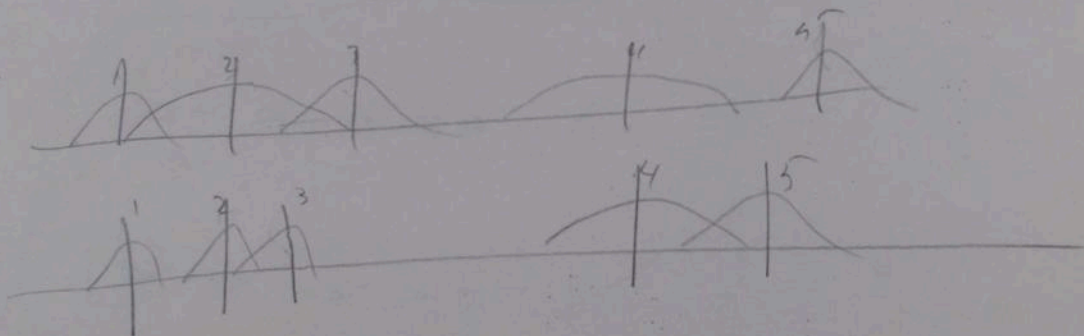
glaucousness.

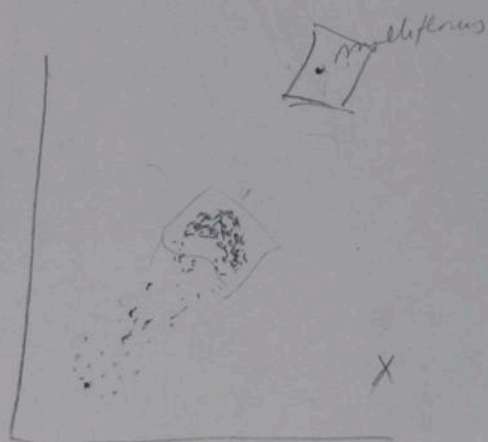
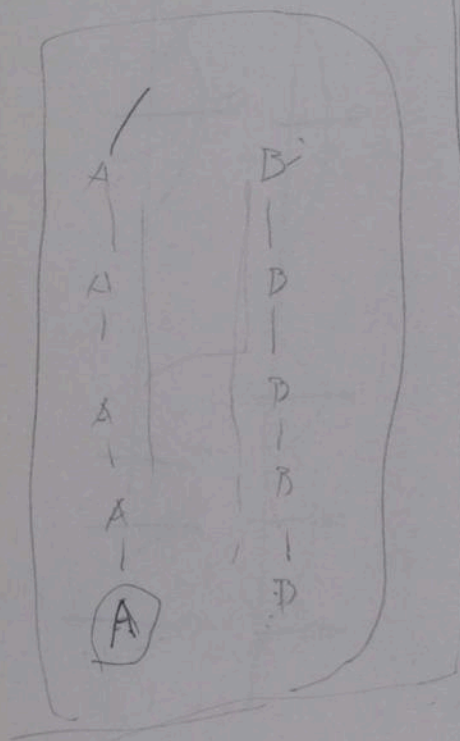
of ovation

color of root. (within)

no " " "









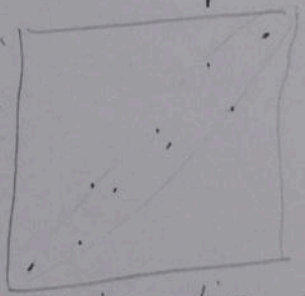
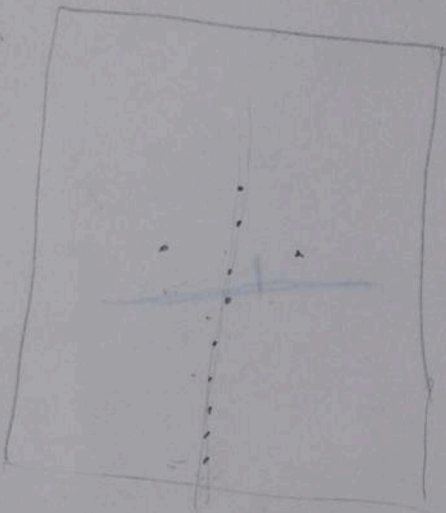
0 3  
1 2  
3 ~~3~~  
4  
9

• 1  
—

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—  
I 6

—  
—  
—

← ONE DECIMETER →



*Reference*

*Baylis's markings*

Measurements made by  
Piquois at Tunnah

A =

B = F. 400

C =

D = B.

E =



Camota Rep. I

\*10  
 ✓ 12 - 12 ✓  
 ✓ 20 - 27 ✓  
 ✓ 26 - 30 ✓  
 ✓ 28 - 32 ✓  
 ✓ 29 - 30 ✓  
 ✓ 30 - 24 ✓  
 ✓ 25 - 22 ✓  
 ✓ 28 - 29 ✓  
 ✓ 26 - 26 ✓  
 ✓ 30 - 30 ✓  
 ✓ 24 - 25 ✓  
 ✓ 23 - 18 ✓  
 ✓ 23 - 22 ✓  
 ✓ 20 - 26 ✓  
 ✓ 30 - 36 ✓  
 ✓ 43 - 40 ✓  
 ✓ 65 - 45 ✓  
 ✓ 54 - 53 ✓  
 ✓ 40 - 30 ✓  
 ✓ 20 - 5 ✓  
 ✓ 20 - 26 ✓  
 ✓ 30 - 25 ✓  
 ✓ 21 - 20 ✓  
 ✓ 20 - 25 ✓  
 ✓ 20 - 20 ✓  
 ✓ 14 - 10 ✓  
 ✓ 15 - 12 ✓  
 ✓ 25 - 15 ✓

\*5  
 ✓ 13 - 18 ✓  
 ✓ 23 - 24 ✓  
 ✓ 31 - 39 ✓  
 ✓ 33 - 32 ✓  
 ✓ 35 - 37 ✓  
 ✓ 32 - 30 ✓  
 ✓ 27 - 27 ✓  
 ✓ 27 - 28 ✓  
 ✓ 23 - 25 ✓  
 ✓ 21 - 22 ✓  
 ✓ 18 - 30 ✓  
 ✓ 30 - 25 ✓  
 ✓ 30 - 27 ✓  
 ✓ 21 - 23 ✓  
 ✓ 25 - 24 ✓  
 ✓ 28 - 22 ✓  
 ✓ 27 - 28 ✓  
 ✓ 30 - 30 ✓  
 ✓ 29 - 30 ✓  
 ✓ 25 - 20 ✓  
 ✓ 20 - 20 ✓  
 ✓ 20 - 22 ✓  
 ✓ 25 - 24 ✓  
 ✓ 24 - 25 ✓  
 ✓ 22 - 20 ✓  
 ✓ 20 - 20 ✓  
 ✓ 18 - 16 ✓  
 ✓ 15 - 15 ✓  
 ✓ 15 - 15 ✓  
 ✓ 15 - 13 ✓  
 ✓ 15 - 10 ✓  
 ✓ 15 - 12 ✓  
 ✓ 13 - 15 ✓

→ No. 2

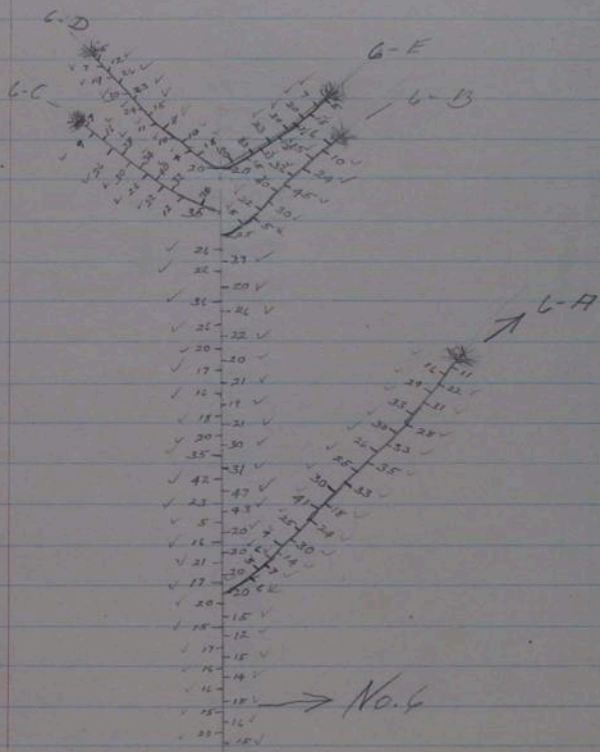
No. 3

## Vainilla

✓ 18	-12	✓ 14	-10
✓ 18	-20	✓ 22	-18 ✓
✓ 23	-20 ✓	✓ 22	-24 ✓
✓ 20	-24 ✓	✓ 27	-27 ✓
✓ 25	-23	✓ 33	-25 ✓
✓ 30	-27 ✓	✓ 32	-30 ✓
✓ 25	-30	✓ 27	-36 ✓
✓ 34	-26 ✓	✓ 28	-30 ✓
✓ 31	-30	✓ 30	-32
✓ 28	-30	✓ 35	-28 ✓
✓ 27	-33 ✓	✓ 30	-32 ✓
✓ 23	-22	✓ 27	-30 ✓
✓ 31	-22	✓ 22	-32 ✓
✓ 26	-27 ✓	✓ 27	-25 ✓
✓ 17	-22	✓ 26	-28 ✓
✓ 26	-25	✓ 26	-26 ✓
✓ 25	-26	✓ 23	-27
✓ 28	-36 ✓	✓ 32	-40 ✓
✓ 34	-44 ✓	✓ 38	-12
✓ 42	-51 ✓	✓ 29	-10
✓ 31	-7	✓ 21	-23 ✓
✓ 13	-41	✓ 22	-14 ✓
✓ 20	-18 ✓	✓ 30	-15 ✓
✓ 14	-41 ✓	✓ 14	-13 ✓
✓ 28	-18 ✓	✓ 12	-19 ✓
✓ 14	-16 ✓	✓ 13	-18 ✓
✓ 26	-15 ✓	✓ 12	-16 ✓
✓ 12	-12	✓ 9	-11
✓ 18	-12	✓ 10	-11
✓ 11	-12	✓ 10	-11
✓ 11	-10	✓ 13	-12
✓ 13	-13	✓ 18	-17
✓ 23	-20	✓ 20	-13
✓ 23	-27		

→ No. 4

→ No. 5



Higuarilla

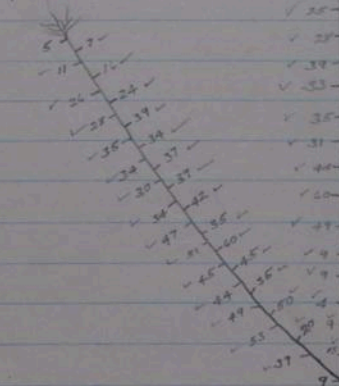
4 - 10  
✓ 12 - 17  
✓ 23 - 20  
✓ 35 - 27  
✓ 35 - 33  
✓ 34 - 31  
✓ 37 - 30  
✓ 35 - 35  
✓ 34 - 29  
✓ 32 - 32  
✓ 31 - 35  
✓ 38 - 41  
✓ 40 - 35  
✓ 33 - 29  
✓ 35 - 30  
✓ 21 - 12  
✓ 23 - 26  
✓ 34 - 25  
✓ 47 - 37  
✓ 31 - 70  
✓ 30 - 10  
✓ 7 - 28  
11 - 19  
✓ 24 - 21  
✓ 22 - 21  
✓ 21 - 20  
✓ 32 - 15  
✓ 21 - 5  
✓ 30 - 20  
✓ 30 - 28  
✓ 16 - 25

4  
✓ 7 - 10  
✓ 15 - 20  
✓ 23 - 30  
✓ 25 - 32  
✓ 27 - 34  
✓ 37 - 45  
✓ 35 - 42  
✓ 35 - 30  
✓ 38 - 39  
✓ 43 - 50  
✓ 40 - 46  
✓ 53 - 48  
✓ 29 - 36  
✓ 30 - 25  
✓ 28 - 29  
✓ 27 - 40  
✓ 41 - 75  
✓ 43 - 30  
✓ 12 - 11  
✓ 13 - 21  
✓ 20 - 15  
✓ 19 - 21  
✓ 23 - 23  
✓ 25 - 23  
✓ 20 - 19  
✓ 19 - 17  
19 - 20  
✓ 13 - 14  
✓ 18 - 11  
✓ 15 - 19  
✓ 15 - 18  
✓ 20 - 10

→ No. 7

→ 8

9-A



- ✓ 6 ✓
- ✓ 9 ✓
- ✓ 12 ✓
- ✓ 13 ✓
- ✓ 18 ✓
- ✓ 20 ✓
- ✓ 25 ✓
- ✓ 28 ✓
- ✓ 29 ✓
- ✓ 31 ✓
- ✓ 33 ✓
- ✓ 35 ✓
- ✓ 38 ✓
- ✓ 40 ✓
- ✓ 42 ✓
- ✓ 44 ✓
- ✓ 46 ✓
- ✓ 48 ✓
- ✓ 49 ✓
- ✓ 50 ✓
- ✓ 51 ✓
- ✓ 52 ✓
- ✓ 53 ✓
- 9
- ✓ 28 ✓
- ✓ 36 ✓
- ✓ 40 ✓
- ✓ 34 ✓
- ✓ 30 ✓
- ✓ 37 ✓
- ✓ 33 ✓
- ✓ 29 ✓
- ✓ 27 ✓
- ✓ 21 ✓
- ✓ 20 ✓
- ✓ 21 ✓
- ✓ 23 ✓
- ✓ 20 ✓
- ✓ 24 ✓
- ✓ 16 ✓
- ✓ 20 ✓
- ✓ 20 ✓
- ✓ 18 ✓
- ✓ 20 ✓
- ✓ 21 ✓

→ No. 9



2-0

3

2-2

2-3

2-2-3

2- $\frac{2}{3}$

2-3

2- $\frac{2}{3}$

2-3

3  
 $\frac{3}{2}$   
0

2- $\frac{3}{2}$

2  
 $\frac{3}{3}$

2  
 $\frac{3}{2}$

2-2

2-3

3-3

3- $\frac{3}{2}$

3- $\frac{3}{2}$   
 $\frac{1}{2}$

3- $\frac{0}{2}$   
 $\frac{0}{2}$

3  
 $\frac{0}{3}$   
3

2  
 $\frac{3}{2}$

3-0

3- $\frac{3}{2}$   
 $\frac{1}{3}$

3  
 $\frac{2}{2}$   
 $\frac{1}{2}$

2  
 $\frac{2}{0}$

lower bank

2nd bank

2

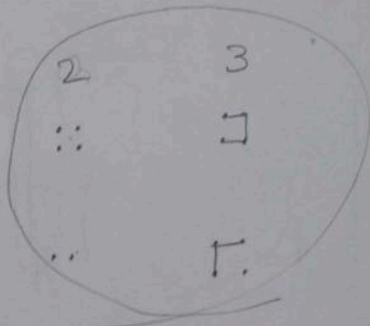
3

☒

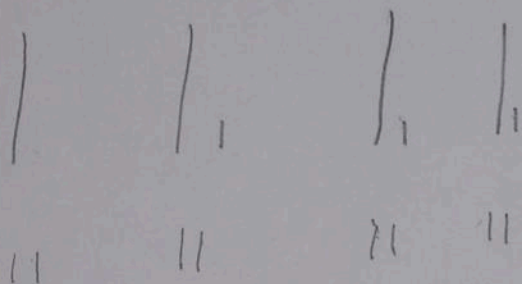
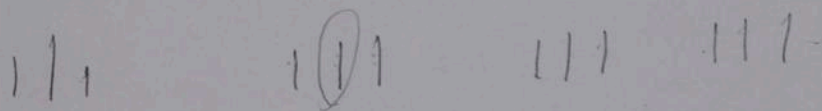
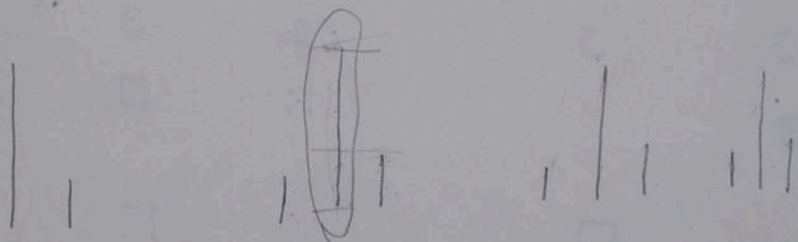
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☐

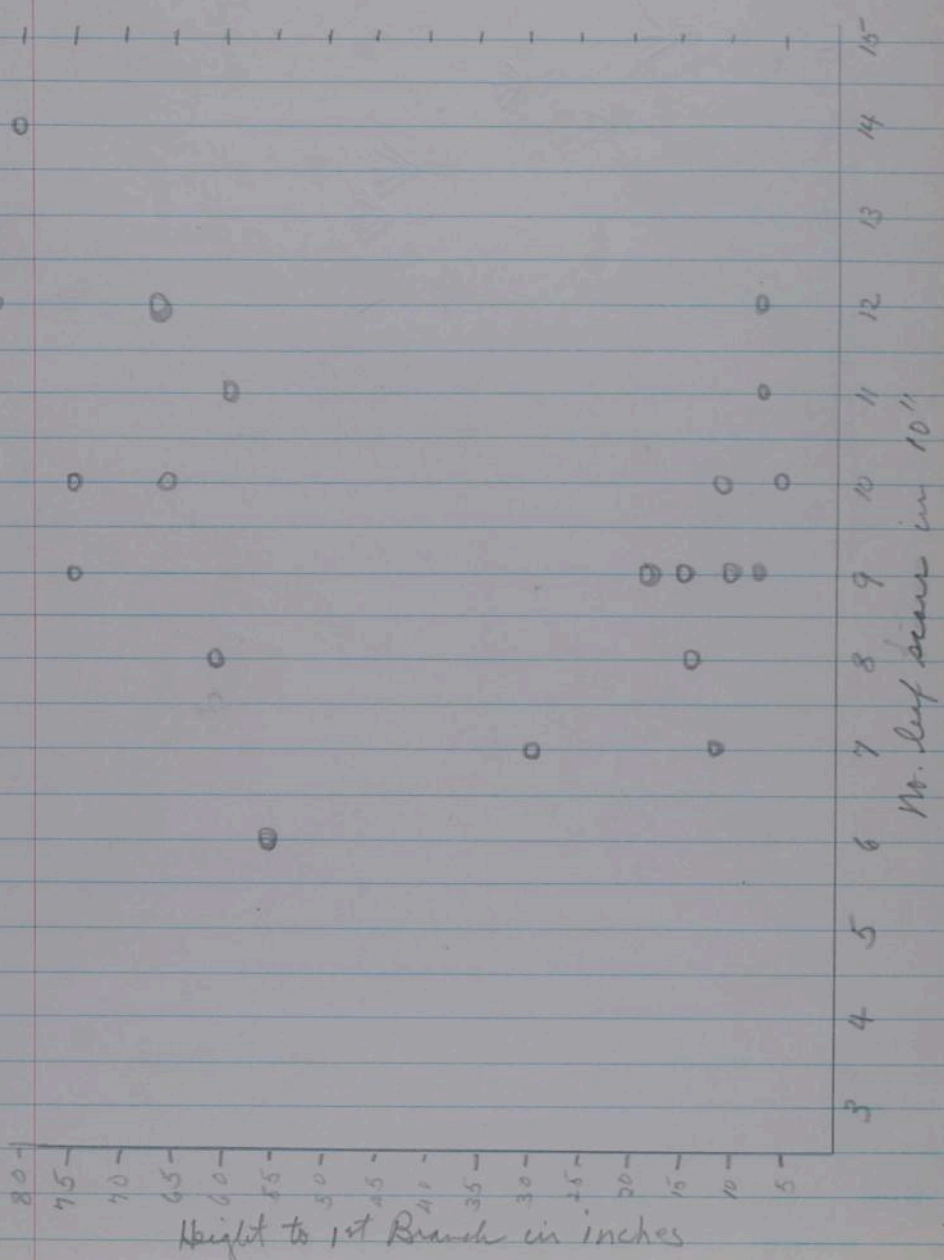


Wendlin

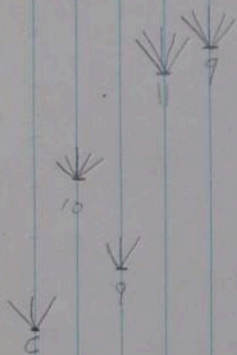




Var-Valencia-2069



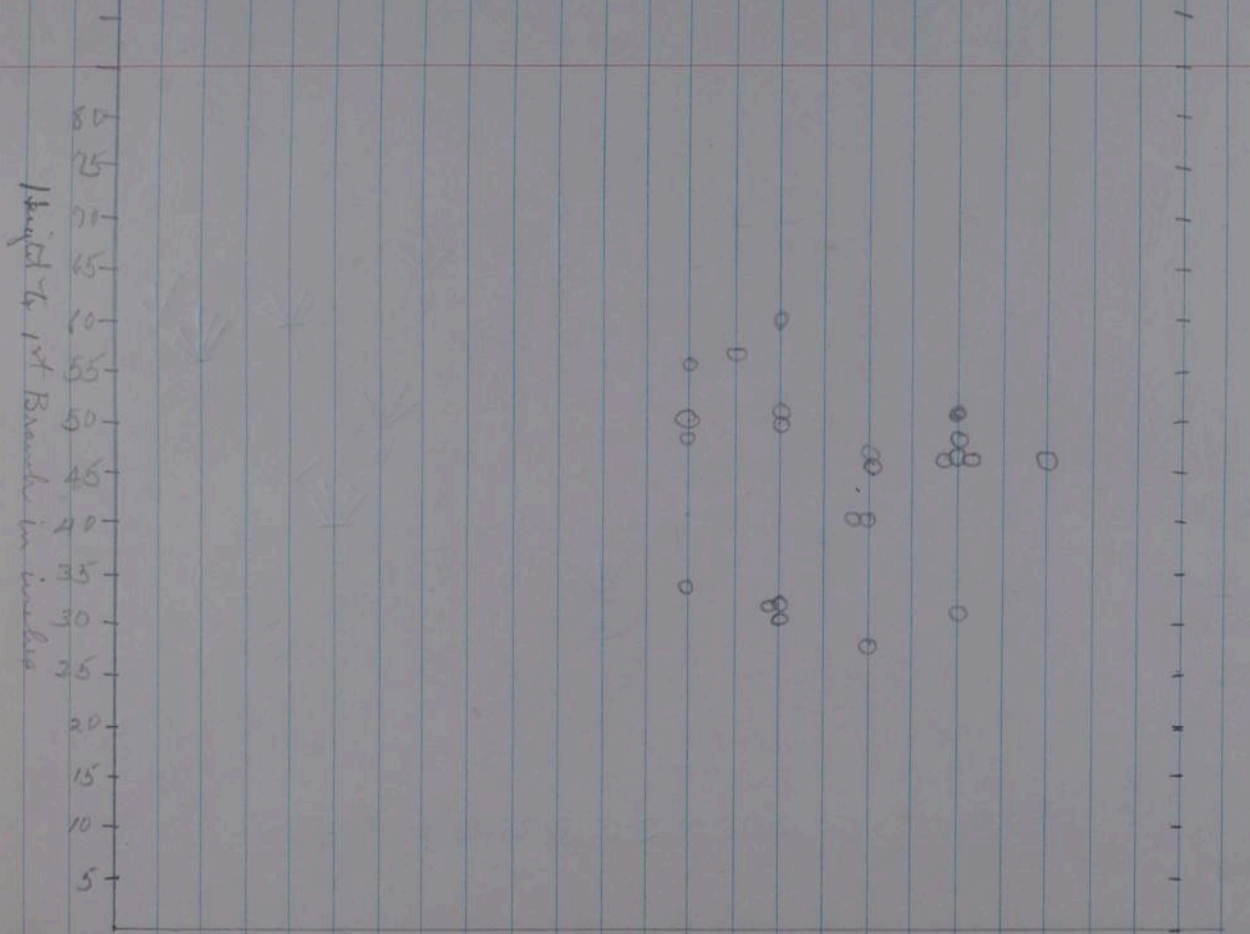
Height to 1st Branch in inches



*Zopilotia*  
 (Andite)  
 plants all more  
 or less upright,  
 not erect.

1 cm = 2 dm.: height from base to 1st branch  
 Figure below branch = no. leaf scars/20 dm.

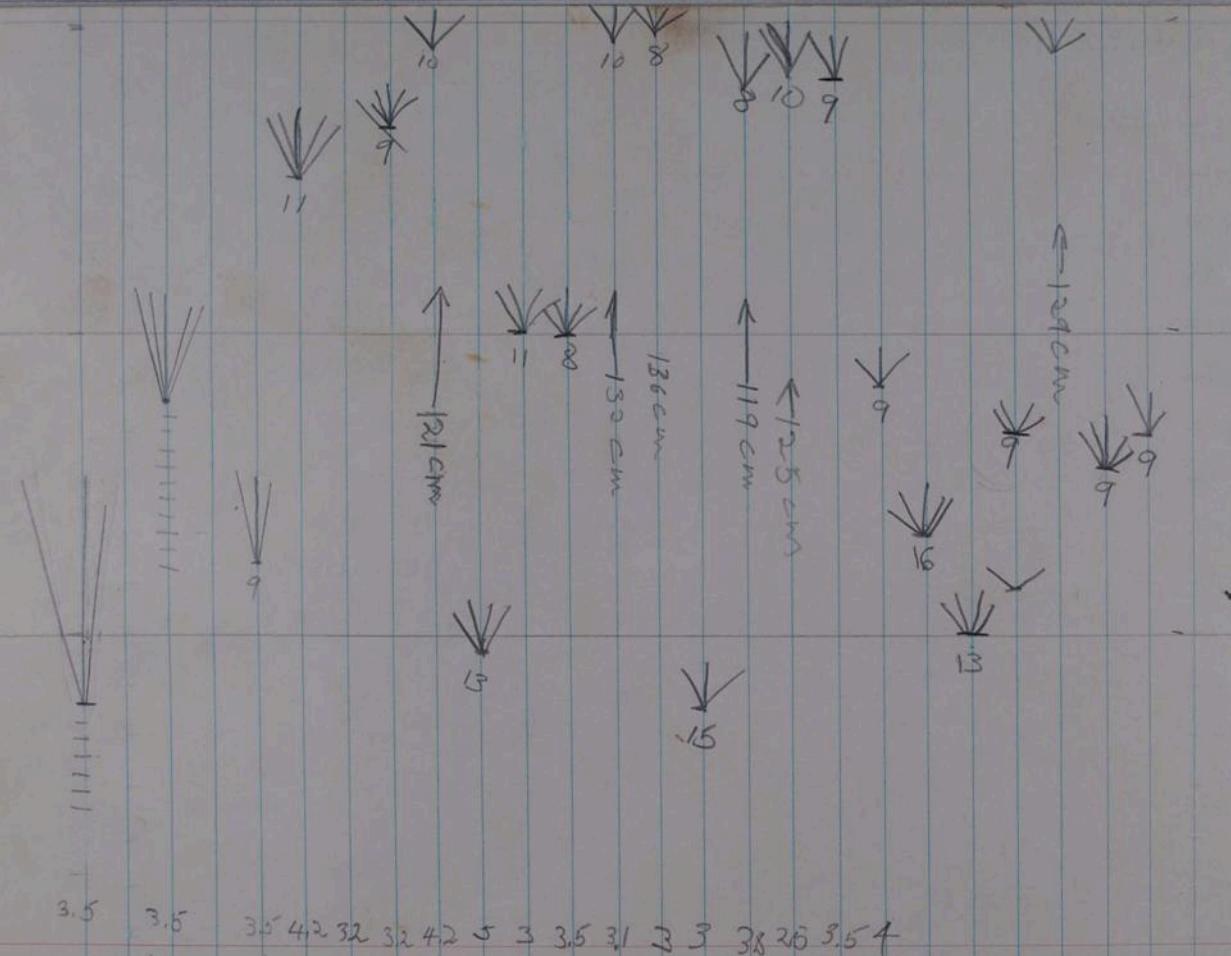
Var. *Amsiallo* *Coriacea*



M

2

1



Zopilotia

1 cm = 1 dm = height of plant from base to 1st branches

Higuera  
 Sumalla  
 8/19/53

	Petiole Length	Median Lobe Length	Lobe No.		Petiole Length	Median Lobe Length	Lobe No.
1	10.4	6.7	9	28	10.9	7.6	8
2	8	7.5	7	29	9	7	7
3	9.5	6.5	9	30	7.6	7.4	7
4	9.5	7.5	7	31	8.8	6.6	7
5	7	7	7	32	9.8	7	8
6	8.7	7.7	7	33	10.7	8	8
7	8.5	7.5	7	34	11	8.4	9
8	8.4	7.4	7	35	11.4	6.8	9
9	11	8.2	7	36	10	7.2	8
10	10.5	8	9	37	9.8	7.5	7
11	8	7	7	38	7.7	6.7	7
12	7.8	6.8	7	39	9	6.9	7
13	8.6	6.9	7	40	8.9	6.8	7
14	9.3	7	7	41	10.5	7.8	9
15	8.8	6.9	7	42	11.4	8.4	9
16	8	7.4	7	43	7.2	7	7
17	9	7	7	44	8.5	6.7	7
18	8.8	6.5	7	45	10.4	6	8
19	8.5	7	7	46	8	7	7
20	8.2	7.4	7	47	9.4	7	9
21	8.9	7.5	7	48	8.4	7.2	8
22	8.9	7.6	7	49	7.5	6.6	7
23	9.5	7.7	7	50	8.4	7.5	7
24	7.8	6.6	7				
25	6.3	6.4	7				
26	9.4	7	8				
27	12.5	8.2	9				

Petioles fairly uniformly light red  
 veins pink at base of lobes

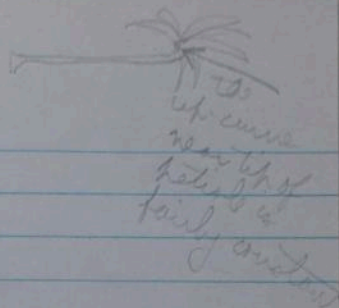
C.B.

No. 2

Sunguella  
8/14/53

Meas. in inches

	Adult Length	Median Lobe Length	Lobe No.				
1	8.2	7	7	25	8	6.8	7
2	11.6	7	7		9.5	6.4	7
3	6.8	6	6		7.8	6	5
4	9.6	6.2	7		11	6.4	7
5	9.5	7	7		9	6.8	7
6	10.5	7.4	7		9.9	5.5	7
7	10.4	6.8	7		10.5	6.6	7
8	9.5	6.5	7		9.5	5.7	7
9	10.4	6.9	7		10	6.5	7
10	8	6.8	6		8.2	6.5	7
11	9.5	5.5	7		8.8	6.4	7
	8.4	6	7		10.4	6.7	7
	8.5	6.5	6		11.1	6.5	8
	8	5.8	7		11.8	7	7
	8.8	6.8	7		8.5	6.3	7
	13	7.5	7		7.1	5.5	7
	8.8	5.5	7		10		7
	8	6	7		8.5	7.4	7
	8	5.5	7		10.4	6.5	7
	11.5	6.4	7		8.8	6.5	7
	9.4	6.4	7		8.5	6.2	7
	7.8	7.1	7		9.9	6.7	7
	8.8	6	7	50	9.5	7	7
	7.4	6	7				
	9.5	6	7				
	9.4	6.8	7				
27	11	7	7				




up. curve  
near top of  
petioles is  
fairly constant

Red described  
only of base of  
petioles with  
dark green  
dark green

1 very small lobe.

of petiole, but sometimes  
all along in the surface  
veins with

CB No 1  
Small

	Actinolo Length	Median Lobe Length	Lobe No		Actinolo Length	Med. Lobe Length	Lobe No	
1	11.1	8.1	7	22	8.6	7	7	Lobes linear, <del>obovate</del>
	7	6.4	7		8.9	7.6	7	frequently narrowed in upper 1/3
	7.6	6.9	7		7.8	6.8	7	
	4.9	6.8	7		8.5	7	7	Petioles light greenish yellow
	7.4	7.2	7		7.5	6.6	7	with inflex. base of node
	6	6	7		6.4	6.4	7	top of pet. near base towards apex. Veins white.
	6.4	6.4	7		8.9		7	Slight up-curve of tip
	7.8	6.5	7		5.5	6.4	5*	of pet. at junction with lamina.
	5.5	5.5	7		7.6	6.6	7	Flowering branches.
10	7.3	6.5	7		7.5	6.9	7	
	6.5	6.8	7		5.5	6.2	7	
Petioles unguis	10.6	7.9	9		8.8	7.7	7	
" " "	9.6	7.5	9		6.7	7.3	7	
	6.5	6.6	7		5.5	5.2	5*	
	7.8	6.8	7		6	6.4	6 <sup>a</sup>	- a lower lobe divided only to distance
	4	6.1	7		6.3	5.8	7	looks like 2 that forget to divide
at tip Ret. unguis	8	7.6	7		5.4	5.7	7	
(Flowering l.f.?)	4.4	5.5	5*		6.6	6	7	
	8.9	7.2	7		7.7	7	7	
	7.4	6.7	7		9	7.5	7	
	5.5	6	7		6.4	8	7	
	8	6.6	7		4	5.5	7	
	6.9	6.6	7	50	9	7.3	7	
	7.5	6.5	7		6	7	7	
	9	7	8					
	7.5	6.5	7					
27	6.4	5.6	7					

Zopilota  
Tunicalha  
8/20/53

	Petiole Length	Median Lobe Length	Lobe No.		Petiole Length	Median Lobe Length	Lobe No.	lobes oblanceolate to
1	12.4	8.4	7	28	10	7.5	7	obovate
	12.5	8.5	8		11.5	7.9	7	acuminata
	11	7.4	7		13	7.6	7	Petioles light green,
	11.3	7.4	7		15	7.9	9	usually reddened toward
	11.4	7.7	7		9.8	7.8	7	apex. Frequently strongly
	10	7.1	7		9.4	7.9	7	curved at apex
	10.4	7.1	7		12	8	7	Venae light green to sl
	10.2	6.8	7		13	8.4	7	pink.
	10.2	7.5	7		11	6.5	7	
	10.3	7.1	7		9.5	6.1	7	
	8.3	6.8	5		6.6	6.6	7	
	11.4	8	7		10.8	7	7	
	8.8	7	6		11.2	7.7	7	
	9.2	6.9	6		9.5	6.7	7	
	8.4	6.6	5		10.4	7.4	7	
	7.5	6.5	5		11.5	7.5	7	
	10.9	7	7		10	7.6	7	
	11.7	7.4	7		10.1	7.2	5	
	11	7	7		10.5	7.5	7	
	11.2	7.5	7		9	7.4	7	
	12.5	8	5		9.8	7	7	
	9.4	7.5	5		10.4	7	7	
	14.5	7.5	7	50	12	8.2	7	
	12.5	8	8					
	13.3	7.5	7					
	11.9	7.6	7					
27	9	7.4	7					



Elmo Stick (B) - Hills Farm, Old Harbour, Jamaica, 7/6/53

Lobe  
Number {  
5 = 5  
6 = 6  
7 = 7  
8 = 8  
9 = 9

14

13

12

11

10

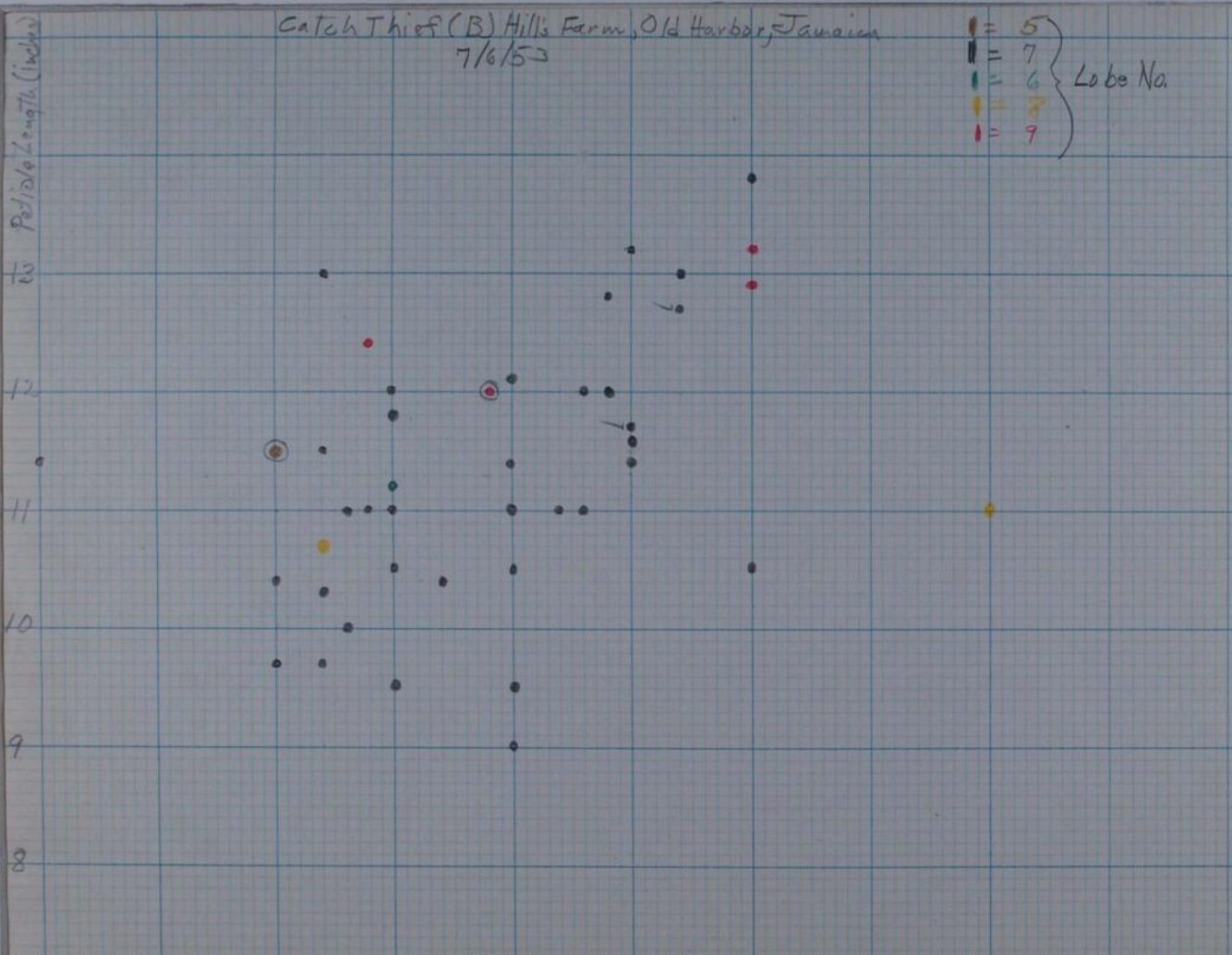
9

8

Catch Thief (B) Hills Farm, Old Harbor, Jamaica  
7/6/53

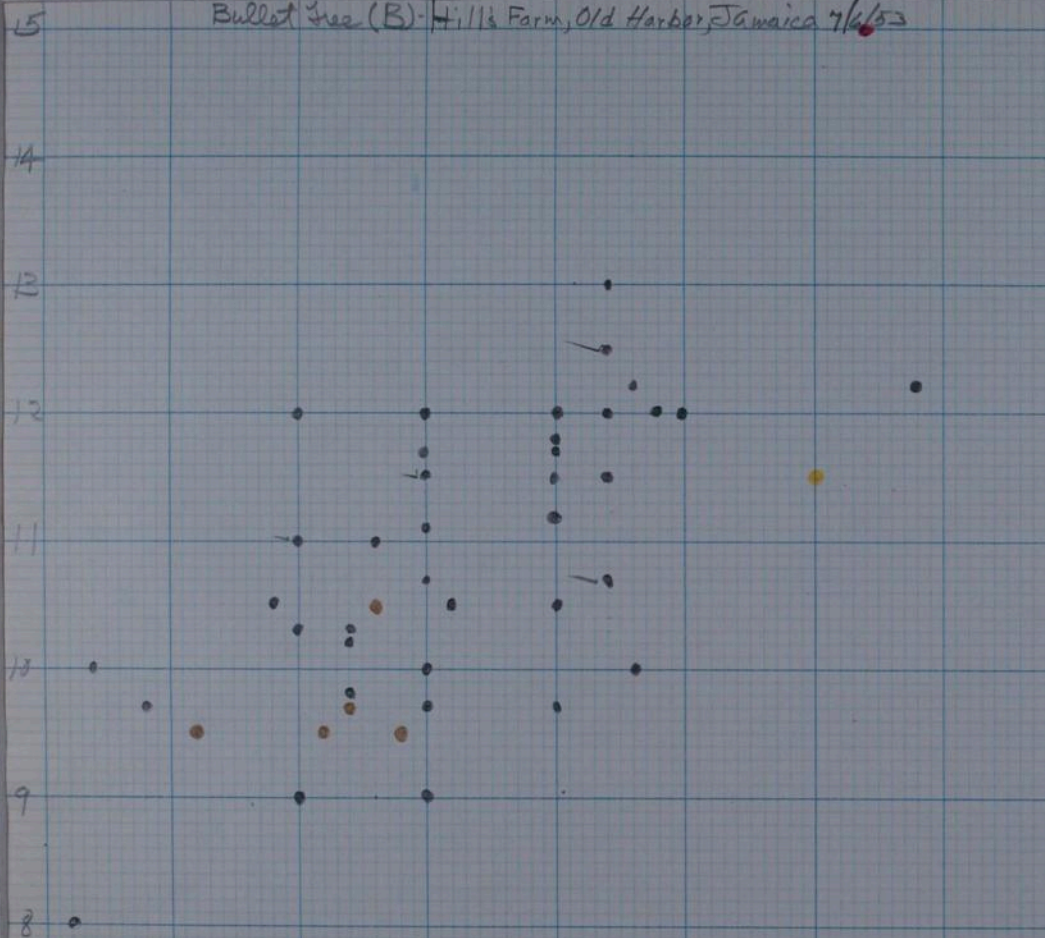
5 = 5  
 7 = 7  
 6 = 6  
 8 = 8  
 9 = 9

} Lobe No.



Bullet Tree (B) - Hill's Farm, Old Harbor, Jamaica 7/6/53

● = 5  
● = 6  
● = 7  
● = 8  
● = 9

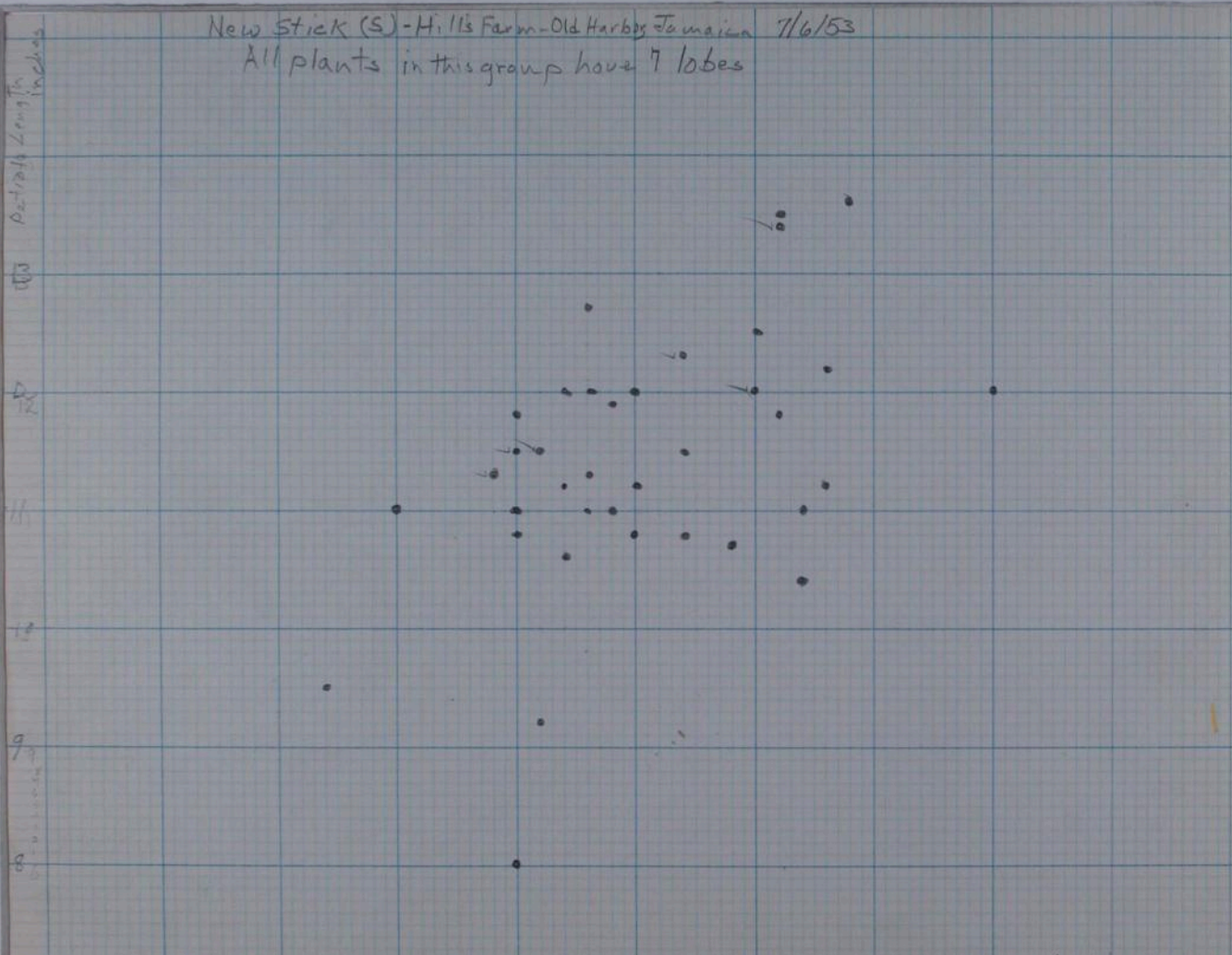


New Stick (S) - Hills Farm - Old Harbor, Jamaica 7/6/53

All plants in this group have 7 lobes

petal length  
inches

13  
12  
11  
10  
9  
8





Richmond & Stick Hills (Sargood) Farm, Old Harbour, Jamaica, 7/7/53

15.9 ↑

Leaf  
Lobe  
No. {  
= 5  
= 6  
= 7  
= 8  
= 9

14

13

12

11

10

9

8

10.7

Concave

leaf base

Length to  
1<sup>st</sup> branch

No Branches

10"

1	8*	5	2
2	11	88	3
3	9	92	3
4	8	96	3
5	7	80	2
6	9	68	2
7	8	37	2
8	7	98	3
9	8	84	3
10	6	81	2
11	9	84	3
12	9	23	2
13	9*	3	2
14	7	56	2
15	9+	8	2
16	6*	6	2
17	8+	6	2
18	7 <sup>c</sup>	4	2
19	8	69	3
20	9+	5	2

Stems erect, dark brown (purplish) Bark & young lvs black  
\* Above 1<sup>st</sup> branch

## Zokilota

	No of Scars 10"	Length to Bud	No Branches
1	10	36	2
2	7*	11	3
3	6*	5	2
4	7	70	4
5	7	57	2
6	8	70	4
7	7* (11-below branch)	17	3
8	6	65	4
9	9*	10	3
10	8	77	3
11	11	5	2
12	9	77	4
13	8	64	4
14	11*	6	2
15	10	8	2
16	8	6	2
17	9	7	2
18	9	6	2
19	9	58	3
20	7*	8	3

Stems dark purple brown - none erect, most slanting  
 about 45°, some more, some less -  
 \* Count taken above 1\* branching  
 Scars not very prominent  
 Terminal buds + fls. bluish

C. Blanca  
#2

	No. Leaf 10"	Height to 1 <sup>st</sup> Branch (in)	No. Branches
1	15	39	2
2	15	48	2
3	12	5	2
4	12	35	3
5	12	42	3
6	13	38	3
7	11	40	3
8	8	46	3
9	14	42	2
10	9	48	3
11	9	47	3
12	8	39	3
13	7	53	3
14	7	52	3
15	13	38	2
16	12	72	3
17	10	27	4
18	12	43	2
19	11	53	3
20	6	64	2

Higuerrilla	No of leaves 10	Height to 1st branch	No branches
1	8	92	3
2	11	33	2
3	8	88	3
4	9	42	3
5	7	88	4
6	11	105	3
7	10	96	4
8	8	37	3
9	9	73	4
10	10	99	3
11	9	38	2
12	6	85	2
13	7	94 - to terminal bud 0 -	
14	10	101	3
15	10	103	3
16	9	53	3
17	8	32	4
18	12	20	3
19	10	93	4
20	9	70	3

This variety derived by all plants in flower.

Valencia 2039- Var	Height to 1 <sup>st</sup> branch	No of branches	No of bifurcations in 10"
1	80.5"	2	14
2	65	2	10
3	7	2	11
4	75	3	9
5	83	2	12
6	5	4	10
7	7	2	12
8	30	2	7
9	61	2	8
10	7	3	9
11	12	2	7
12	75	2	10
13	14	2	8
14	18	2	9
15	11	2	10
16	15	2	9
17	10	2	9
18	57	3	6
19	68	2	12
20	60	2	11

Var Amarillo Cov.	No fls.		No. Branches
	No leaf scars 10"	Height to 1st Branch	
1	12	32	3
2	10	30	2
3	11	28	3
4	13	47	3
5	11	47	3
6	9	57	3
7	10	50	3
8	9	50	3
9	10	51	3
10	11	47	3
11	9	49	3
12	9	33	3
13	12	47	2
14	10	33	3
16	11	40	3
16	12	47	3
17	12	51	3
18	12	48	3
19	9	56	3
20	10	61	3

65	
20	75
<hr/>	<hr/>
1300	30
22.50	2250
<hr/>	
35.50	

Inter-American Institute of Agricultural Sciences  
Turrialba

Project No.:

Cassava (*Manihot* spp)

Project Title: Study of varieties of *Manihot utilissima*

Index Title:

Leader: David J. Rogers\* and Jorge Leon

Cooperators: Dr. Frederick Wallman, <sup>VOAR</sup> Dr. W. S. Wright, Dept. of Ag.,  
Kingston, Jamaica; Dr. Ramon Mejia, Jefe, Fed. Nac.  
Cafeteros de Colombia; Dr. Carlos A. Krug, Inst. Agron.  
Campinas, Brasil.

Associates: Dr. Claud L. Horn, Dr. Edgar Anderson

Assistants: None.

Location: Inter-American Institute of Agricultural Sciences,  
Turrialba, Costa Rica.

Reasons for Undertaking the Study, (including the Review of Literature):

1. Although yuca has been one of the most fundamental food plants for the people of tropical countries, and its products utilized by peoples of temperate climates for a very long period, very little is known about the plant. Its varieties remain unclassified, its real value and best utilization unknown. Botanists have ignored the plant for various reasons, none of them valid. Agronomists have made some studies, but without too much validity for other than local conditions. The lead has been taken by the agronomists of Brazil in present day studies, but without too much interest in the background and evolution of the plants. Knowledge of the diseases of yuca is very incomplete. The Dutch have worked on the breeding and cultivation techniques, but again on those plants transported to the East Indies, without reference to the basic entities which probably occur in South America (according to Vavilov).

2. Aside from these problems of great practical value, there exists within the study of this plant some of the best possibilities to understand basic biological problems. For example: man's influence on evolution of plants; the center of origin of and routes of migration of the plants; the genetic complement which allows for the tremendous amount of variation which exists. <sup>The</sup>

Either the practical or the basic biological problems would be sufficient reason for undertaking this study. <sup>By own</sup> basic reason is interest in the plants per se, but at the same time with an eye towards its value to man.

Philadelphia, Pa.

\* Supported in part by grant from The American Philosophical Society,  
in part by Allegheny College, Meadville, Pa.

Review of the Literature:

1. From the standpoint of classification, there has been one single study of the varieties of Manihot utilissima: "Estado Sobre Algumas Variedades de Mandiocaas Brasileiras" by Leo Zehntner, published by the Sociedad Nacional de Agricultura, Rio de Janeiro, 1919. As the author himself points out, this work is applicable only to some 74 varieties which he collected from three areas of Brazil. He made his keys from the varieties in cultivation, without reference to basic variations, and only for the sake of convenience. There is some value to this work, but not from the standpoint of the total picture of the basic variations.
2. It is impossible to review all of the agronomic studies done in both the Western and Eastern Hemispheres. These studies are largely devoted to techniques of planting, fertilizer trials, analyses of starch production, local variety trials, etc. It is not within the scope of the present program to make similar trials. However, after the basic data of variation has been accumulated, it is hoped that continuing studies of agronomic importance will be incorporated.
3. One physiological study of importance to the present program is a color reaction reported by Bolhus, GG. in Rev. Internat'l. de Bot. Appl. and D'Agr. Trop. 32: 559-563, 1952. This color reaction is utilized to determine the amount of HCN contained in various varieties, and seems useful in distinguishing the bitter and sweet varieties.
4. Other basic studies of importance are those of Viegas, A. P. (Inst. Agron. Campinas, Bol. Tecn. 74, 1940) on the vegetative anatomy, and Graner, E.A. (Bragantia 2: 1942) on some aspects of the genetics of yuca.

5.

Objectives:

1. To determine the fundamental variation which exists in the species Manihot utilissima.
2. To make this data generally available to those people for whom the crop is of basic importance.
3. To understand the evolution of the species, in order to determine the best methods of selection and breeding.

Procedures:

1. Cuttings of varieties sent to Turrialba will be placed in "museum plot" in order to compare variations under similar environmental conditions. These cuttings to be sent from important areas of cultivation, i.e. Brazil, Colombia, Peru, Equado, Venezuela, Jamaica, Kenya, Malaya, India, Java, but with special emphasis on Brazilian, Colombian and Venezuelan varieties, since these areas are considered to be some where near the center of origin.
2. Methods of breeding will be studied.
  - a. Time of pollination
  - b. Degree of compatibility.
  - c. Degree of sterility.
3. Statistical methods to determine stability of characteristics of varieties under varying environmental conditions.
4. Keys to the basic variations.
5. Maps in detail of distribution of basic variations.
6. Correlation of information of each basic variation.
  - a. Description of the morphology.
  - b. Starch yield and other properties (vitamin and protein content).
7. Disease problems and quarantine will be carefully controlled through the assistance of Dr. Wellman

Publication Intended: Progress reports in Turrialba, or in Dept. of Agriculture Bulletins, such as that of Jamaica, Brazil, or others. Probable cumulative report in ~~Magantis~~ <sup>Turrialba</sup>, or other publication which has wide range of tropical distribution.

Date of initiation of work: in progress. Feb, 1953.

Probable duration: 3-6 years.

Estimated Annual Expenditure: none. \$ 60<sup>00</sup> per year.

Dr. Rogers:

I suggest you may be interested in looking up the work of Dr. H. K. Storey and his coworkers on maundie in the EAFFRO Experiment Station, Nairobi, Kenya (British East Africa). I have no literature, nor citations at the present time, but I am going to write to Washington for material on it. As you know, perhaps, I've asked the Mycologist John A. Stevenson about a literature list of yuca diseases. When that comes, I'll share it with you.

On page 2, at the end of your Review of Literature you might add something like this:

"5. Work in Kenya by Dr. H. K. Storey and coworkers has been carried on for some 10 years with respect to both disease (virus) control, through resistance, and increasing of yield. ~~This~~ literature is now being secured relating to this work."

Under procedures you might add:

"7. Disease problems will be noted, and attention given to diseases in relation to production."

In Estimated Annual Expenditures, that surely must be a little something. There is your time and travel, and other side things. Can you make a fair estimate, put it in, but indicate not paid for by the Institute at present?

Please be sure that Cloud Horn gets a copy of this.

Frederick Wellman,

Line Project:

Inter-Am. Inst. Ag. Sci.  
Turrialba

Project No. 3

Date Submitted:

Project Title: ~~Systemat~~ Study of Varieties of *Manihot utilisima* Yuca

Index Title:

Leader: H.C. Thompson +  
David J. Rogers + Jorge Leon

Cooperators:

Associates:

Assistant:

Location: Turrialba, Instituto

Reasons for Undertaking the Study, including the Review of Literature:

- 1.
- 2.

Objectives

- 1.
- etc.

Procedures:

- 1.
- etc.

Publication Intended:

Date of Initiation of work:

Probably Duration:

Estimated Annual Expenditure:

## Review of the literature:

1. From the standpoint of classification, there has been one single study of *Manihot* varieties: "Estudo Sobre Algumas Variedades de Mandioca Brasileira", by Leo Zehntner, published by the Sociedade Nacional de Agricultura, Rio de Janeiro, 1919. Both author himself points out, this work is applicable only to some 72 varieties which he collected from 3 sp. areas of Brazil. He made his keys from the varieties in cultivation, without reference to basic varieties, and only for the sake of convenience. There is some value to this work, but not from the standpoint of the total picture of the *Manihot* basic varieties.
2. It is impossible to review all of the agronomic studies done in both the western and eastern hemispheres. Some of these are important to note, however.
  1. Color reactions of Guignard used as a test for selection of *Manihot* varieties - Bolhuis, F.G. in Rev. Internat. de Bot. Appl. + D'Ag. Trop. 32; 559-563, 1952. A color reaction for content of HCN in tubers makes it possible to determine variation in HCN content of various varieties.
  2. See attached bibliography of important studies.
3. Other works of a basic nature, which will contribute to this study are:
  1. Anatomie de parte vegetativa da mandioca: Viçegas, A.P. Inst. Agron. Campinas, Bol. Tecn. 74, 1940
  2. Genetics of manioc: Graner, E.A. in *Pragmatica* 2, 1943

## Procedures:

1. Collections + experimental
  - a. Cuttings of varieties sent to Turrialba will be placed in "museum plot" in order to compare variations under similar environmental conditions. These cuttings to be sent from important areas of growth of cultivation, i.e. Brazil, Columbia, Peru, Ecuador, Venezuela, Jamaica, Kenya, Malaya, India, Java, but with special emphasis on Brazilian, Colombian and Venezuelan varieties, since these areas <sup>are</sup> considered to be center of origin.
2. Methods of breeding will be studied. Time of pollination, sterile Time of pollination:
  - Whether self sterile or not.
  - Degrees of relationship on basis of compatibility, stability or partial sterility.
3. Statistical methods to determine stability of characteristics of varieties under constant or varying ag. conditions.
4. Keys to the basic varieties.
5. Maps in detail of distribution of basic variations.
6. Correlation of information of each basic variation
  - a. Description of the variety.
  - b. Starch yield + other properties (vitamin + protein content)
  - c. Ag. methods utilized

## Project:

Title: Study of the varieties of *Manihot utilissima*.

Leader: <sup>Dr.</sup> W.C. Thompson, David J. Rogers, Jorge Leon

Cooperators: Charles Breitenbach, STICA, Asuncion, Paraguay; Carlos A. Krug, Inst. Agron., Campinas, Brasil, Ahmes P. Viegas (same address as Krug); Ramon Mejia, Jefe, Fed. Nac. Cafeteros Columbia, Bogotá; W.S. Wright, Dir., Dept. Ag., Hope Gardens, Kingston, Jamaica, et al.

Associates: Oland A. Horn, Dir., Tec. Serr. Branch, IITA, Washington, D.C.  
Dr. Fredorick Wellman, IIAA, Turrialba.

Assistants: None

Location: Institute, Turrialba.

Objectives ~~Reason for undertaking~~ the Study, including the Review of the Literature.

1. To understand the fundamental variation which exists in the species *Manihot utilissima*.
2. To determine the best utilization of the crop under different environmental + cultural conditions, i.e. utilization ~~for~~ of foliage + stems as cattle feed concentrates, high starch production, vitamin content, etc.
3. To understand the evolution of the species, in order to determine best methods of selection + breeding

### Reasons for undertaking the study:

Although yuca has been one of the most fundamental food plants for the people of tropical countries, and its products utilized by peoples of temperate climates for a very long period, very little ~~fundam~~ is known about the plants. Its varieties remain unclassified, its real value and best utilization unknown. Botanists have ignored the plant for various reasons, none of them valid. Agronomists have made some studies, but without too much validity for other than local conditions. The lead has been taken by the ~~people~~ agronomists of Brazil, but still in present day studies, but without too much interest in the background and evolution of the plants. Knowledge of the diseases of yuca is very incomplete.

Aside from these problems of ~~extreme~~ great practical value, there exists within the study of this plant some of the best possibilities to understand basic biological problems. For example: man's influence on evolution of plants; the center of origin of agriculture, and routes of migration of the plants; the genetic complement of the plants which allows for the tremendous amount of variation which exists.

Either the practical or the basic biological problems (which have practical value) would be sufficient reason for undertaking this study. My own basic reason is interest in the plants for themselves, but at the same time with an eye towards its value to man.

ESTUDIOS SOBRE YUCA (Manihot spp.)

I. Importancia de la Yuca

- A. Almidón (usos como alimento, goma, engomado de papeles, o telas)
- B. Proteína (follaje 19-35% en peso seco), usado para alimentación humana y animal.
- C. Vitaminas (en el follaje) contenido alto en carotina, tiamina, riboflavina, niacina y ácido ascórbico.
- D. Acido láctico (ensayos hechos por la Dupont Co demostraron buena producción).
- E. Salsa - base para salsa del tipo Worcestershire.

II. Distribución

Se encuentra en todos los continentes, excepto Europa, entre 27°N a 27°S, en regiones que varían de húmedas a semiáridas, desde el nivel del mar hasta 3000 pies de altitud.

III. Historia

La yuca es originaria probablemente de la región este de Sur América, y se extendió por todo Centro y Sur América en tiempos precoloniales. Los primeros exploradores europeos la distribuyeron por el resto de los trópicos.

Pocos estudios se conocen anteriores a este siglo. Hacia 1920 se habían completado varios estudios agronómicos, y se habían realizado algunos intentos de clasificación de variedades. Desde esa fecha en adelante se han realizado varios estudios, la mayor parte de aplicación local.

IV. Clasificación

Familia Euforbiáceas, género Manihot. Número de especies dudoso. El nombre más usado es M. utilissima, pero frecuentemente se le llama M. esculenta. Algunos autores separan la yuca dulce (M. dulcis) de la yuca amarga (M. utilissima). Otra forma aparece a menudo en relación con este complejo, M. saxicola, pero éste

último nombre necesita más estudio para aclarar su posición.

V. Método de estudio

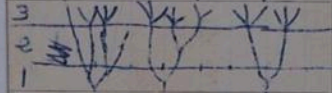
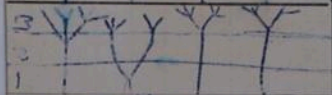
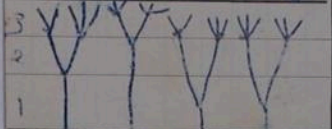
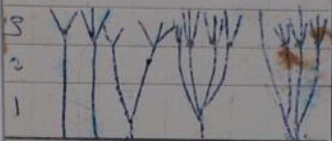
El método por seguir en el estudio de variedades se basará en morfología comparada de los distintos grupos. Las plantas se establecerán en una colección, en la que se incluirán las introducciones que se hagan en el futuro. Este lote servirá también para observaciones sobre enfermedades, insectos dañinos, etc.

- A. Los caracteres principales que se estudiarán en estas variedades serán los siguientes:
1. Tipo de ramificación
  2. Distribución de las hojas en el tronco y ramas
  3. Número de segmentos por hoja
  4. Forma de esos segmentos
  5. Longitud de los peciolo
  6. Color y forma de las raíces
- B. Caracteres de importancia secundaria serán los que se estudien en la flor y el fruto, debido a limitaciones en su uso.
- C. Estudios genéticos para determinar su ploidia. Se supone que las formas de cultivo son poliploidias, pero no existe prueba directa de ello.

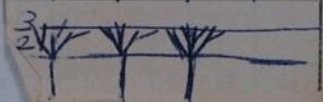
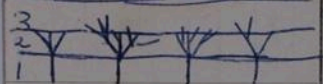
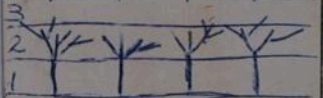
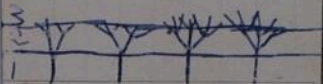
Nota: Si Ud. tiene interés en el estudio de yuda, en cualquier aspecto, me agradecería mucho poder comunicarme con Ud. para intercambiar información.

CO-SEM-572-53

2069



Vanilla



(Signature of Secretary.)

194

To—The Marketing Officer,

P.O.

N.B.—These Returns should be forwarded to the Marketing Officer immediately after the close of each week so that he might co-operate with the Loan Bank in the prompt recovery of Loans.

6213—47,000—12.40.

Journal = 2069

1st leaf scars in angle of the  
rib - Sample from margin  
of 1st stem

2069

7  
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2071

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Richmond Steel mass in water  
 Sengstacke Farm 7/7/53 +10<sup>th</sup> over

	Petal Length	Lobe Length	Lobe No.				
<del>1</del>	11.1	8.9	7	<del>24</del>	10	7.7	7
<del>2</del>	11.5	8.6	7	<del>25</del>	11.9	8	7
<del>3</del>	9.9	7.5	9	<del>26</del>	13.5	9	9 <sup>and</sup> 9 <sup>st</sup>
<del>4</del>	10	7.8	9	<del>27</del>	11.4	8.5	7
<del>5</del>	10.5	8.8	9	<del>28</del>	11.4	8.5	7
<del>6</del>	10.5	8.8	9	<del>29</del>	9.5	8.1	7
<del>7</del>	11	7.8	9	<del>30</del>	11.6	8.4	9
<del>8</del>	11.5	9.1	7	<del>31</del>	10.5	8.3	7
<del>9</del>	9.7	7.8	7	<del>32</del>	11.3	9	9
<del>10</del>	10.6	8.1	9	<del>33</del>	9.2	7.9	9
<del>11</del>	10.3	7.5	9	<del>34</del>	11	—	9
<del>12</del>	9.3	9	9	<del>35</del>	11	—	9
<del>13</del>	10.7	7.7	7-8?	<del>36</del>	12.1	9.5	9
<del>14</del>	10.1	8	9	<del>37</del>	10	7.6	8
<del>15</del>	10.2	8.5	7	<del>38</del>	10.4	8.3	7
<del>16</del>	14.2	8.8	9	<del>39</del>	11.5	8.5	9+10 <sup>th</sup>
<del>17</del>	11.2	8.5	9	<del>40</del>	9.7	8	8
<del>18</del>	12.3	—	7	<del>41</del>	11.3	8.3	9
<del>19</del>	11.3	10.7	7	<del>42</del>	10.1	7.9	9
<del>20</del>	16.9	9.2	9	<del>43</del>	9	6.7	9
<del>21</del>	13.2	9.8	8	<del>44</del>	9.5	6.8	8
<del>22</del>	11.5	8.9	7	<del>45</del>	10.1	7.3	7
<del>23</del>	9.5	7.8	7	<del>46</del>	11.6	8.8	9
<del>24</del>	11.5	8.8	7	<del>47</del>	10.1	8.3	7
				<del>48</del>	12	8.5	9
				<del>49</del>	11.6	9	9
				<del>50</del>	8.8	8.4	6

Yellow Saunders 7/1/53  
Sangre de Toros

1	10	7	7 <sup>2</sup>	26	10.5	6.9	8 <sup>2</sup>
2	8.2	6.7	5 <sup>2</sup>	27	11.4	8	7 <sup>2</sup>
3	8.4	6.7	6 <sup>2</sup>	28	9.8	7.7	7 <sup>2</sup>
4	9.7	7.3	7 <sup>2</sup>	29	10.5	7.8	7 <sup>2</sup>
5	11.5	8.7	7 <sup>2</sup>	30	10.5	7	7 <sup>2</sup>
6	9.8	7.8	7 <sup>2</sup>	31	11.6	8	7 <sup>2</sup>
7	9.3	6.5	6 <sup>2</sup>	32	11.4	7.8	7 <sup>2</sup>
8	9.8	7.5	7 <sup>2</sup>	33	12.1	8.5	7 <sup>2</sup>
9	7.1	6.3	7 <sup>2</sup>	34	11.1	8.8	7 <sup>2</sup>
10	10	6.9	7 <sup>2</sup>	35	10.3	7	7 <sup>2</sup>
11	8.5	7.3	5 <sup>2</sup>	36	11.3	8.2	7 <sup>2</sup>
12	10	7.9	7 <sup>2</sup>	37	10.7	7.5	7 <sup>2</sup>
13	10	6.7	7 <sup>2</sup>	38	10.1	7.9	7 <sup>2</sup>
14	10.4	7.9	7 <sup>2</sup>	39	11.1	8.4	7 <sup>2</sup>
15	7.3	5.9	7 <sup>2</sup>	40	11	7.7	7 <sup>2</sup>
16	9	6.8	7 <sup>2</sup>	41	10.7	7.6	7 <sup>2</sup>
17	9.5	6.8	7 <sup>2</sup>	42	11.3	7.9	7 <sup>2</sup>
18	10	7.8	7 <sup>2</sup>	43	12	8.3	7 <sup>2</sup>
19	9.6	7.1	7 <sup>2</sup>	44	11.5	8	7 <sup>2</sup>
20	8.8	6.1	5 <sup>2</sup>	45	9.6	7.1	7 <sup>2</sup>
21	8.7	5.5	7 <sup>2</sup>	46	10.9	7.5	7 <sup>2</sup>
22	9.5	7.4	6 <sup>2</sup>	47	10	7.6	7 <sup>2</sup>
23	8.6	6	5 <sup>2</sup>	48	11.8	7.9	7 <sup>2</sup>
24	10.3	7.8	7 <sup>2</sup>	49	9.8	7.7	7 <sup>2</sup>
25	10.5	7	7 <sup>2</sup>	50			

Exponent in 3<sup>rd</sup> Column  
intensity of color of  
petiole 1 = Green 2 = Yellow Green 3 = Red

Bullet Tree (Hills Farm) 7/6/52

Length of petiole  
no of lobes  
Length of longest lobe

Sl. No.	Pet	Len L	Lob No	Length of longest lobe	no of lobes	Length of petiole	
1	10.75	7.75	7	21	15	8.7	9
2	12.25		7	22	12	7.5	7
3	11.5	7	7	23	11	6.5	7
4	9.7	7.5	7	24	17.7	7.5	7
5	11.0	6.5	7	25	10.7	7.0	7
6	10.0	5.7	7	26	9.7	6.7	5
7	12.0	7.9	7	27	9.9	7	7
8	11.5	7.5	7	28	9.8	6.7	7
9	11.7	7	7	29	10.0	7	7
10	13	7.7	7	30	11.0	6.8	7
11	11.5	7	7	31	10.2	6.7	7
12	10.7	7.7	7	32	11.8	7.5	7
13	12.5	7.7	7	33	10.3	6.5	7
14	12.2	7.8	7	34	9.5	6.9	5
15	12.0	8	7	35	9.5	6.6	5
16	12.0	7.7	7	36	10.5	6.8	5
17	12.0	7	7	37	12.5	7.7	7
18	11.2	7.5	7	38	12.2	8.9	7
19	10.5	7.2	7	39	11.1	7	7
20	11.5	7.7	7	40	9.5	6.2	5

Bullet Tree  
Hills Farm 4/6/53

	Pet. L	Lobe L	Lobe no.
1	9.7	5.9	7
2	10.5	7.5	7
3	12.0	6.5	7
4	10.0	7.8	7
5	10.5	6.4	7
6	10.4	6.7	7
7	8	5.6	7
8	9	6.5	7
9	11.5	8.5	8
10	9	7	7

Petioles usually dark red,  
veins green. A few petals  
lighter + more green.

7/6/53

	Stem	Leaf	Flower				
	Dist	Leaf	Flower				
1	11	8.5	9	30	9.5	7.0	9
2	11	9	7	31	11.2	7.7	9
3	13	8	9	32	11.5	7.8	9
4	11	7.8	8	33	10.0	8	8
5	9	9.2	6	34	11.8	10.0	7
6	12	7.4	8	35	12.5	7.3	9
7	11.5	10.0	7	36	12.0	8.0	9
8	11.8		9	37	11	7.7	9
9	11.6	9	9	38	9.7	8.8	9
10	12.5	8.5	9	39	9	7.7	7
11	10.7	9	7	40	8.7	8.2	6
12	10.7		7	41	9.7	8.7	9
13	10.2	8.8	9	42	11.0	7.5	9
14	10.5	9.5	7	43	10.7	8.8	7
15	11.8	8.7	9	44	11.0	8.0	9
16	11.4		9	45	9.4	8.7	9
17	10.7	9.6	7	46	12.0	7.0	9
18	9	9.4	7	47	9.4	7.8	7
19	9.5	8.6	8	48	11.7	7	7
20	12.7	8.5	9	49	9.7	8.5	9
21	12.4	8.1	9	50	9.4	8.8	7
22	11.8	9.5	9				
23	10.5	7.5	7				
24	11.2	9.5	7				
25	9.5	9.5	9				
26	12.0	9.5	9				
27	10.0	7.8	7				
28	12.0	8.0	9				
29	9.0	8.7	5				

Petioles  
uniformly  
green

Catch chief 7/6/53  
Kull's name

over

1	12.7	8.2	7	26	11.8	7	7
2	11.5	6.7	7	27	9.5	7	7
3	10.5	8.5	7	28	10.5	7.5	7
4	11	7.5	7	29	11.2	7	6
5	9.7	6.7	7	30	10.3	6.7	7
6	9	7.5	7	31	12.4	6.9	9
7	11.4	7.5	7	32	12.1	7.5	7
8	9.7	6.5	7	33	10.5	7	7
9	13.0	7.8	7	34	8.5		7
10	11.0	9.5	7	35	12.0	7.8	7
11	13.0		9	36	11.7	8	7
12	11.0	6.9	7	37	12.0	7.9	7
13	12.0	7.4	9	38	12.0	7	7
14	12.7	8.2	7	39	10.4	6.5	7
15	13	6.7	7	40	12.0		7
16	13.2	8	7	41	11.7	8	7
17	13.2	8.5	9	42	13.0	8.2	7
18	13.8	8.5	7	43	10.4	7.2	7
19	11.0	7.7	7	44	11.6	8	7
20	12.4	8.5	9	45	11.1	8	7
21	11.5	6.5	5	46	10.0	6.8	7
22	11.4	5.5	7	47	11	6.8	7
23	11.5	6.5	7	48	9.5	7.5	7
24	11.0	7.8	7	49	12.0	7.4	7
25	12.8	7.9	7	50	11.0	7	7
				51	10.7	6.7	8

New Series (5) 7/6/52  
 Lobe No. length of Middle lobe

No.	Pat. L.	Lobe	Wgt.	No.	Pat. L.	Lobe	Wgt.
1	11.2	7.7	7	26	10.8	8.2	7
2	11.5	7.5	7	27	11		7
3	11	7.5	7	28	12	9.5	7
4	11	7.8		29	11	8.7	7
5	12.5	8.5	7	30	11	7.9	7
6	12.4		7	31	13.5	8.6	7
7	11			32	13.4	8.6	7
8	12	7.7	7	33	11.9	7.9	7
9	11.8	7.5	7	34	11.5	7.6	7
10	12.5		7	35	12	8.5	7
11	12	7.8	7	36	11.5	7.6	7
12	10.0		7	37	10.4	8.7	7
13	8	7.6	7	38	10.6	7.7	7
14	9.2	7.6	7	39	11.5	7.5	7
15	11	7	7	40	12	8.5	7
16	12.3	8.2	7	41	10.7	8.4	7
17	9.5		7	42	11.4		7
18	11.2	8	7	43	13.4	8.6	7
19	12.3	8.2	7	44	10.8	8	7
20	10.8	7.5	7	45	12	8	7
21	11.3	7.4	7	46	11.2	8.8	7
22	11.3	7.4	7	47	13.6	8.9	
23	11.5	8.2	7	48	11.3	7.6	7
24	9.5	6.7	7	49	11.8	8.6	7
25	12.2	8.8	7	50	12.7	7.8	7

Richmond Steel - Hills farm  
 7/6/53 Pa. Lvs, 4<sup>+</sup>, 2 leaf bud  
 Yellow Saunders

1-6	1-4 <sup>+</sup>
2-6	2-6
3-6	3-6
4-6	4-4 <sup>1</sup>
5-6	5-4
6-6	6-5
7-6	7-7
8-6	8-6
9-7	9-6
10-6	10-6
11-5	11-7
12-5	12-6
13-6	13-7
14-6	14-5
15-6	15-6
16-4	16-6
17-5	17-7
18-6	18-6
19-6	19-8
20-4 <sup>+</sup>	

Average height of these plants  
 about 5.5 - the other ones  
 at Hills farm are 8-11 ft.

\* - Mostly young plants  
 1 - Mature

Elms stick - No. 224, 2"  
from Terminal Bud

1	6
2	5
3	6
4	5
5	5
6	6
7	7
8	7
9	7
10	8
11	8
12	6
13	7
14	6
15	7
16	8
17	7
18	6
19	5
20	5

		No. of leaves on stem & long, 2 per branch	
Catkins	Short	new	old
1	7	23	7
2	5	24	7
3	4	25	5
4	5	26	7
5	7	27	7
6	5	28	6
7	7	29	5
8	6	30	7
9	5	31	4
10	6	32	8
11	4	33	6
12	4	34	5
13	5	35	5
14	7	36	8
15	4	37	5
16	3	38	6
17	5	39	6
18	4	40	6
19	4	41	7
20	5	42	5
21	102	43	6
22	-5.0	44	131
		45	-6
		46	
		47	

Length of random sample of mature  
petioles -

New Stock	<del>Stk. Stck.</del>	<del>Length</del>	Label
Length	No. lobes		
1	10.5	7	
2	12.7	7	
3	10	7	
4	11.5	7	
5	8	7	
6	10.7	7	
7	12.5	7	
8	10.5	7	
9	11.75	7	
10	11.3	7	
11	13.75		
12	11.75	7	
13	11.75	7	
14	12.35	7	
15	10.75	7	
16	12.0	7	
17	13.35	7	
18	12.0	7	
19	11.5	7	
20	11.5	7	
21	13.75	7	
22	13.5	7	
23	11.25	7	
24	10.75	7	
25	11.25	7	
26	12.00	7	
27	11.00	7	
28	12.00	7	
29	10.25	7	
30	11.00	7	

Petioles + veins  
yellow green

8/24/53

List of numbers (Institute) of yucas at Tuxtla

2766 -	Cubano Blanco	-	"El Cacao, Alajuela
2767 -	"Flor de lis" Brasil	"	"
2768 -	Brasil	"	"
2769 -	Chilena	"	"
2780 -	Blanco from	Nicaragua,	San Rafael del Sur
81 -	Colorado	"	" " " "
82 -	"	"	" " " "
83 -	Cubana	"	" Masaya
84 -	M. guatemalensis	"	" San Rafael del Sur
85 -	no name	(1)	Las Mercedes, Managua
86 -	" "	(2)	" "
87	" "	(3)	" "
88	" "		El Cacao, Alajuela
89	" "		" "

Vars. already at Institute

Higuerilla

Camote Blanca No. 2

" " No. 1

Camote

Crema

Zopilota

Vainilla

2069 Valenca

Camote corriente

Yuca No 1

7 Meses

Amarillo corriente

Yuca No. 2

2070 "Sra. esta en la mesa"

2072 - Brasil RE 144731

2071 - Manje

This is import  
from E. America,  
thru Cuba.

## Studies on yuca

Seminar report on the varieties of yuca (Manihot spp.) cassava, mandioca.

### Importance of yuca

1. Starch--used as food (for man & animal) glue, paper and textile sizing.
2. Protein--foliage, for man and cattle, various % of protein 19-35 (dry wt.)
3. Vitamins--foliage contains fairly high % of carotene, thiamine, riboflavin, niacin, and ascorbic acid.
4. Lactic acid--trials by Dupont found good production
5. Sauces--basis for such as Worcestershire.

Distribution--occurs on all continents except Europe, within latitudes from 27° North to 27° South, in regions ranging from moist to semi-arid conditions, from sea level to about 3000 feet.

Historical--Yuca probably originated in Eastern South America, and spread to all areas of Central and South America previous to arrival of Columbus. Early Spanish, Portuguese, Dutch and English explorers transported it to all parts of the tropical world.

Few studies were made on the plants prior to 20th century. Neither agriculturists nor botanists made extensive experiments with yuca, but increased population pressures, with a greater demand for food supplies forced attention towards yuca, along with other food plants. By 1920 several works on agronomic practice and one effort towards classification of the varieties had been completed. Since 1920 more work on various aspects of agronomy, pathology and selection has been done. Most of the data are scattered and only locally applicable.

Classification: Family Euphorbiaceae, genus Manihot. Question of numbers of species involved is in doubt. Most workers call all yucas M. utilissima, but frequently it is called M. esculenta. Some divide the "bitter" yuca (M. utilissima) from the sweet (M. dulcis). Another name is sometimes found involved: M. saxicola, but this name requires further study to determine validity as a species and relations to yuca.

A closely allied species, M. Glaziovi, produces Ceara rubber.

Method of study: This work is primarily based upon utilization of ~~morphological~~ comparative morphological techniques, in order to determine the basic variations which exist within the plants called yuca. Within a population it is possible to determine to a large extent which characteristics are genetically controlled, which are influenced by environment.

In order to properly study the variation of the plants, it is imperative to have available in one situation as much of the variation as exists. To do this, a "museum plot" is being established at the Institute for varieties from all important areas of cultivation. At the same time, this plot can be utilized to determine the disease condition of plants brought from various areas.

Once the plots have been established, it will be possible to apply the above named techniques, an example of which is as follows, for those varieties in cultivation on the grounds at present:

1. Characters of importance are
  - a. the branching pattern--from unbranched stems to as many as 5 branches from a single stem.
  - b. the distribution of leaf bases per length of stem.
  - c. number of lobes of leaf--usually a fairly stable character (within limits)
  - d. shape of lobes of leaves
  - e. length of petioles of mature leaves
  - f. color and shape of the roots.
2. Characters of little importance in this study are those of flower and

fruit, since both are produced in very small numbers, and may not occur at all at time of harvest.

3. Genetic studies will be made to determine condition of ploidy. It is suspected that all the cultivated yucas are a polyploid race, but no accurate data exists on this condition.

If you have any interest in the study of yuca,  
I should like to have your name and address,  
plus any information which you may wish  
to contribute concerning any aspect of yuca.

Inter-American Institute of Agricultural Sciences  
Turrialba, Costa Rica

PROJECT No.

Date submitted: July 1953

Project Title: Study of varieties of cassava or yuca (Manihot spp.)

Index Title:

Leader: David J. Rogers<sup>1</sup> and Jorge León

Cooperators: Dr. Frederick L. Wellman, FAS; Dr. W. S. Wright, Dept. of Agriculture, Kingston, Jamaica; Dr. Ramón Mejía, Jefe, Fed. Sac. Cafeteros de Colombia; Dr. Carlos A. Krug, Inst. Agron., Campinas, Brasil.

Associates: Mr. Claud L. Horn, Dr. Edgar Anderson

Location: Inter-American Institute of Agricultural Sciences, Turrialba, C.R.

Reasons for Undertaking the Study:

1. Although yuca has been one of the most fundamental food plants for the people of tropical countries, and its products utilized by peoples of the temperate climates for a very long period, very little is known about the plant. Its varieties remain unclassified, its real value and best utilization unknown. Botanists have ignored the plant for various reasons, none of them valid. Agronomists have made some studies, but without too much validity for other than local conditions. The lead has been taken by the agronomists of Brasil in present day studies, but without too much interest in the background and evolution of the plants. Knowledge of the diseases of yuca is very incomplete. The Dutch have worked on the breeding and cultivation techniques, but again on these plants transported to the East Indies, without reference to the basic entities which probably occur in South America (according to Vavilov).
2. Aside from these problems of great practical value, there exists within the study of this plant some of the best possibilities to understand basic biological problems. For example: man's influence on evolution of plants; the center of origin of and routes of migration of the plants; the genetic complement which allows for the tremendous amount of variation which exists.

Either the practical or the basic biological problems would be sufficient reason for undertaking this study. The basic reason is my interest in the plants per se, but at the same time with an eye towards its value to man.

1. Supported in part by grant from the American Philosophical Society, Philadelphia, Pa., & in part by Allegheny College, Meadville, Pa.

Review of the literature:

1. From the standpoint of classification, there has been one single study of the varieties of Manihot utilisima: "Estudo Sobre Algumas Variedades de Mandioca Brasileiras" by Leo Lehmann, published by the Sociedade Nacional de Agricultura, Rio de Janeiro, 1919. As the author himself points out, this work is applicable only to some 74 varieties which he collected from three areas of Brazil. He made his keys from the varieties in cultivation, without reference to basic variations, and only for the sake of convenience. There is some value to this work, but not from the standpoint of the total picture of the basic variations.
2. It is impossible to review all of the agronomic studies done in both the Western and Eastern Hemispheres. These studies are largely devoted to techniques of planting, fertilizer trials, analyses of starch production, local variety trials, etc. It is not within the scope of the present program to make similar trials. However, after the basic data of variation has been accumulated, it is hoped that continuing studies of agronomic importance will be incorporated.
3. One physiological study of importance to the present program is a color reaction reported by Dolfus, G. G. in Rev. Internat'l. de Bot. Appl. & B'Ag. Trop. 32: 559-563, 1952. This color reaction is utilized to determine the amount of HCN contained in various varieties, and seems useful in distinguishing the bitter and sweet varieties.
4. Other basic studies of importance are those of Viegas, A. P. (Inst. Agron. Campinas, Bol. Tecn. 74, 1940) on the vegetative anatomy, and Grener, H. A. (Bragantia 2: 1942) on some aspects of the genetics of yuca.
5. Work in Kenya by Dr. H. H. Storey and co-workers has been carried on for some time (10 years) with respect to both disease (virus) control through resistance, and increasing of yield. This work is being secured at this moment.

Objectives:

1. To determine the fundamental variation which exists in the species of Manihot which produce the crops called yuca, manioc, or cassava.
2. To make this data generally available to those people for whom the crop is of basic importance.
3. To understand the evolution of the species, in order to determine the best methods of selection and breeding.

Procedures:

1. Cuttings of varieties sent to Turrialba will be placed in "museum plots"

in order to compare variations under similar environmental conditions. These cuttings to be sent from important areas of cultivation, i. e. Brazil, Colombia, Peru, Ecuador, Venezuela, Jamaica, Kenya, Malaya, India, Java, but with special emphasis on Brazilian, Colombian and Venezuelan varieties, since these areas are considered to be somewhere near the center of origin.

2. Methods of breeding will be studied.
  - a. Time of pollination
  - b. Degree of compatibility
  - c. Degree of sterility
3. Statistical methods to determine stability of characteristics of varieties under varying environmental conditions.
4. Keys to the basic variations.
5. Maps in detail of distribution of each basic variation.
6. Correlation of information of each basic variation.
  - a. Description of the morphology
  - b. Local names of various areas applied to each of the variations.
  - c. Starch yield and other properties (vitamin and protein content).
7. Disease problems and quarantine will be carefully controlled through the assistance of Dr. Wellman.

Publication Intended: Progress reports in Turrialba, or in Dept. of Agriculture Bulletins such as that of Jamaica, Brazil, or others. Probable cumulative report in Turrialba or other publication which has wide range of tropical distribution.

Date of Initiation of Work: July, 1953

Probable Duration: 3-6 years.

Estimated Annual Expenditure: Labor, 100 colones per year. Otherwise, self-supporting, or through assistance of granting agencies.

Approved:

H.C. Thompson Head of Department

H.C. Thompson Director of Research and Education

\_\_\_\_\_  
Director of the Institute

DJR/ar.

August, 1953



Agricultural Chemistry Division,  
 DEPARTMENT OF AGRICULTURE,  
 Hope, Kingston,  
 JAMAICA, B.W.I.

PLEASE QUOTE RKR/mec

REFERENCE No. 347/54

14th June, 1954

Dr. David J. Rogers,  
 "Maryfield",  
 60 Hope Road,  
 Half Way Tree P.O.

Dear Sir,

I have now been able to find the analytical figures for the Cassava Tubers received July 11, 1953 and which we were discussing last Saturday. It appears that no moisture determinations were carried out hence all the figures quoted below are based on the original material as received at this laboratory.

Laboratory No. 214/53

Sample	mm HCN.	% Starch
1. Elmo Stick	N11	27.1
2. New Stick	21	30.1
3. Bullet Tree	38	30.4
4. Richmond Stick	27	28.6
5. Catch Thief	29	28.6
6. Yellow Saunders	38	22.4

Yours faithfully,

R.K. Richardson  
 for Agricultural Chemist.

c.c.

Chief Agricultural Officer  
 Agronomy Division.

REPORT OF ANALYSIS ON SAMPLES OF YUCA GROWING AT TURRIALBA, COSTA RICA

INCAP Sample No.	656	658	659	660
IICA Sample No.	2	3	1	4
Sample Name:	Yuca de 7 meses	Yuca-vainilla	Yuca-camota	Yuca-Higuerillo
Humedad	57.9	59.8	62.3	62.6
Extracto Etéreo	0.7	0.4	0.5	0.7
Fibra Cruda	0.9	0.9	0.8	----
Proteínas **	0.5	0.5	0.3	0.4
Cenizas	0.9	1.0	1.0	1.0
Calcio	125	91	85	93
Fósforo	31	75	18	30
Hierro	0.8 <sup>***</sup>	1.6 <sup>***</sup>	0.0 <sup>***</sup>	5.7 <sup>***</sup>
Carotenos	0.026	0.018	0.056	0.020
Tiamina	0.07	0.09	0.07	0.08
Riboflavina	0.03	0.03	0.02	0.02
Niacina	0.91	0.85	0.66	0.74
Acido Ascórbico	61	58	50	58

\*\* Nitrógeno x 6.25

\*\*\* Probably some contamination

DEPARTMENT OF AGRICULTURE,

JAMAICA, B.W.I.

PLEASE QUOTE

REFERENCE No. G 326

20<sup>th</sup> August, 1955

Dr. David Rogers,  
Department of Biology and Geology,  
Allegheny College,  
Meadville,  
Pennsylvania,  
U. S. A.

Dear Dr. Rogers,

I have now received from our Agricultural Chemist, the various analyses of cassava leaf and tuber samples from Grove Place and Bodles. I am forwarding one copy to you and trust the information will be of use to you.

-----  
It was very nice to have you with us again and I hope you will continue your association with this Department.

Yours sincerely,

Acting Director of Agriculture