PEACH PALM (*Bactris gasipaes H.B.K.*) GERM PLASM BANK

US-AID Project nº 936-5542

REPORT

First International Peach Palm Collecting Expedition

08 January to 06 February, 1983

PEACH PALM *(Bactris gasipaes H.B.K.)* GERM PLASM BANK

US-AID PROJECT Nº 936-5542

REPORT

on the

FIRST INTERNATIONAL PEACH PALM COLLECTING EXPEDITION

from

08 January to 06 February

1983

on

the AMAZON RIVER, BRAZIL

Responsible for this

Document:

CHARLES R CLEMENT

Co-Director of the Project

Manaus, AM, Brazil

July, 1983

TABLE OF CONTENTS

1. INTRODUCTION PAGE 01

2. THE PARTICIPANTS OF THE FIRST EXPEDITION 02

3. ITINERARY AND ROUTE 03

4. THE COLLECTIONS OF PEACH PALM 06

4.1. Tabatinga, AM 06

4.2. Benjamin Constant, AM 06

4.3. Fonte Boa, AM 25

4.4. Tefé, AM 40

4.5. Coarí, AM 53

4.6. Manacapuru, AM 69

4.7. Itacoatiara, AM 69

4.8. Parintins, AM 80

4.9. Alenquer, PA 80

4.10. Gurupá, PA 93

4.11. Belém, PA 101

5. THE BOTANICAL COLLECTIONS 102

6. OBSERVATIONS ON POPULATIONS OF PEACH PALM IN THE BRAZILIAN AMAZON 104

7. THE EXPERIMENTAL SAMPLING METHODOLOGY 109

8. THE BIASED SAMPLING METHODOLOGY 112

9. CONCLUSIONS 114

ACKNOWLEDGEMENTS 116

APPENDIX 1 117

APPENDIX 2 118

I. INTRODUCTION

This report relates to the first expedition of the US-AID sponsored project: "Peach Palm (Bactris gasipaes H.B.K.) Germ Plasm Bank", nº 936-5542. The agreement between US-AID and CENARGEN/EMBRAPA and INPA/CNPq calls for four international collecting expeditions to make a reconnaissance and collection of the peach palm germ plasm from the populations in the Amazon basin.

The first expedition covered about 2,000 km of the Amazon river, from the western frontier of Brazil to Belém, Pará, near the mouth of the river. This route extends from areas adjacent to the supposed center of origin and domestication in Peru/Ecuador/Bolivia to one of the extremes of its present distribution at the mouth of the Amazon river. It was expected that along this route it would be possible to identify the principal populations of peach palm in the Brazilian Amazon, as well as to collect new material for the three established germ plasm banks as well as for the proposed bank in Peru.

This expedition would also test a new sampling methodology that would theoretically allow a more efficient collection of peach palm genetic variability. This experimental sampling methodology was designed to eliminate the collector's biases, which theoretically would make more probable the collection of genes in low frequency in the population. According to the original design, 6 experimental samplings, well distributed along the route, would be collected. However, only 3 of these were collected, because of a severe drought in eastern Amazonia. Although none of the team members thought that the random selection of trees in the populations was valid, all agreed that the descriptor list used was much better than the biased collection descriptor list.

In general this expedition was a success, as the data and results presented show.

II. THE PARTICIPANTS OF THE FIRST EXPEDITION

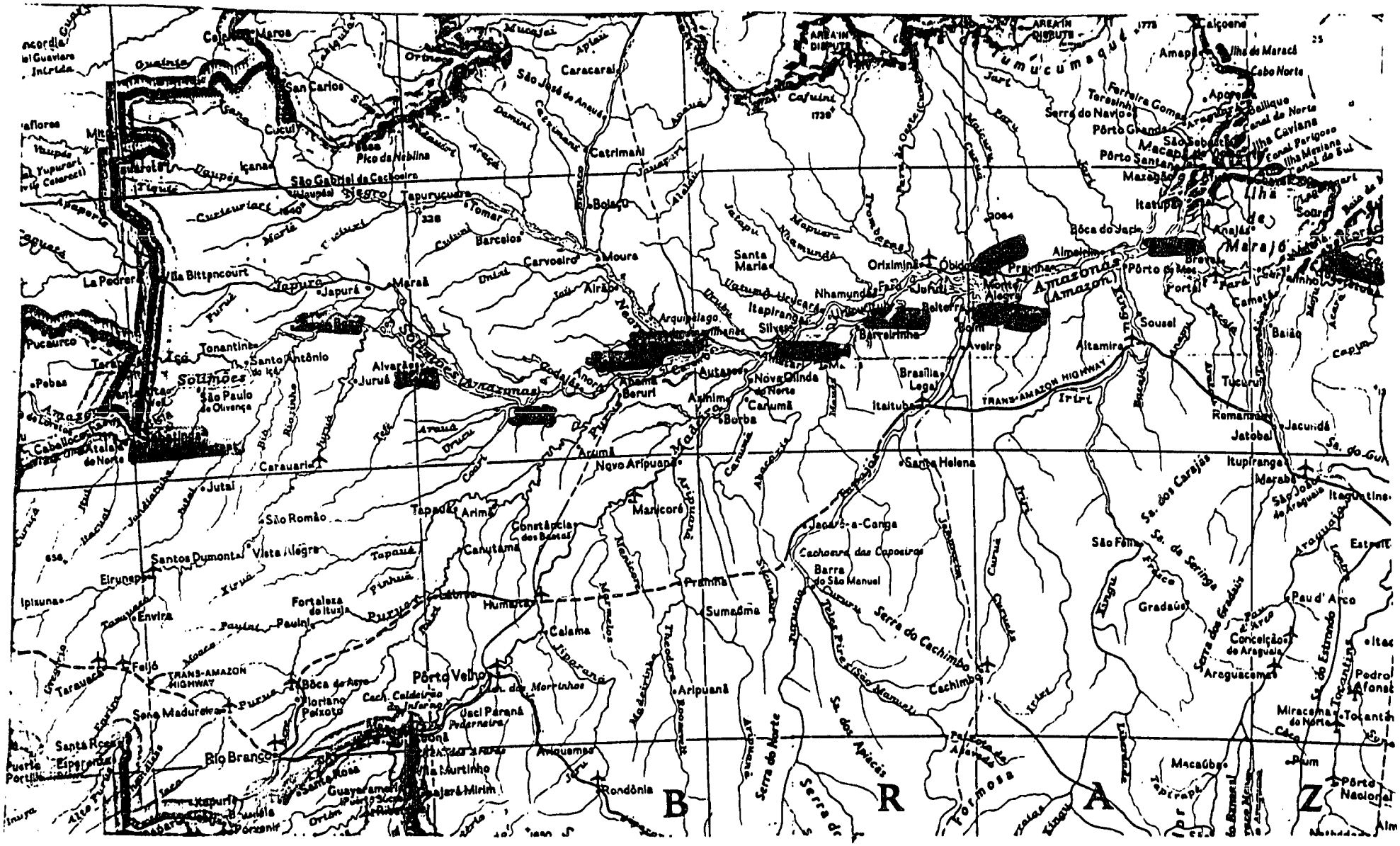
1.	Leader	:	Charles R. Clement (Biologist, BA) Div. Fruticultura/DCA Instituto Nacional de Pesquisas da Amazônia - INPA
2.	Vice-leader	:	Sidney A. N. Ferreira (Agronomist, BS) Div. Fruticultura/DCA INPA
3.	Botanist	:	J. Tadeu de Medeiros Costa (M.Sc.) Deptº Botânica - C. Ciências Biológicas Univ. Federal de Pernambuco
4.	Colombia	:	Oscar Rojas Noriega (Forester, BS) Div. Florestal Instituto Vallecaucano de Investigaciones Científicas - INCIVA
5.	Costa Rica	:	Jorge E. Mora Urpí (Geneticist, Ph.D.) Escuela de Biologia Universidad de Costa Rica
6.	Peru	:	Mario H. Pinedo P. (Agronomist, BS) Estación Experimental Agropecuaria "San Roque"; CIPA, Iquitos Instituto Nacional de Investigaciones y Promoción Agropecuaria - INIPA
7.	Technical Assistent	:	Dionísio Fernandes Coelho Deptº Botânica INPA
8.	IICA/CENARGEN	:	Eduardo Lleras P. (Physiologist, Ph.D.) Coordenator of the Experimental Sampling Experiment at CENARGEN

III. ITINERARY AND ROUTE (MAP)

- 08-01-83 - Expedition members meet in Tabatinga, AM, BR
- 09-01-83 - Collection at the Aldeia Umari-açu
- 10-01-83 - Day trip to Colonia Bom Jardim, Benjamin Constant
  - Reconnaissance of local peach palm population
- 11-01-83 - Shift to Benjamin Constant
  - Collection at Colonia Bom Jardim using experimental sampling methodology
- 12-01-83 - Collection at Colonia Bom Jardim
  - Departure by boat for Fonte Boa, AM
- 13-01-83 - Boat
- 14-01-83 - Reconnaissance of local peach palm population at Vila da Rodagem, Fonte Boa, AM
  - Collection at Vila da Rodagem using experimental sampling methodology
- 15-01-83 - Collection at Vila da Rodagem
- 16-01-83 - Departure by boat to Tefé, AM
- 17-01-83 - Collection at the Paraná de Tefé
- 18-01-83 - Collection in Nogueira (lake of Tefé)
  - Collection in Tefé plantation zone
  - Departure by boat to Coari, AM
- 19-01-83 - Excursion to islands near Coari
- 20-01-83 - Collection at Colonia Santa Fé, Paraná do Mamiá using experimental sampling methodology
  - Departure by boat to Manaus, AM
- 21-01-83 - Boat
- 22-01-83 - Manaus
- 23-01-83 - Collection on Manaus- Manacapuru road
- 24-01-83 - Federal Police and other organizational items
- 25-01-83 - Reconnaissance and collection in Colonia Rondon, Itacoatiara, AM
- 26-01-83 - Collection at Colonia Rondon
- 27-01-83 - Departure by boat to Parintins, AM
- 28-01-83 - Collection in the region of Parintins, AM
  - Departure by boat to Alenquer, PA
- 29-01-83 - Reconnaissance in Alenquer
- 30-01-83 - Collection along Alenquer-Obidos road
  - Departure by boat to Santarém, PA
- 31-01-83 - Reconnaissance in the region of Santarém, PA
  - Departure by boat to Almirim
- 01-02-83 - Reconnaissance in Almirim, PA
  - Departure by boat to Gurupá, PA

- 02-02-83 - Collection on the Igarapé Gurupá-mirim
- 03-02-83 - Collection on the Gurupá-Bacá road
- 04-02-83 - Departure by air to Belém, PA
- 05-02-83 - Visits to the local market and Museu Goeldi
- 06-02-83 - Departure by air to Manaus, AM

Map of the towns visited during the first expedition to collect Peach Palm in the Brazilian Amazon



IV. THE COLLECTIONS OF PEACH PALM

1. Tabatinga, AM, BR. Lat. 4°13'S; Long. 69°56'W

At the Tukano indian village, Aldeia Umari-açu, the peach palm season was already drawing to a close. However, between 10 and 15% of the trees still had a few bunches. In the village itself, about 40 to 50% of the houses had one or more peach palms as a door-yard tree. Very few of these had fruit.

Penetrating into the "terra firme" plantations, the number of trees increased. Generally each family plantation area would have a concentration of between 10 and 50 trees. However, because of the rain, few of the owners were available.

At the plantation area of Sr. Rodrigo, the first two biased collections were made. See Collection data I, Outlines and Photos 001-AID and 002-AID. Both of these collections were of material typical of the region, with large, starchy fruit containing little fiber and very little oil. The owner gave us some cooked fruit from these trees: 001 was rather tasteless; 002 had a better flavour, which Mora Urpí compared favorably with some from Costa Rica.

In this population there are occasional trees with no spines on the trunk, perhaps 5 to 10% of the population.

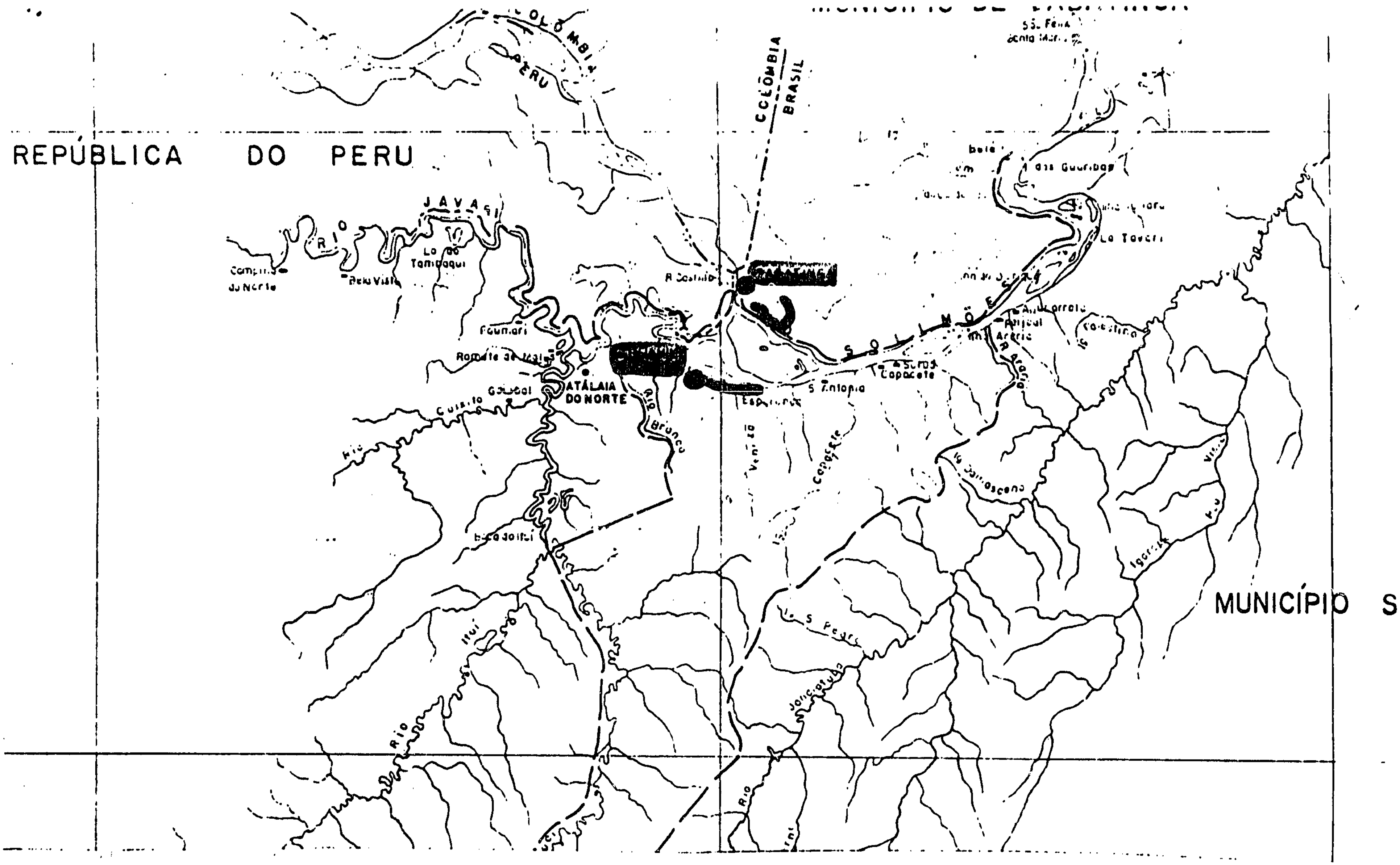
2. Benjamin Constant, AM, BR. Lat. 4°22'S; Long. 70°1'W

At the agricultural colony Bom Jardim, the preliminary reconnaissance showed about 90 trees with fruit, out of a population of about 500 trees. As in Tabatinga, the peach palm season was already drawing to a close. The greater percentage of trees with fruit was due to many being extremely tall and difficult to collect.

The peach palm population at Bom Jardim has many trees near the houses but a greater number further away. Each time the farmer cuts, burns and plants an area of forest he also plants some peach palm, so that the trees are found in small concentrations of 3 to 20 at varying distances from the houses. Since most of the intermediate distance concentrations are in varying aged secondgrowth, between the house and the newest plantation, access is frequently somewhat to very difficult.

The original plan was to map/list all trees with sufficient (125) ripe fruit. After the preliminary

Map showing areas visited in Benjamin Constant and Tabatinga, AM, during the first expedition

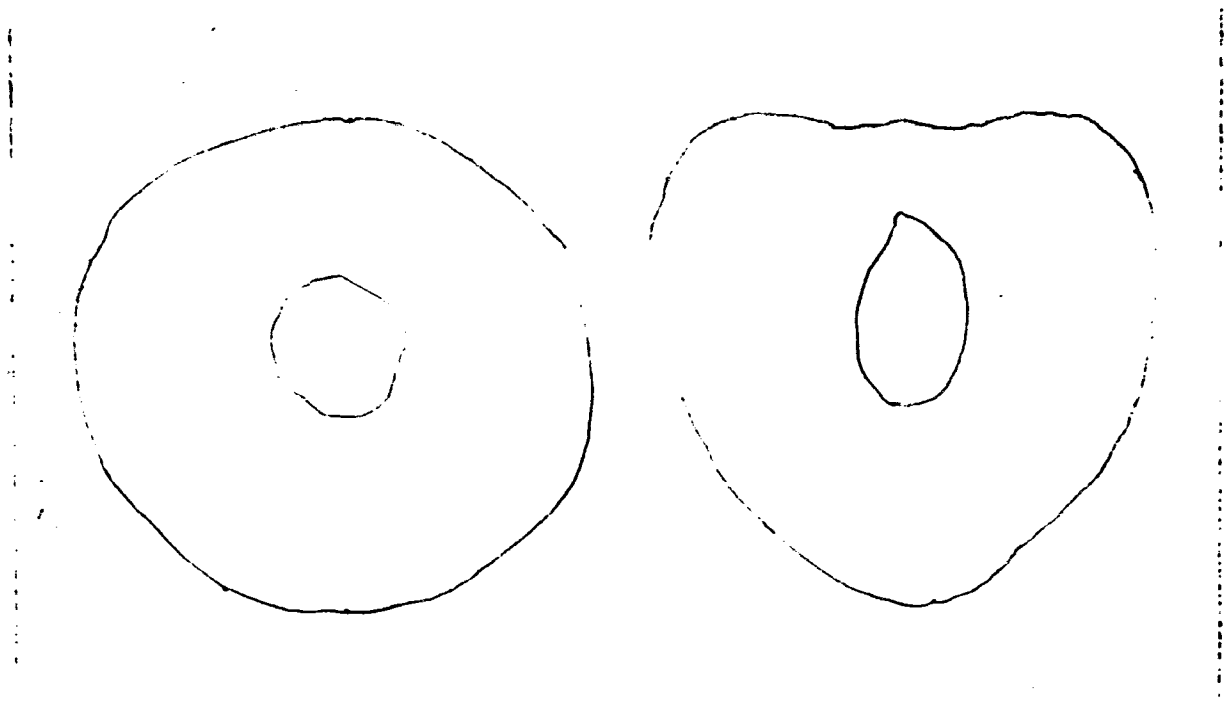


Collection data I

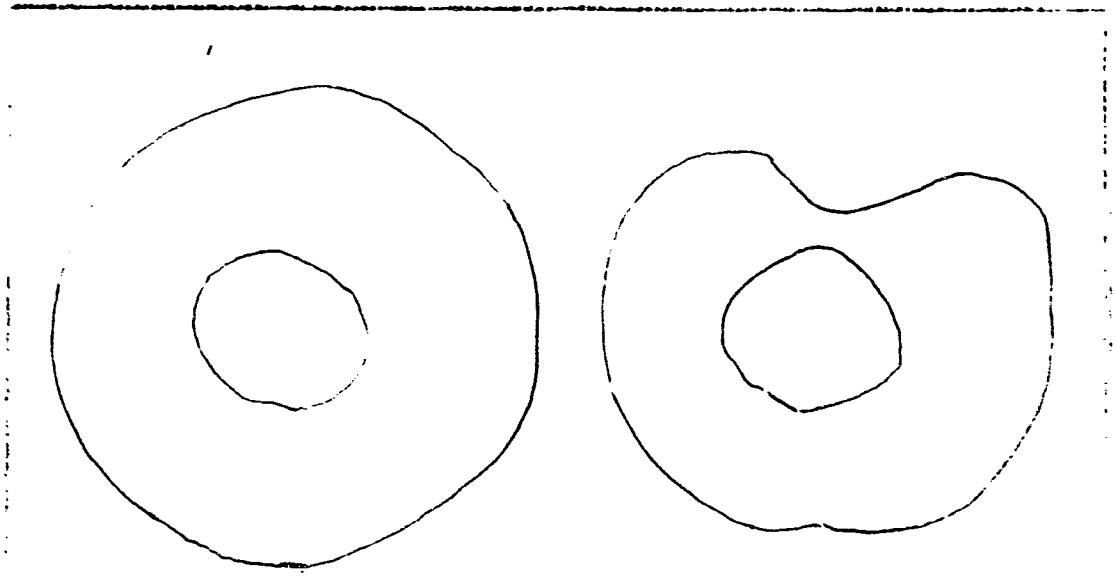
Biased Sampling of Peach Palm in Tabatinga, AM, BR (see Appendix 1 for explanation).

Character//	Sample-	001	002
1. Spine density on trunk	1.	7	6
2. Bunch number/trunk	2.	4	5
3. Fruit number/bunch	3.	46	-
4. Mature fruit color	4.	3	3
5. Cracks in skin of fruit	5.	1	1
6. Pulp color intensity	6.	5	5
7. Seed position in fruit	7.	4	3
8. Quantity of fiber	8.	3	3
9. Texture of raw pulp	9.	8	6

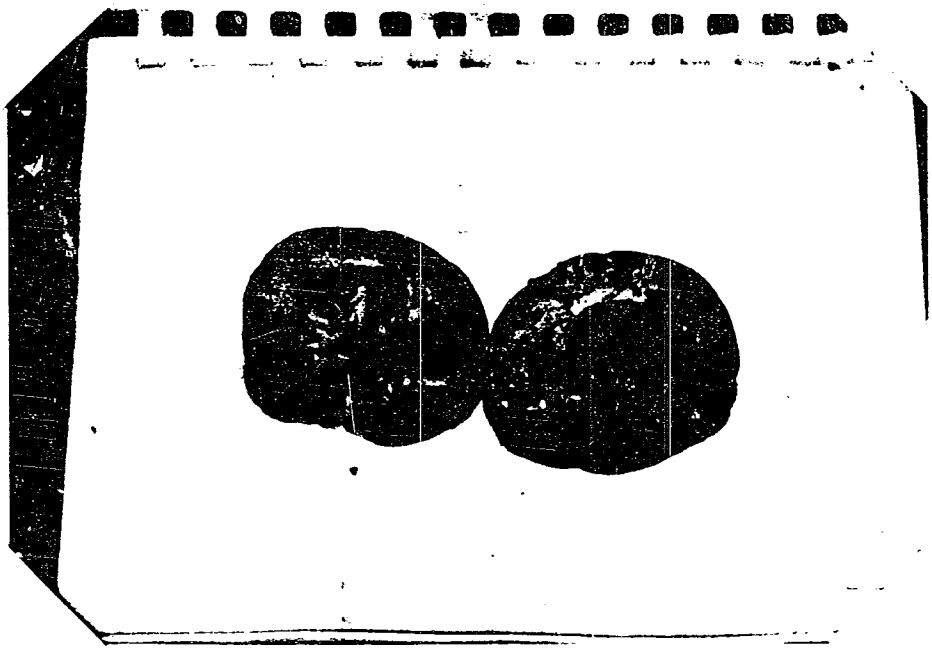
001-AID



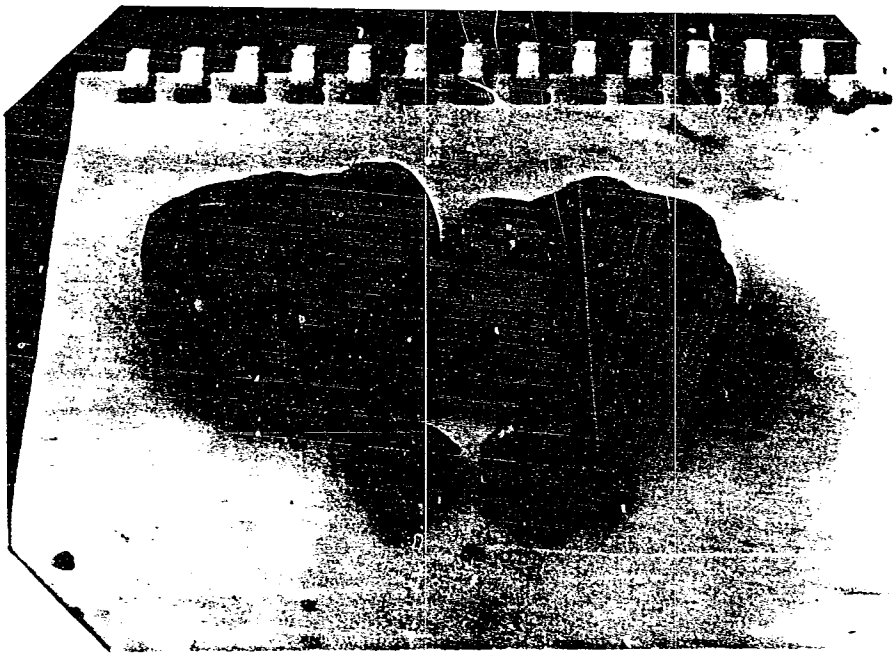
002-AID



001-AID



002-AID



reconnaissance it was recognized that this would take the better part of a day. Therefore it was decided to randomly select 20 numbers from the 90 fruiting trees and to start at one end of the colony and work through to the other, counting trees with ripe fruit for collecting.

On the first day, all 5 peach palm collectors worked together so as to familiarize everyone with the descriptor list, as to minimize differences in recording the descriptors. Because of intense rain only 2 trees were collected on the first day.

On the second day, the group was divided into three sub-groups: 2 groups of 2 people each to characterize the collected material; and 1 person to accompany the hired collector to identify and collect sufficient material for the other 2 groups. This worked very well, but the characterization of each tree still took an excessively long time. As we were scheduled to travel that night, it was decided to reduce the collection to 10 individuals, so as to be able to finish that day.

At the end of the experimental collection at Bom Jardim, the 10 trees collected and characterized had take 51 1/2 man/hours of work.

The material collected at Colonia Bom Jardim was rather similar to that from Umarí-açu, so much so that one must assume that they belong to the same regional population, or race (see Mora Urpí on populations, part VI). See Collection data II, Outlines and Photos 003-AID through 012-AID. Again all fruit were typical of the region, being large (averaging 100 gr.), starchy, with little fiber or oil.

Some of the trees deserve special notice. Tree number 005-AID has especially large fruit (average - 148 gr.), with parthenocarpic fruit of nearly the same size (average - 113 gr.). This similarity in sizes between fertil and parthenocarpic fruit is rather rare, and especially so in fruit of this size. Although the bunches were small (35 to 45 fruit) the tree produced 10 bunches in that season. Tree number 006-AID was also interesting because of its large bunch size (14.7 kg and 299 fruit) and because it contained moderate amounts of oil in a starchy mesocarp. This tree also produced 8 bunches in that season, which gives a much greater total weight than any of the other trees sampled.

In general all trees exhibited rather small bunches, less than 100 fruits, except for 006-AID; very high mesocarp

BEST AVAILABLE DOCUMENT

Collection data II

Experimental Statistical Sampling of Peach Palm in Benjamin Constant, AM, BR (see Appendix 2 for explanation)

Character	Sample-	003	004	005	006	007	008	009	010	011	012	$\bar{x}$	SD	CV
Tree														
1. Spine density in $5cm^2$	1.	0	1	9	17	0	0	16	10	4	4	6.1	6.56	107.49
2. Medium size of spines (mm)	2.	0	10	7	19	0	0	20	25	7	26	11.4	10.33	90.61
3. Trunk DBH (mm)	3.	186	204	200	146	197	185	232	226	170	165	191.1	26.66	13.95
4. Trunk color	4.	3	4	3	3	3	3	4	3	3	4	-	-	-
5. Length of 5 internodes (cm)	5.	93	76	105	104	126	127	99	97	74	114	101.5	18.04	17.78
6. Height of first bunch produced (mm)	6.	1500	-	-	-	-	-	-	-	-	-	-	-	-
Leaf														
7. Number of leaves	7.	16	15	23	18	12	21	18	17	14	18	17.2	3.22	18.75
8. Number of leaflets	8.	203	228	229	250	212	242	236	219	148	253	222	30.50	13.74
9. Medium length of leaflets (mm)	9.	730	800	800	900	850	720	740	920	780	870	811	71.41	8.80
10. Medium width of leaflets (mm)	10.	35	35	34	38	40	-	35	43	-	40	37.5	3.25	8.67
11. Spines on leaf petiole	11.	0	0	0	1	0	3	3	3	3	0	-	-	-
12. Spines on leaflet blade	12.	0	0	0	0	0	0	0	0	0	0	-	-	-
* Leaf area/leaf (m^2)	*	3.02	3.72	3.63	4.98	4.20	3.76	3.56	5.05	2.49	5.13	3.95	0.89	22.41
* Leaf area/tree (m^2)	*	48.36	55.81	83.49	89.69	50.41	78.90	64.12	85.84	34.85	92.36	68.38	20.27	29.64
Bunch														
13. Spines on spathe	13.	3	3	3	3	3	2	5	3	0	3	-	-	-
14. Length of bunch stalk (mm)	14.	240	350	480	370	310	380	300	460	380	430	328.6	119.97	36.51

Experimental Statistical Sampling of Peach Palm in Benjamin Constant, AM, BR

Character (continued)	Sample-	003	004	005	006	007	008	009	010	011	012	$\bar{x}$	SD	CV
Bunch (continued)														
15. Length of bunch rachis (mm)	15.	250	370	390	500	360	420	300	510	260	490	385	96.06	24.95
16. Total number of spikelets	16.	40	47	39	42	42	55	32	58	42	53	45	8.12	18.05
17. Number of fruited spikelets	17.	17	35	11	37	25	46	27	54	16	44	31.2	14.33	45.92
18. Percentage of fruited spikelets	18.	42.5	74.5	28.2	88.1	59.5	83.6	84.4	93.1	38.1	83.0	67.5	23.60	34.96
19. Total bunch weight (gr)	19.	3460	7520	3680	14700	4500	9700	4900	7150	4520	5400	6553	3460.88	52.81
* Rachis weight (gr)	*	330	440	-	300	800	1700	-	1455	640	620	-	-	-
Fruit														
20. Number of fertil fruits	20.	37	94	30	186	26	98	52	67	47	34	67.1	48.89	72.87
21. Number of parthenocarpic fruits	21.	0	0	9	113	0	0	0	0	0	1	12.7	35.36	-
22. Fertil fruit outline (see anex)	22.	-	-	-	-	-	-	-	-	-	-	-	-	-
23. Longitudinal diameter of 22 (mm)	23.	54	57	75	52	58	63	54	63	58	65	59.9	6.84	11.42
24. Max. transversal diameter of 22 (mm)	24.	58	49	35	45	58	53	54	56	53	62	52.3	7.75	14.81
25. Ratio 24/23	25.	1.07	0.86	0.47	0.87	1.0	0.84	1.0	0.89	0.91	0.95	0.886	0.165	18.62
26. Compare form with standards	26.	-	-	-	-	-	-	-	-	-	-	-	-	-
27. Calyx outline (see anex)	27.	-	-	-	-	-	-	-	-	-	-	-	-	-
28. Compare form with standards	28.	-	-	-	-	-	-	-	-	-	-	-	-	-
29. Mature fruit color (skin)	29.	3	1	1	3	3	1	3	1	3	3	-	-	-
30. Sequence of color change in maturation	30.	3	2	2	3	3	3	3	3	3	3	-	-	-
31. Skin brilhance	31.	5	7	3	7	5	5	7	5	3	3	-	-	-

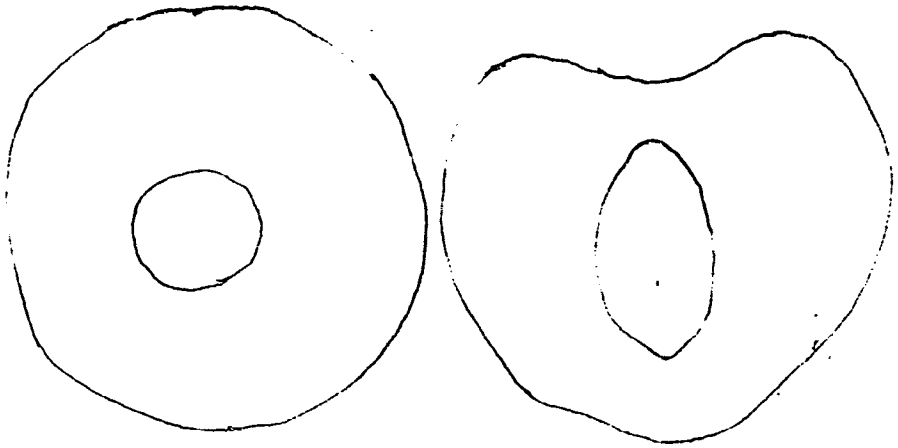
BEST AVAILABLE DOCUMENT

Experimental Statistical Sampling of Peach Palm in Benjamin Constant, AM, BR

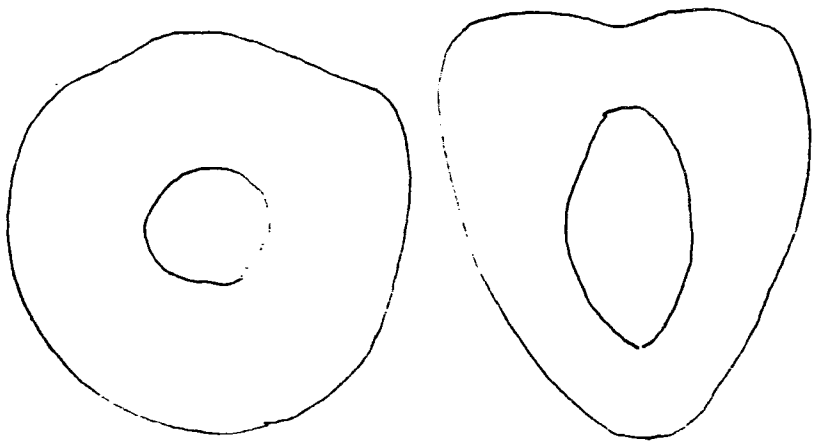
Character (continued)	Sample-	003	004	005	006	007	008	009	010	011	012	$\bar{x}$	SD	CV
Fruit (continued)														
32. Cracks in skin	32.	1	0	1	0	1	1	0	1	1	1	-	-	-
33. Distribution of skin cracks	33.	4	-	2	-	2	1	-	1/2	4	2	-	-	-
34. Presence of skin blemishes	34.	5	0	0	1	1	0	0	5	0	3	-	-	-
35. Medium weight of fertil fruits (gr)	35.	84.6	75.3	148.7	58.0	142.3	81.6	112.0	85.0	82.6	138.0	100.8	32.01	31.75
36. Medium weight of parthen. fruits (gr)	36.	-	-	113.3	32.0	-	-	-	-	-	80.0	75.1	40.87	54.42
37. Percentage of fertil fruits	37.	100	100	76.9	62.2	100	100	100	100	100	97.1	83.6	32.12	38.42
38. Percentage of parthenocarpic fruits	38.	0	0	23.1	37.8	0	0	0	0	0	2.9	6.4	13.18	-
Mesocarp														
39. Color of raw mesocarp	39.	4/5	1/2	1/2	2/5	2/5	2	2/5	1/2	5	2/5	-	-	-
40. Texture of raw mesocarp	40.	2	2	2(4)	2(3)	2	2	2(3)	2	2	2	-	-	-
41. Adherance of seed to mesocarp	41.	3	1	3	5	3	3	5	3	3	5	-	-	-
42. Medium weight of mesocarp (gr)	42.	81.0	71.6	143.6	56.0	138.1	75.6	108.4	78.6	78.8	133.0	96.5	31.61	32.76
43. Percentage mesocarp/fruit weight	43.	95.7	95.1	96.6	96.6	97.0	92.6	96.8	92.5	95.4	96.4	95.6	1.66	1.74
Seed														
44. Seed outline (see anex)	44.	-	-	-	-	-	-	-	-	-	-	-	-	-
45. Medium weight of seed (gr)	45.	3.6	3.7	5.1	2.0	4.2	6.0	3.6	6.4	3.8	5.0	4.3	1.30	30.33
46. Percentage seed/fruit weight	46.	4.3	4.9	3.4	3.4	3.0	7.4	3.2	7.5	4.6	3.6	4.5	1.66	36.88

BEST AVAILABLE DOCUMENT

003-AID



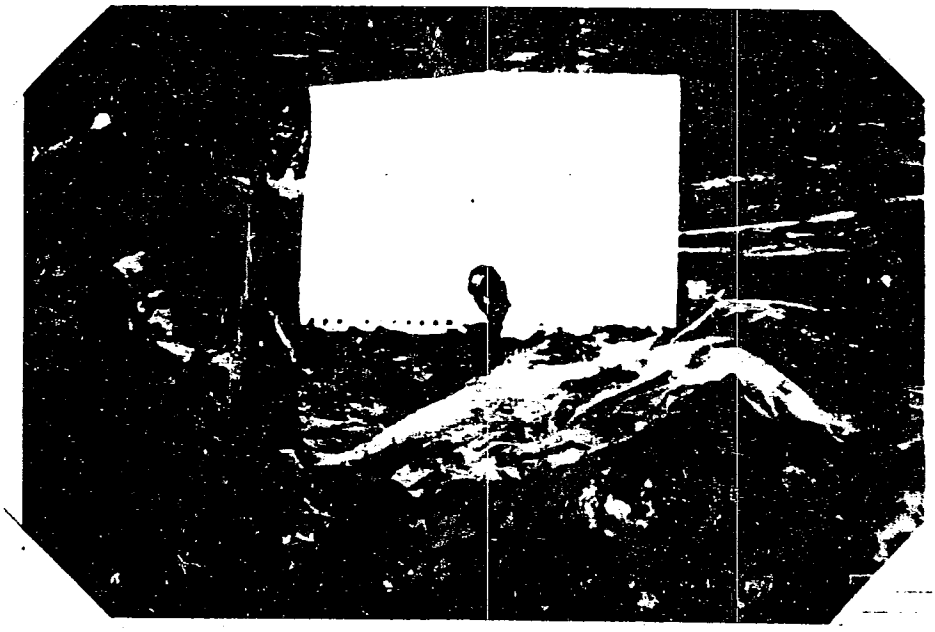
004-AID



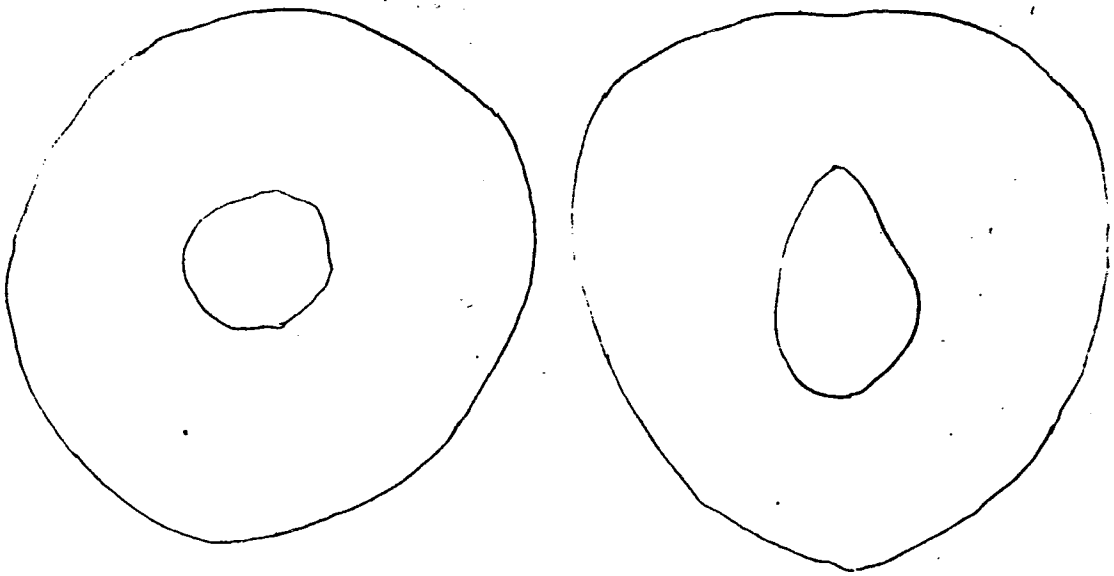
003-AID

negative severely underexposed

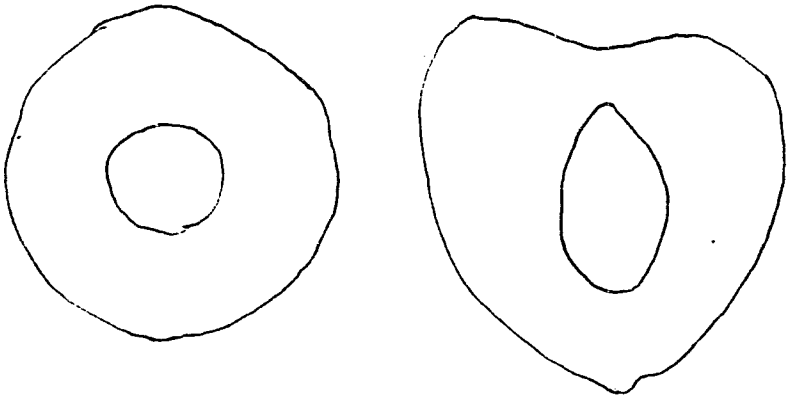
004-AID



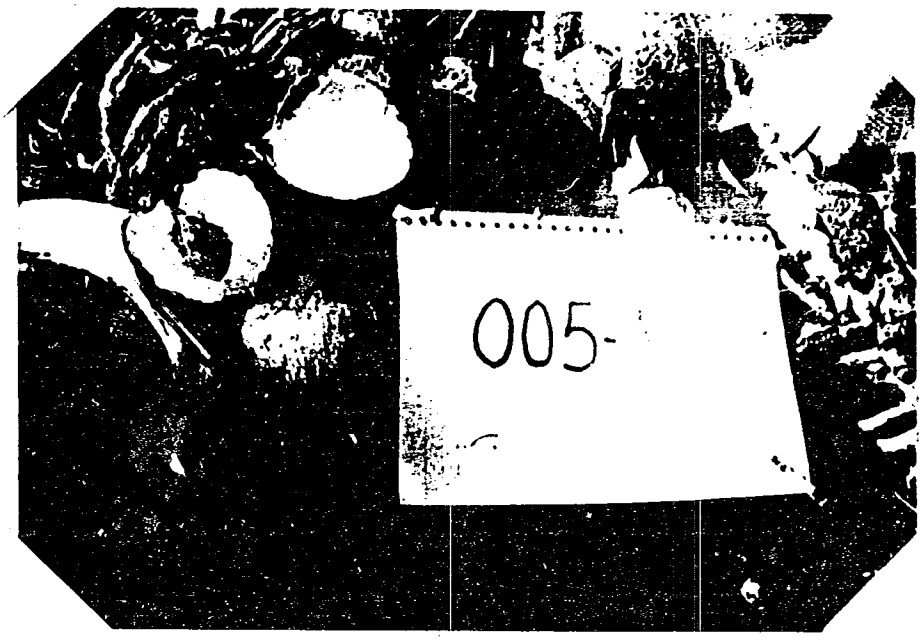
005-AID



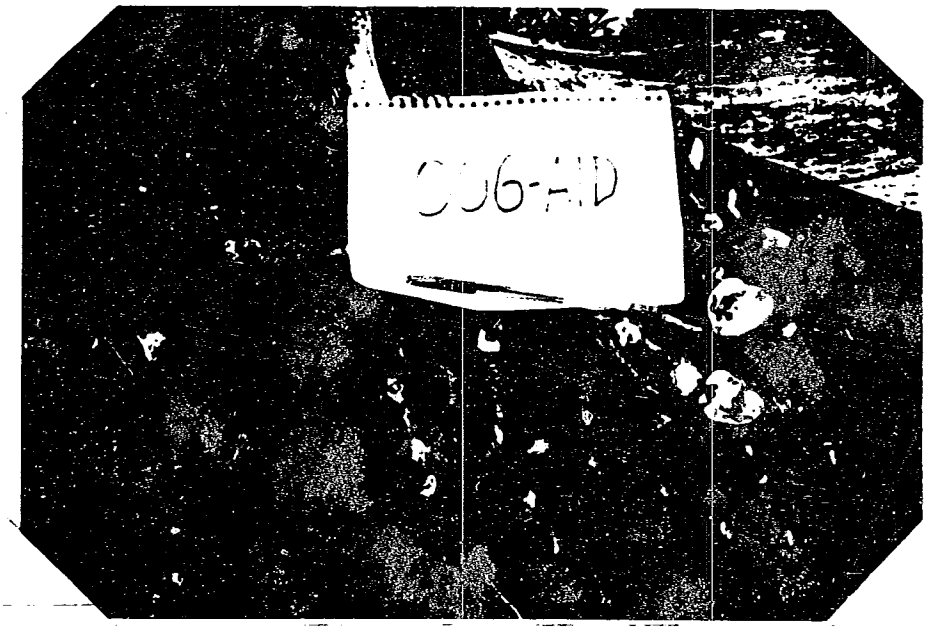
006-AID



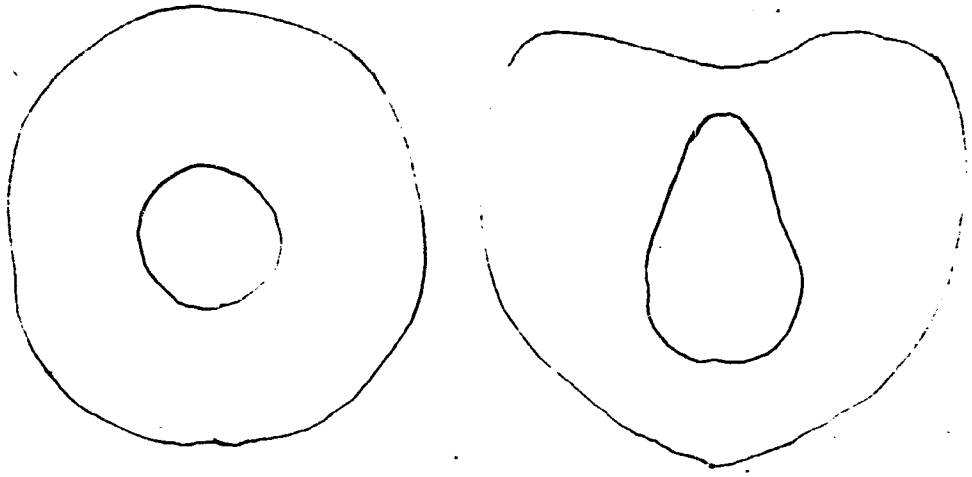
005-AID



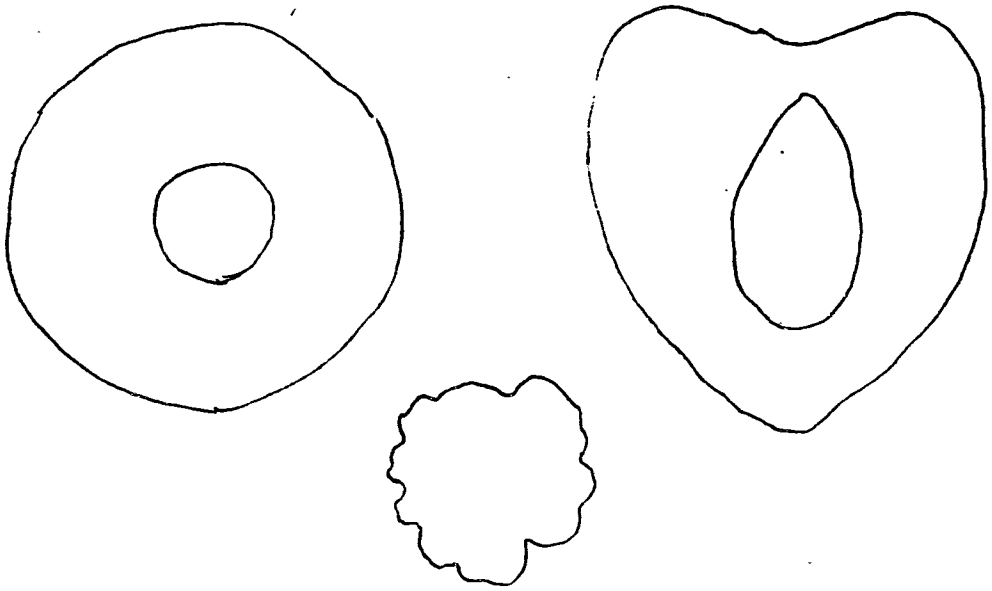
006-AID



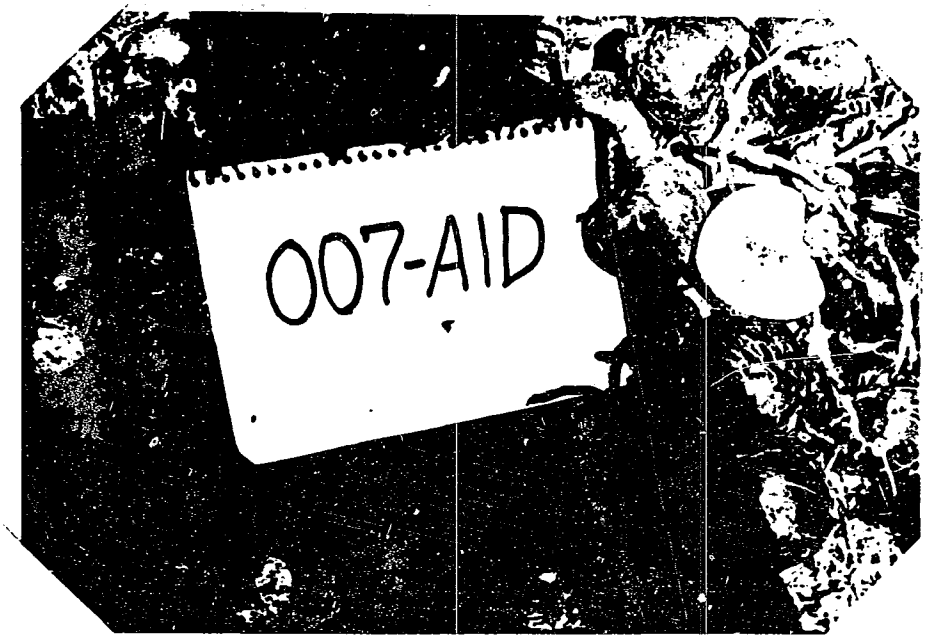
007-AID



008-AID



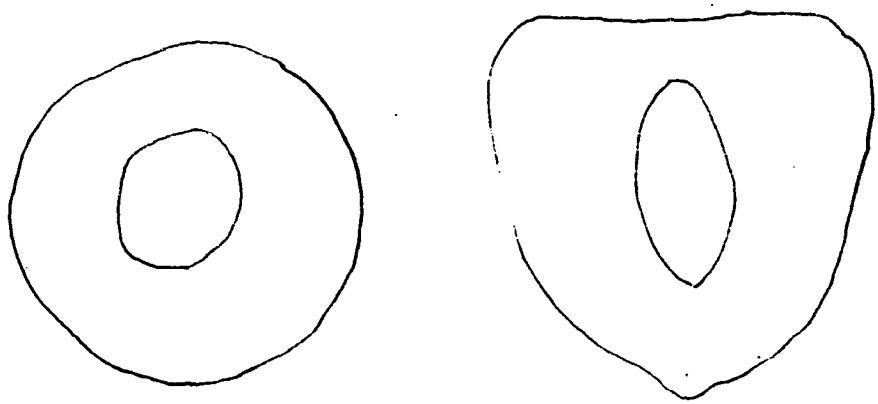
007-AID



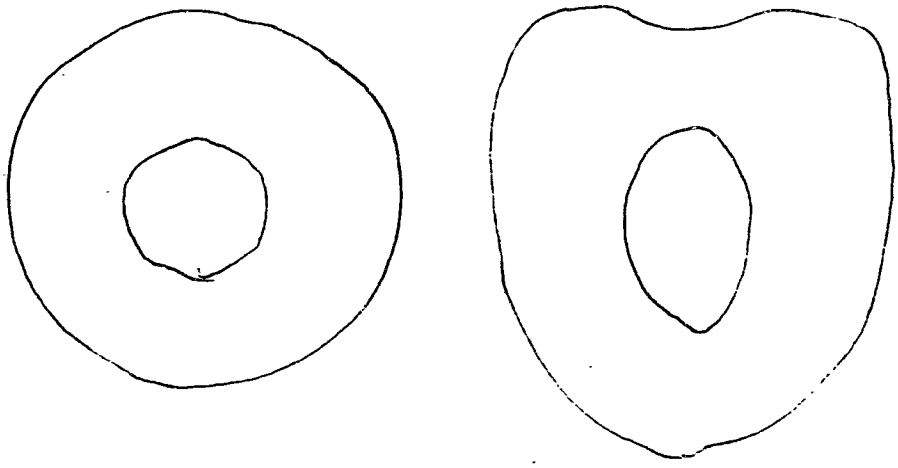
008-AID

negative severely underexposed

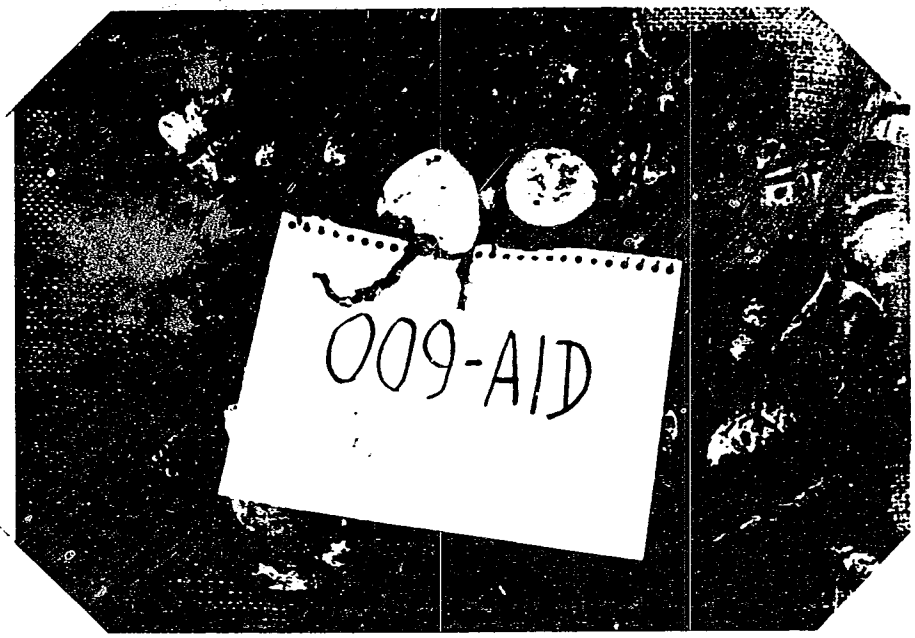
009-AID



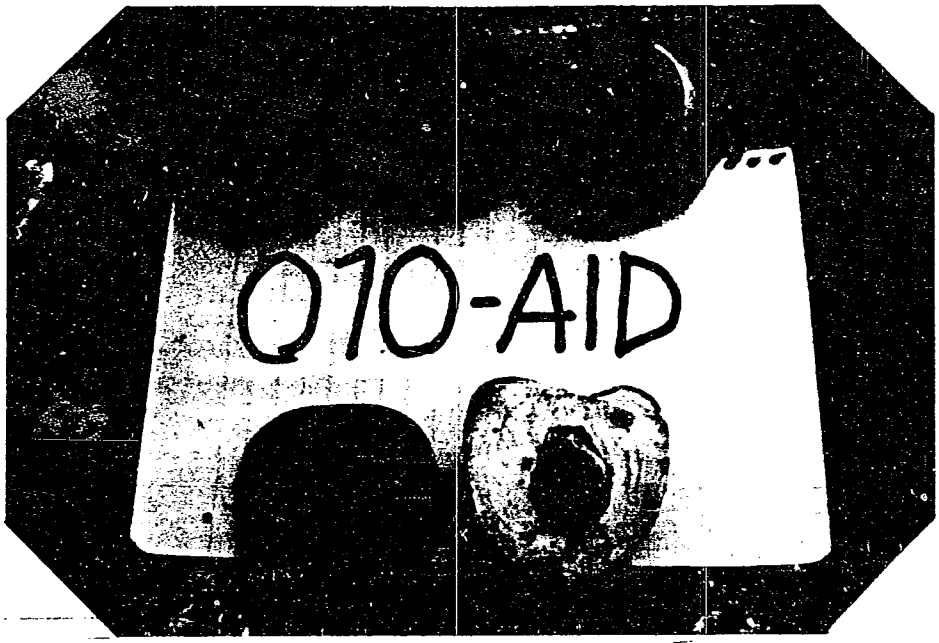
010-AID



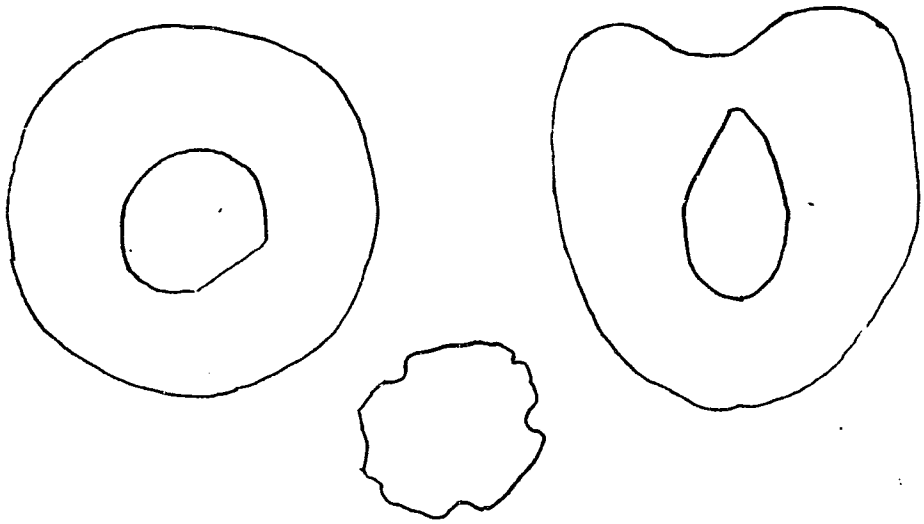
009-AID



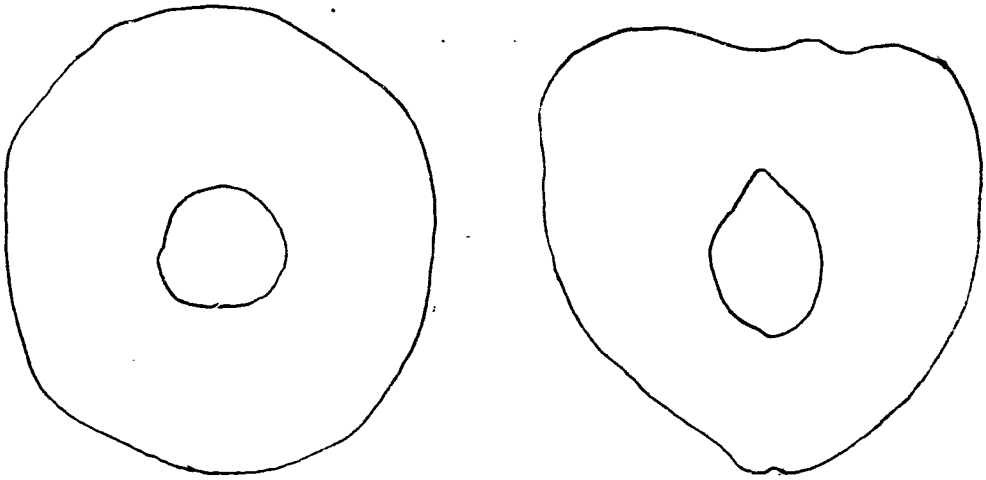
010-AID



011-AID



012-AID



011-AID

Negative severely underexposed

012-AID

Negative severely underexposed

to fruit ratios (92.5 to 97%); starchy to very starchy mesocarp; seeds that do not adhere excessively to the mesocarp; and no spines on the leaflet. The sampled trees also presented 3 individuals that were completely spineless on the trunk, 1 nearly so and 2 with very few. Half of the trees also did not present spines on the petiole, while the other half presented few spines. Most of the trees (7 of 10) presented fruit with skin cracks, a genetic trait common in Central America and less so in the Brazilian Amazon. Trunk diameter at breast height averaged 19.1 cm, very good for "palmito" production.

3. Fonte Boa, AM, BR. Lat. 2°30'S; Long. 66°1'W

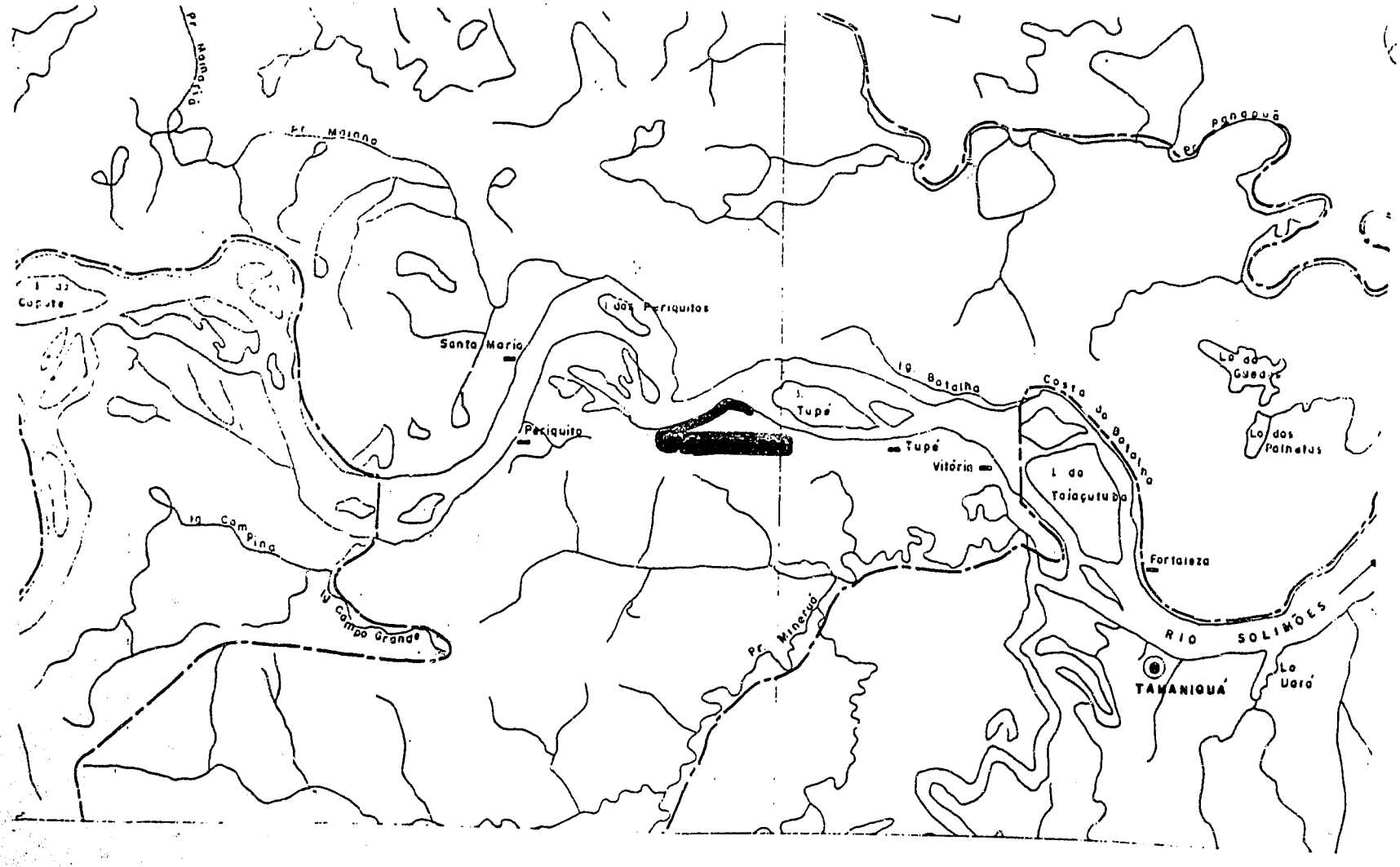
At the agricultural colony Vila da Rodagem, the preliminary reconnaissance showed about 40 trees with ripe fruit, out of a population of about 1000 trees, 500 of which in one plantation. The harvest season was at mid-point in this region, except for the plantation which, being juvenile (4 years), was just starting. However 2 days before our arrival a boat from Manaus had visited the area to buy peach palm at Cr$400/bunch (about US$1.50), thus reducing drastically the material available for us to sample.

After the first experimental sampling in Benjamin Constant, Dr. Mora Urpí suggested that we modify the experimental methodology to take into account the fact that the pollen flux in peach palm does not exceed 50 to 100 meters under normal conditions. With this in mind, each concentration of trees that are seperated by more than 100 meters may be considered to be a sub-population in respect to gene exchange. Therefore, each concentration may be randomly sampled as a sub-unit, rather than randomly sampling the whole population continuously.

Fortunately the Vila da Rodagem is physically adequate to attempt this methodology, because all the family units are strung-out along one side of a road that runs along the river bank. Each unit has 100 meters of front by 1000 m of depth, with most of the peach palm within 100 m of the houses. Thus we could attempt to sample the concentrations of the first, third, fifth, seventh, and nineth houses to get a sample of this population. Two samples were generally collected from each concentration.

On the first day 6 trees were collected; the other 4 being collected on the second day. At the end of the

Map showing areas visited in Fonte Boa, AM, during the first expedition



Collection data III

Experimental Statistical Sampling of Peach Palm in Fonte Boa, AM, BR (see Appendix 2 for explanation)

Character	Sample-	013	014	015	016	017	018	019	020	021	022	$\bar{x}$	SD	CV
Tree														
1. Spine density in $5cm^2$	1.	7	7	4	5	7	10	11	10	14	22	9.7	5.25	54.13
2. Medium size of spines (mm)	2.	32	36	19	27	20	20	32	50	25	35	29.6	9.56	32.29
3. Trunk DBH (mm)	3.	175	223	181	191	156	143	191	229	239	194	192.2	31.00	16.13
4. Trunk color	4.	3	3	3	3	3	4	-	3	3	3	-	-	-
5. Length of 5 internodes (cm)	5.	61	-	100	128	94	155	62	50	86	91	96.3	29.72	30.86
6. Height of first bunch produced (mm)	6.	-	-	-	-	-	2500	-	-	-	-	-	-	-
Leaf														
7. Number of leaves	7.	15	-	-	-	17	17	13	-	13	18	15.5	2.17	13.99
8. Number of leaflets	8.	195	251	229	237	235	204	213	207	224	195	219	19.11	8.73
9. Medium length of leaflets (mm)	9.	790	940	930	830	770	800	660	740	810	970	824	97.09	11.78
10. Medium width of leaflets (mm)	10.	44	31	34	33	29	42	38	48	38	42	37.9	6.14	16.19
11. Spines on leaf petiole	11.	3	3	0	3	3	3	3	3	3	5	-	-	-
12. Spines on leaflet blade	12.	0	0	0	0	0	1	0	0	0	0	-	-	-
* Leaf area/leaf (m^2)	*	3.95	4.26	4.22	3.78	3.06	3.99	3.11	4.29	4.02	4.63	3.93	0.50	12.79
* Leaf area/tree (m^2)	*	59.26	-	-	-	51.99	67.91	40.47	-	52.24	83.34	59.20	14.90	25.17
Bunch														
13. Spines on spathe	13.	3	3	3	3	1	3	0	3	3	3	-	-	-
14. Length of bunch stalk (mm)	14.	230	-	390	380	280	350	220	380	360	370	328.9	67.16	20.42

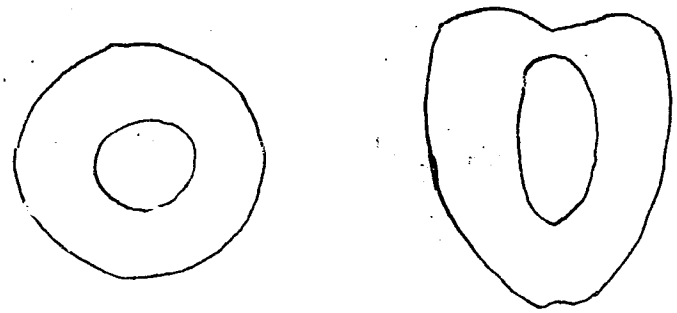
Experimental Statistical Sampling of Peach Palm in Fonte Boa, AM, BR

Character (continued)	Sample-	013	014	015	016	017	018	019	020	021	022	$\bar{x}$	SD	CV
Bunch (continued)														
15. Length of bunch rachis (mm)	15.	185	350	270	320	250	360	270	310	260	310	288.5	52.18	18.09
16. Total number of spikelets	16.	31	57	36	42	35	31	49	50	46	52	42.9	9.27	21.60
17. Number of fruited spikelets	17.	31	56	31	29	35	31	49	44	46	46	39.8	9.51	23.89
18. Percentage of fruited spikelets	18.	100	98.2	86.1	69.0	100	100	100	88.0	100	88.5	93.0	10.22	10.99
19. Total bunch weight (gr)	19.	3880	14580	13600	3510	8750	8800	3010	5610	9460	8890	8010	4034.97	50.37
* Rachis weight (gr)	*	360	200?	-	-	-	354	250	810	340	770	-	-	-
Fruit														
20. Number of fertil fruits	20.	160	275	322	59	197	206	75	108	177	185	176.4	82.54	46.79
21. Number of parthenocarpic fruits	21.	0	38	0	0	0	0	0	2	0	2	4.2	11.91	-
22. Fertil fruit outline (see anex)	22.	-	-	-	-	-	-	-	-	-	-	-	-	-
23. Longitudinal diameter of 22 (mm)	23.	52	55	55	57	45	44	42	46	48	45	48.9	5.38	11.01
24. Max. transversal diameter of 22 (mm)	24.	41	53	42	49	42	38	43	48	47	43	44.6	4.50	10.09
25. Ratio 24/23	25.	0.79	0.96	0.76	0.86	0.93	0.86	1.02	1.04	0.98	0.96	0.92	0.10	10.36
26. Compare form with standards	26.	-	-	-	-	-	-	-	-	-	-	-	-	-
27. Calyx outline (see anex)	27.	-	-	-	-	-	-	-	-	-	-	-	-	-
28. Compare form with standards	28.	-	-	-	-	-	-	-	-	-	-	-	-	-
29. Mature fruit color (skin)	29.	3	1	3	2	3	3	3	3	2	3(5)	-	-	-
30. Sequence of color change in maturation	30	3	2	2	3	2	3	2	2	3	3	-	-	-
31. Skin brilhance	31.	5	7	3	5	5	7	8	5	5	5	-	-	-

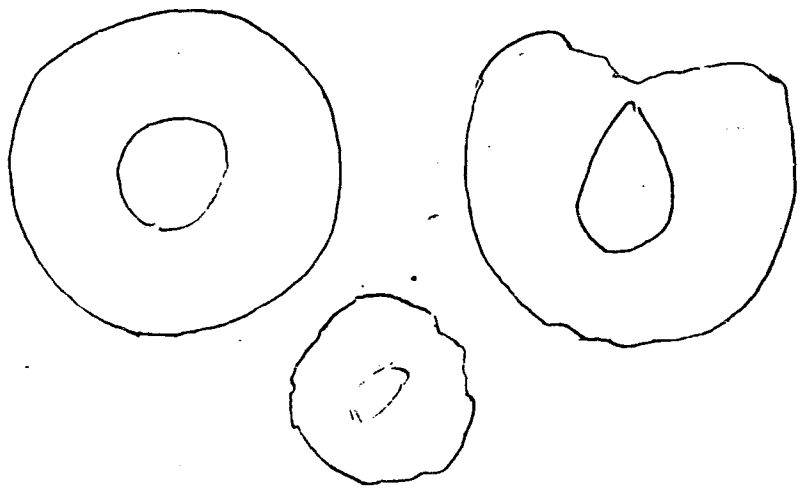
Experimental Statistical Sampling of Peach Palm in Fonte Boa, AM, BR

Character (continued)	Sample—	013	014	015	016	017	018	019	020	021	022	x	SD	CV
Fruit (continued)														
32. Cracks in skin	32.	0	0	0	0	0	0	0	0	0	0	-	-	-
33. Distribution of skin cracks	33.	-	-	-	-	-	-	-	-	-	-	-	-	-
34. Presence of skin blemishes	34.	0	0	0	0	0	0	0	0	0	0	-	-	-
35. Medium weight of fertil fruits (gr)	35.	22.0	49.4	59.0	73.8	45.8	41.0	36.8	44.1	51.5	43.7	46.7	13.63	29.20
36. Medium weight of parthen. fruits (gr)	36.	-	21.0	-	-	-	-	-	18.5	-	21.9	20.5	1.76	8.59
37. Percentage of fertil fruits	37.	100	87.9	100	100	100	100	100	98.2	100	98.9	98.5	3.78	3.83
38. Percentage of parthenocarpic fruits	38.	0	12.1	0	0	0	0	0	1.8	0	1.1	1.4	3.80	-
Mesocarp														
39. Color of raw mesocarp	39.	5	2	4	2/5	5	2/4	5	6	2	5	-	-	-
40. Texture of raw mesocarp	40.	1(4)	2(4)	4	2(4)	1(4)	2(1)	1(4)	1(4)	1(4)	1(4)	-	-	-
41. Adherance of seed to mesocarp	41.	-	5	5	3	3	3	3	3	3	3	-	-	-
42. Medium weight of mesocarp (gr)	42.	18.9	46.0	56.4	70.0	42.3	37.8	33.5	40.7	49.4	41.5	43.7	13.58	31.08
43. Percentage mesocarp/fruit weight	43.	85.9	93.1	95.6	94.9	92.4	92.2	91.0	92.2	96.0	94.9	92.8	2.96	3.19
Seed														
44. Seed outline (see anex)	44.	-	-	-	-	-	-	-	-	-	-	-	-	-
45. Medium weight of seed (gr)	45.	3.1	3.4	2.6	3.8	3.5	3.2	3.3	3.4	2.1	2.2	3.1	0.57	18.39
46. Percentage seed/fruit weight	46.	14.1	6.9	4.4	5.1	7.6	7.8	9.0	7.8	4.0	5.1	7.2	2.96	41.08

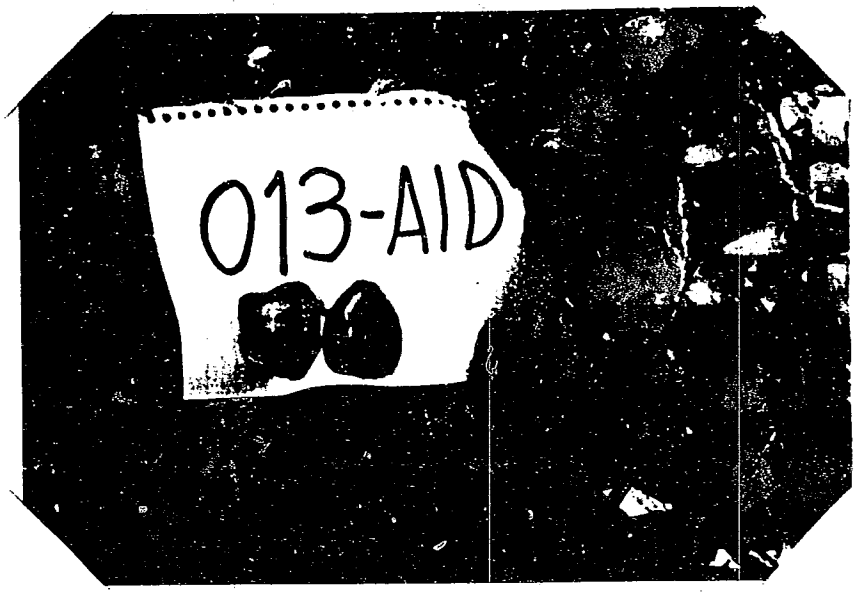
013-AID



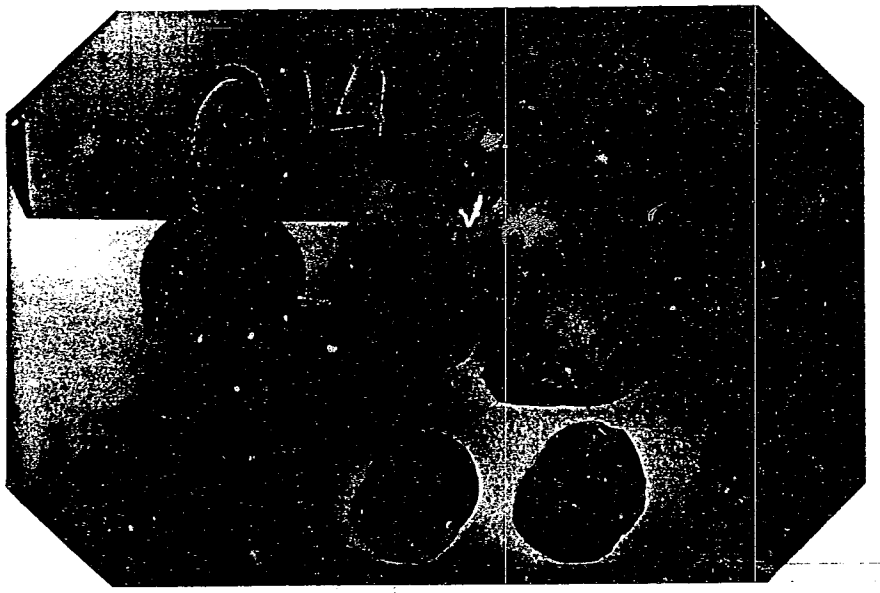
014-AID



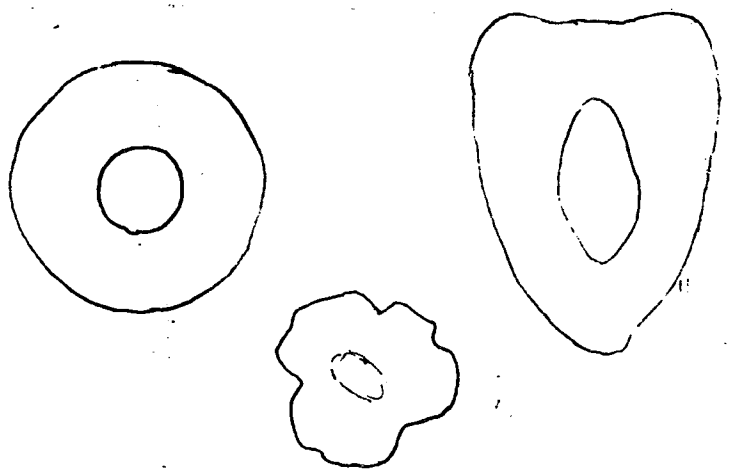
013-AID



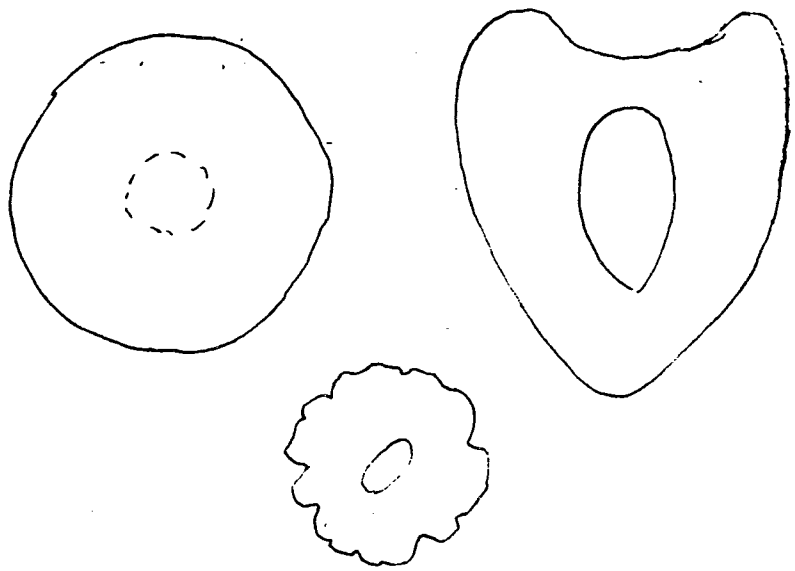
014-AID



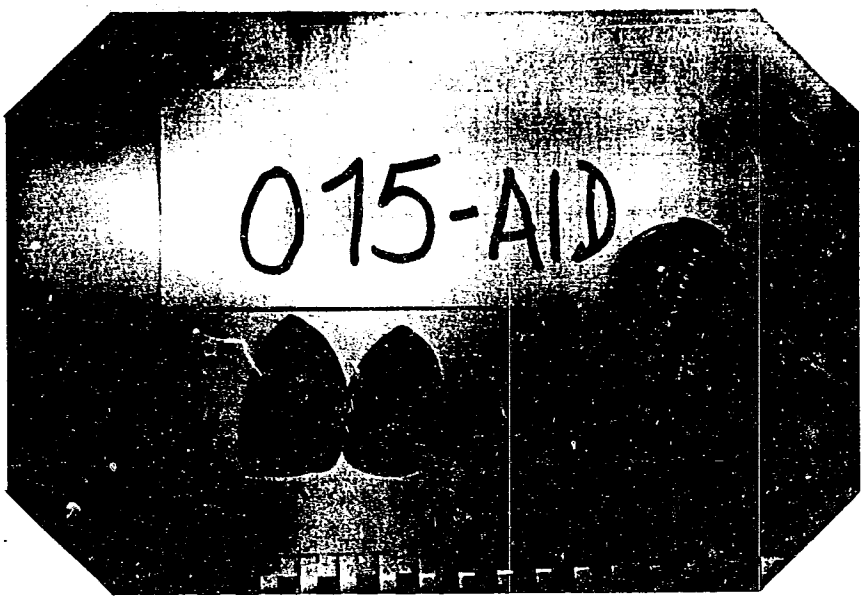
015-AID



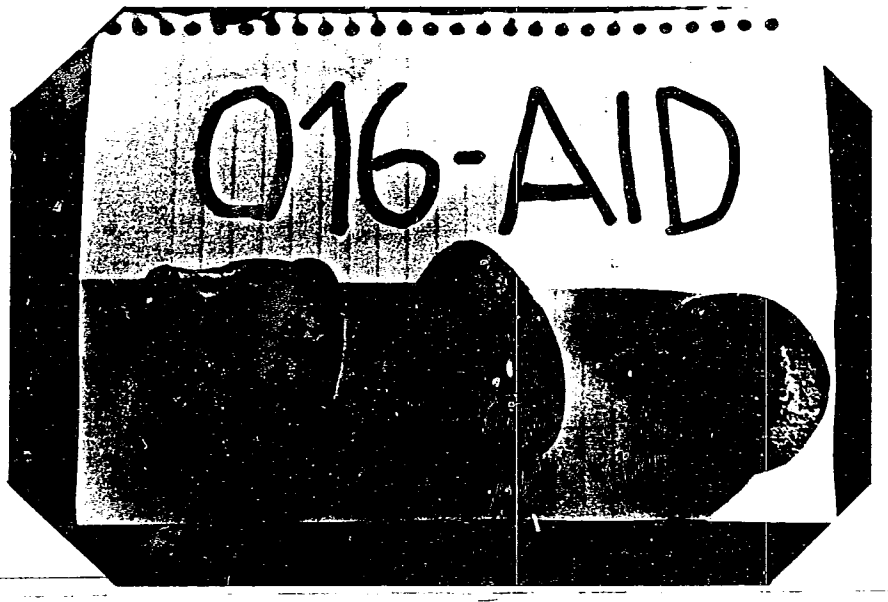
016-AID



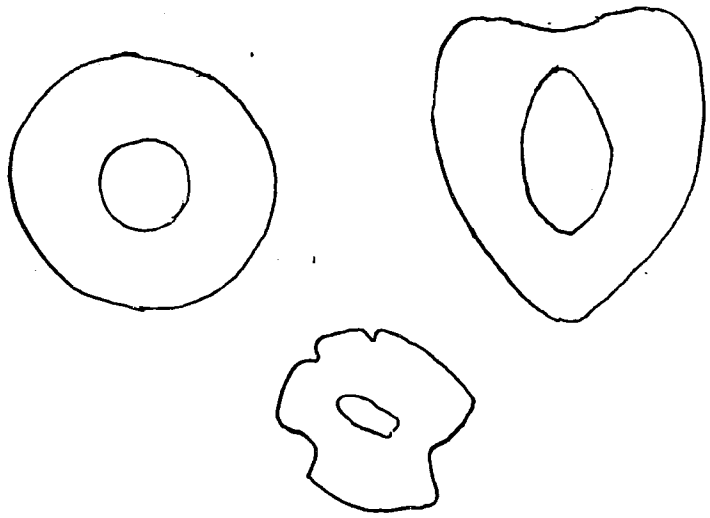
015-AID



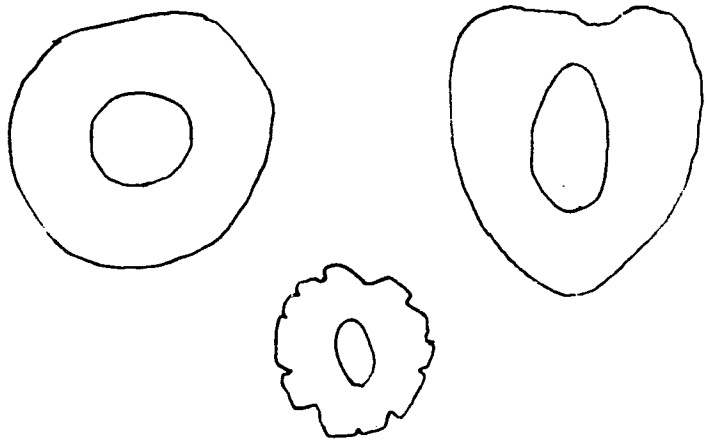
016-AID



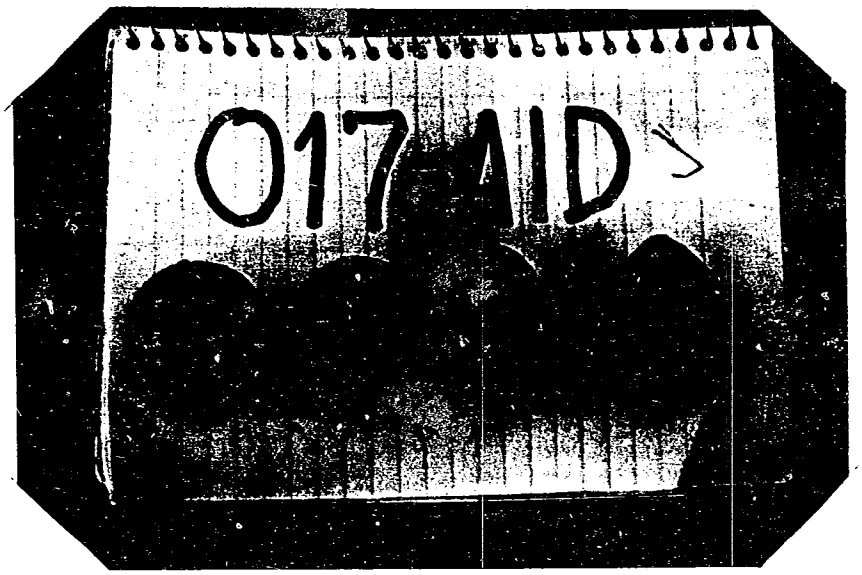
017-AID



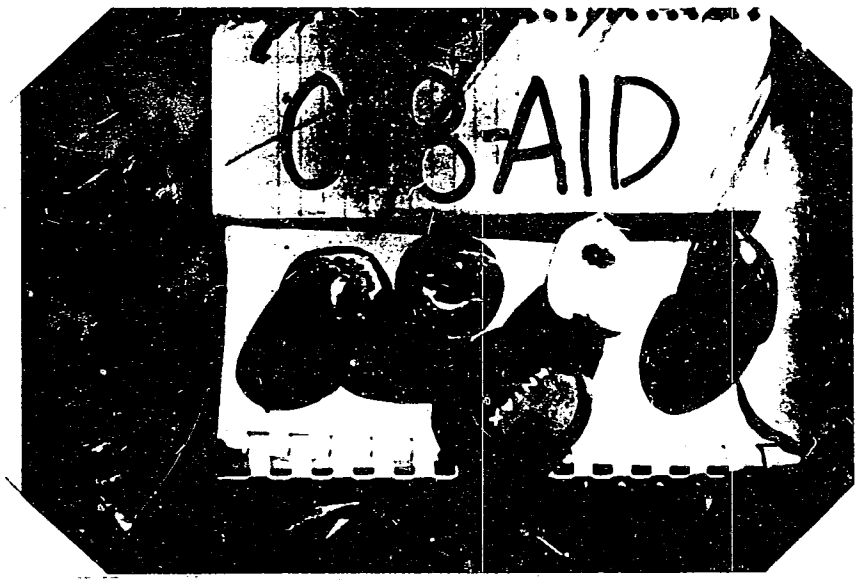
018-AID



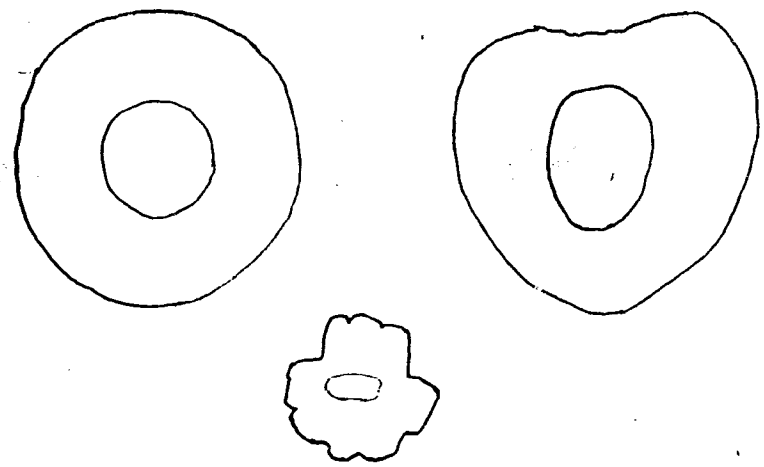
117-AID



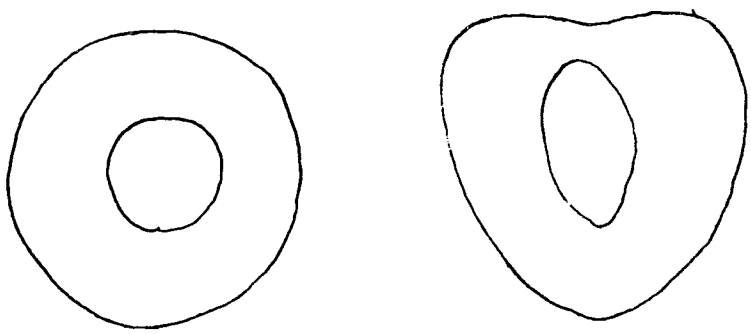
018-AID



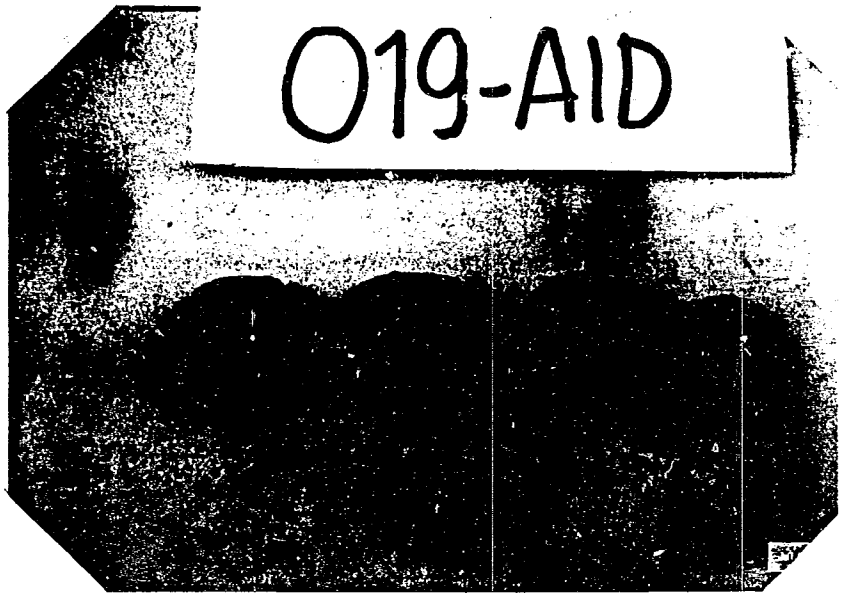
019-AID



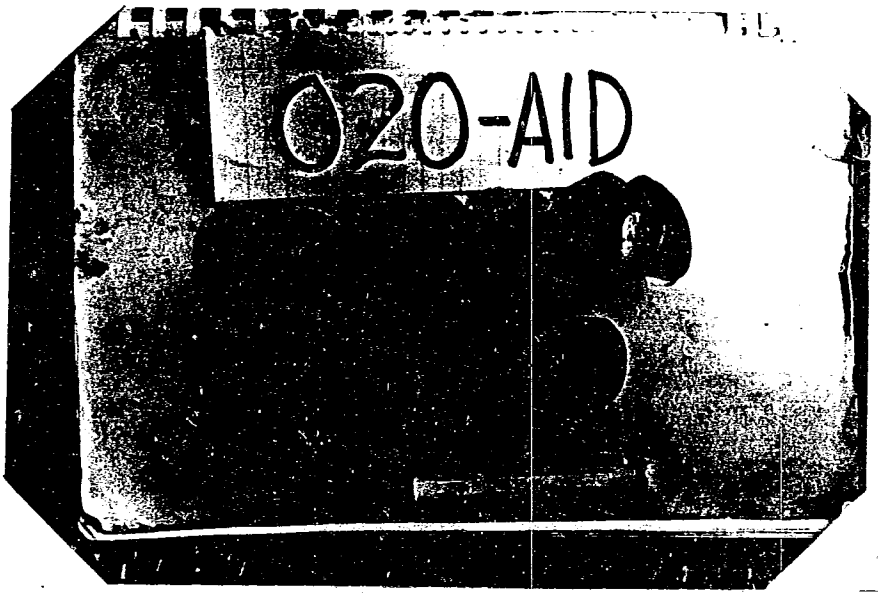
020-AID



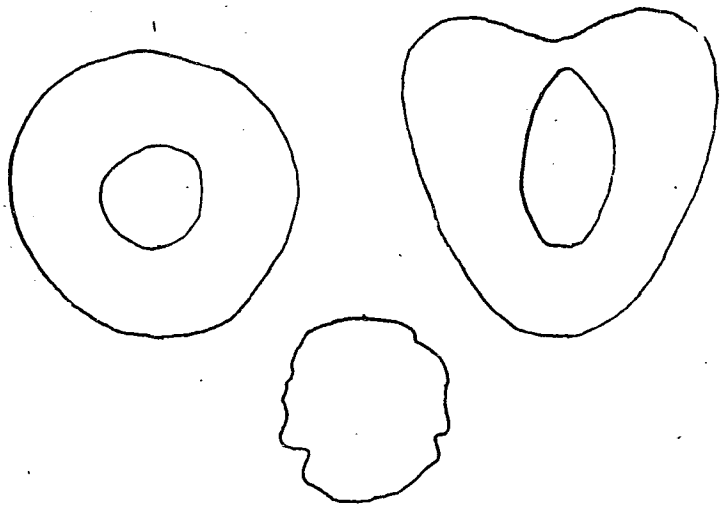
019-AID



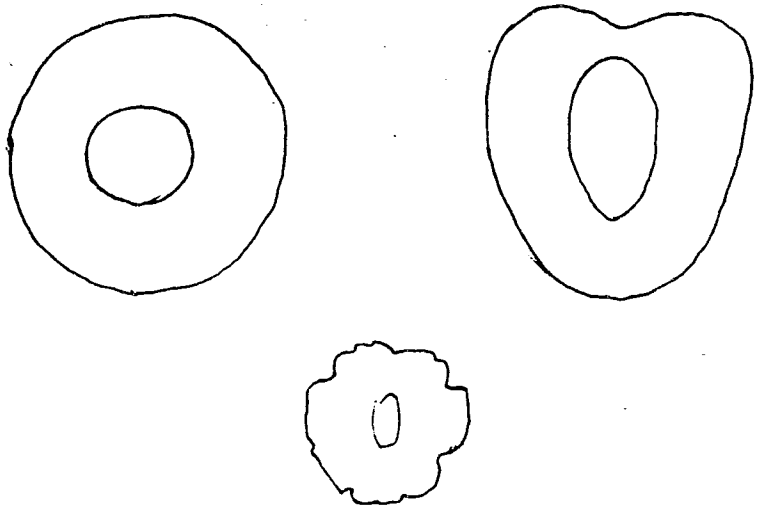
020-AID



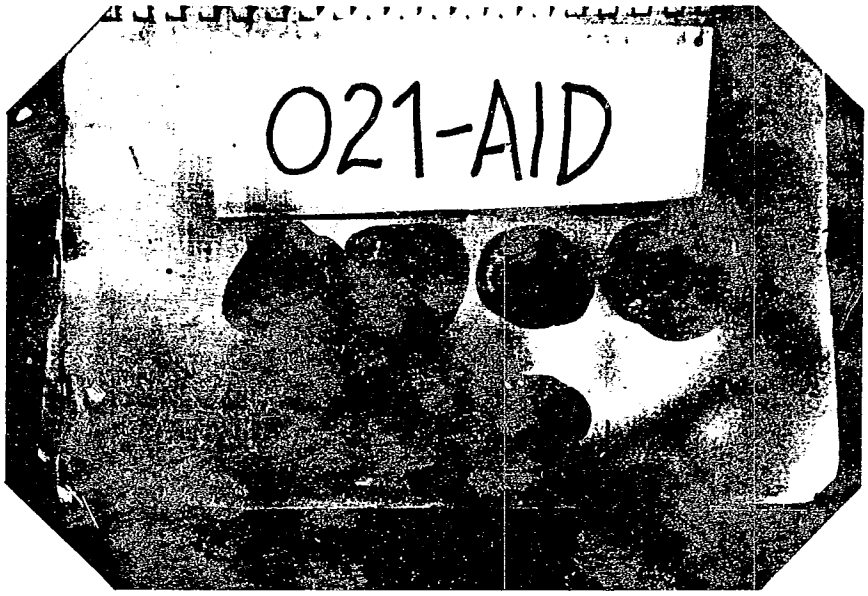
021-AID



022-AID



021-AID



022-AID

experimental collection at Vila da Rodagem, the 10 trees collected and characterized had taken 32 1/2 man/hours of work, a significant improvement.

The material collected at Vila da Rodagem was quite different from that collected previously. See Collection data III, Outline and Photos 013-AID through 022-AID. One of the most noticeable differences between Benjamin Constant and Fonte Boa is the larger bunch, both in fruit number (176 as compared to 67) and in bunch weight (8 kg as compared to 6.5 kg.), although the individual fruit are smaller (46 gr. as compared to 100 gr.). Another noticeable difference is the quantity of fiber in the mesocarp in the Fonte Boa peach palm population. In Benjamin Constant all samples were characterized as starchy to very starchy, whereas in Fonte Boa, while all obviously presented appreciable quantities of starch, the quantity of fiber was most evident. Also a few of the samples presented fruit with a very watery pulp (probably in excess of 60% H_2O).

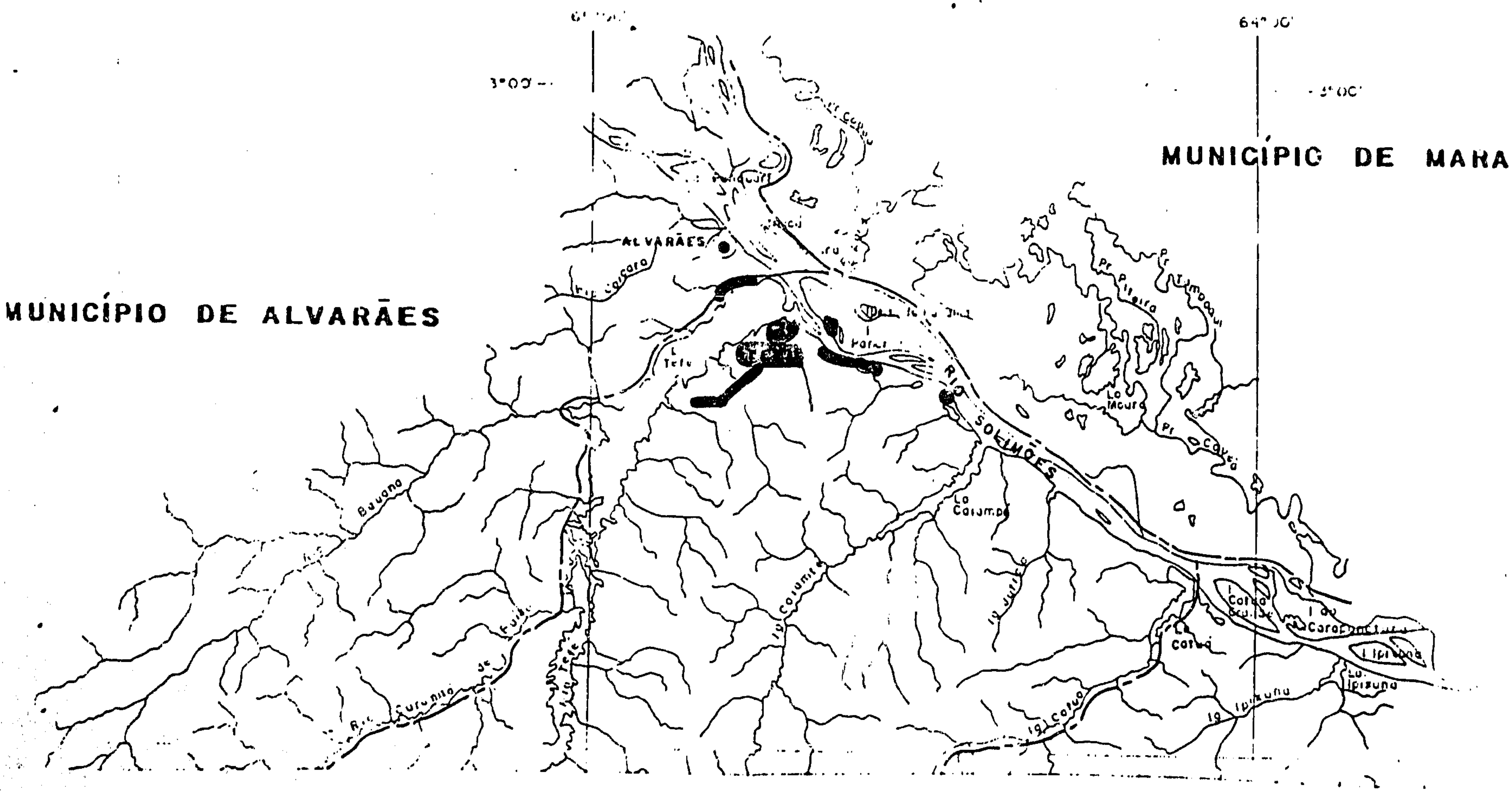
Also the mesocarp percentage in the fruit decreased slightly, from 95.6 to 92.8%, which reflects the smaller fruit size, even though the seed of the Fonte Boa population are somewhat smaller. In the Fonte Boa region spinelessness is much less common than in Benjamin Constant. None of the trees samples were spineless on the trunk and only one was spineless on the petiole. However the leaflets continued to show the spineless trait, only one tree presented spines on the leaflets. While leaflet number, length and width varied somewhat, leaf area estimates remained the same, although leaf area/tree was somewhat less. This last estimate may not be significant because of fewer samples in Fonte Boa.

4. Tefé, AM, BR. Lat. 3°38'S; Long. 64°42'W

The first afternoon was devoted to a reconnaissance of the Paraná de Tefé, which includes a large area of Terra Preta do Indio, and has thus been occupied continually for a long time. However, this area was already at the end of the principal harvest season so that only biased collection (023-AID) was possible. It would appear that, although Terra Preta do Indio is extremely rich in phosphorus and several minor nutrients, there is a deficiency of potassium which does not allow good production of the peach palm in most of this area.

The second day the group split in two: 2 collectors

Map showing areas visited in Tefé, AM, during the first expedition

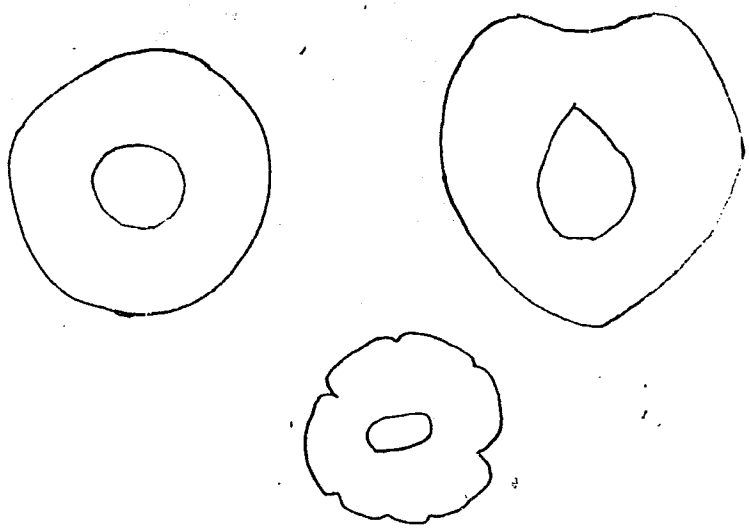


Collection data IV

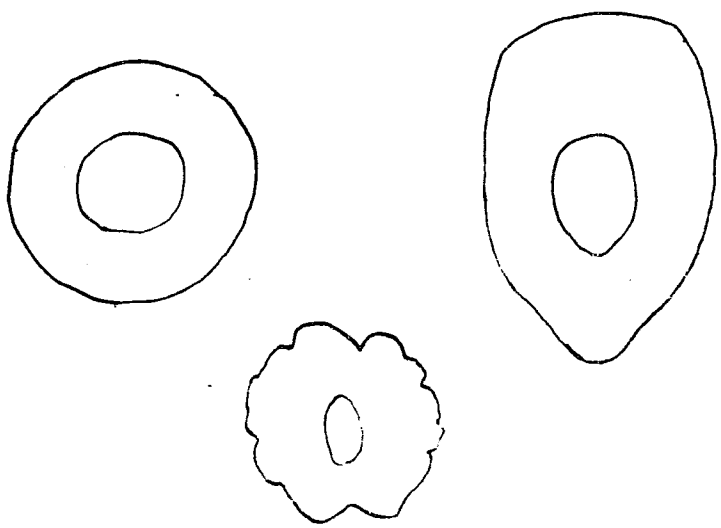
Biased Sampling of Peach Palm in **Tefé, AM, BR** (see Appendix for explanation)

Character//	Sample-	023	024	025	026	027	028	029	030	031	032	033	$\bar{x}$	SD	CV
1. Spine density on trunk	1.	3	5	5	3	7	3	5	0	7	7	7			
2. Bunch number/trunk	2.	3	7	10	5	10	8	7	5	2	4	5	6	2.65	44.10
3. Fruit number/bunch	3.	66	103	89	75	199	72	96	99	51	140	403	126.6	100.26	79.17
4. Mature fruit color	4.	2	2	2	3	1	2(3)	1	2	2	2	2			
5. Cracks in skin of fruit	5.	0	0	0	0	0	0	0	0	1	0	0			
6. Pulp color intensity	6.	5	5	5	1	3	5(1)	3	7	5	6	6			
7. Seed position in fruit	7.	5	5	7	4	5	5	3	5	3	5	7			
8. Quantity of fiber	8.	5	5	3	3	7	3	7	4	6	5	5			
9. Texture of raw pulp	9.	5	5	5	5	3	5	5	5	7	6	6			

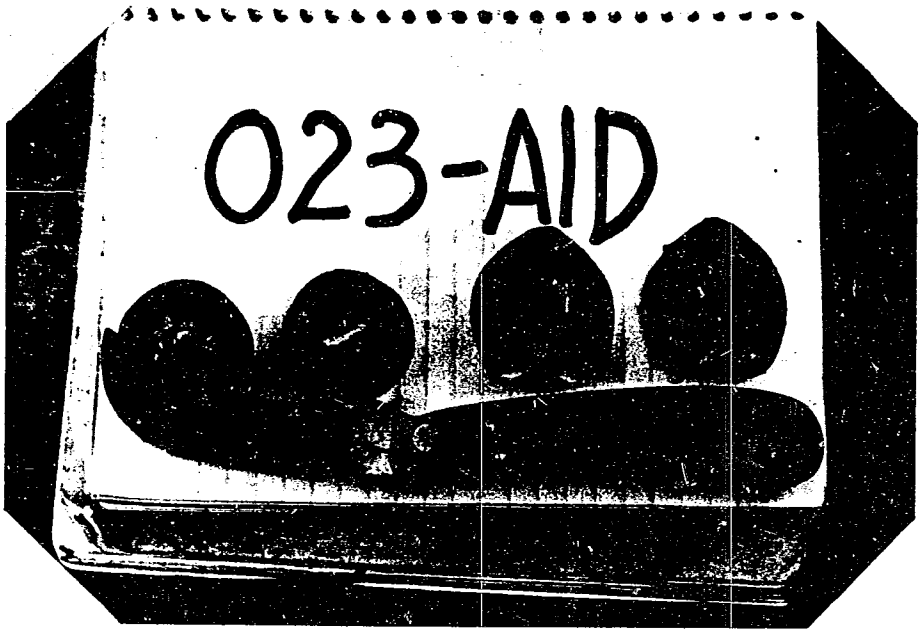
023-AID



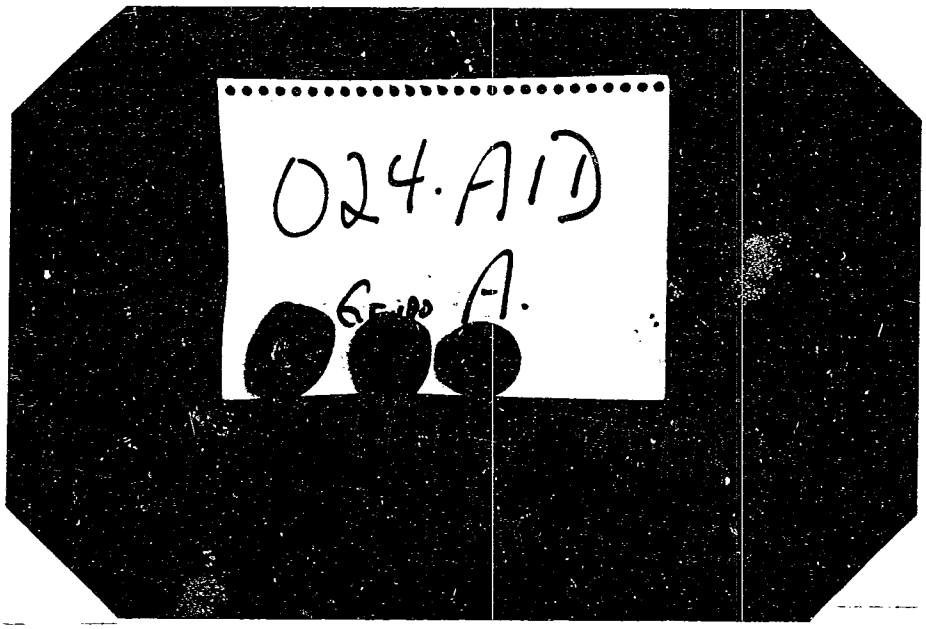
024-AID



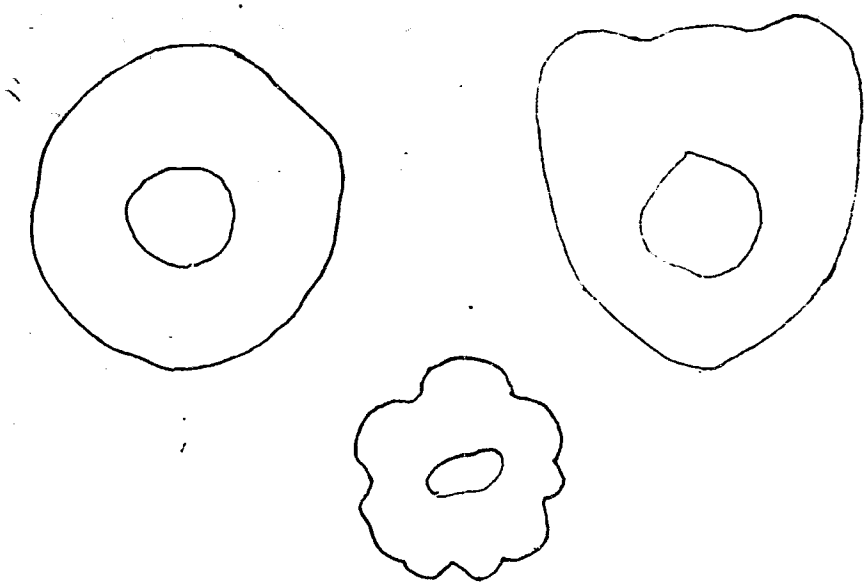
023-AID



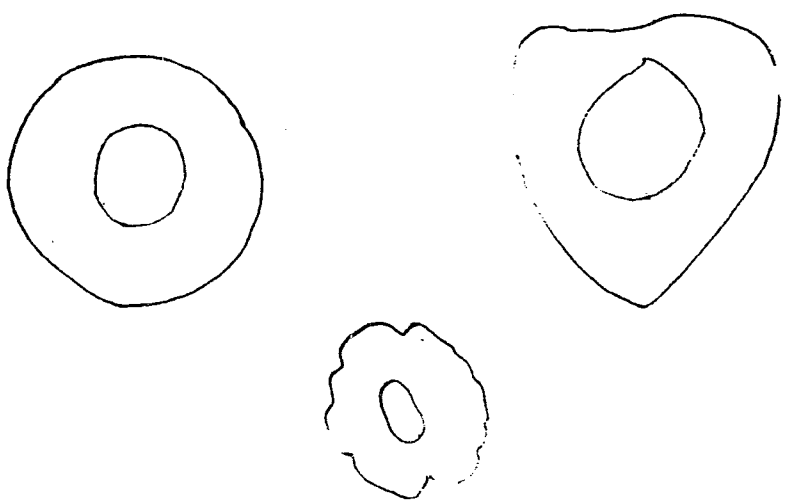
024-AID



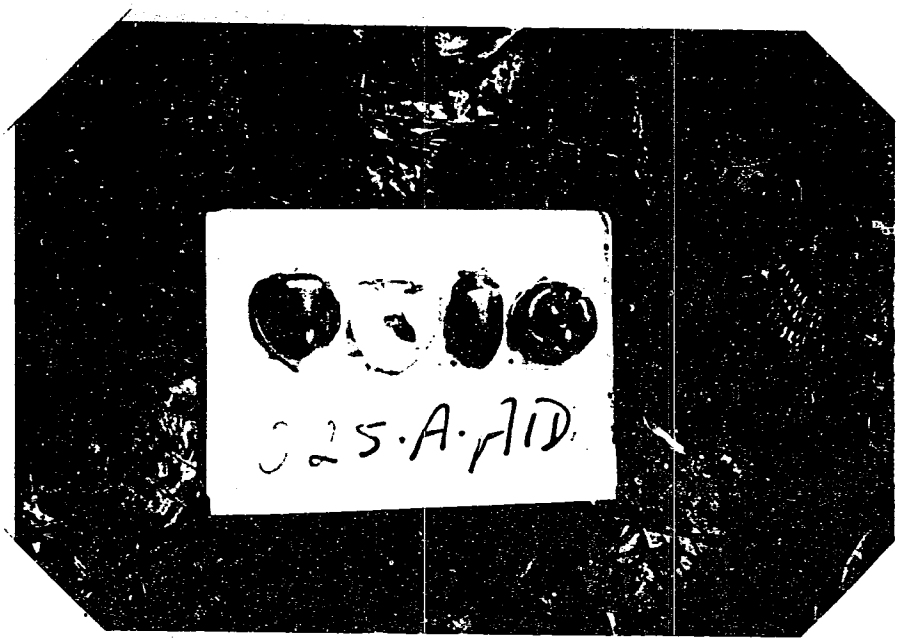
025-AID



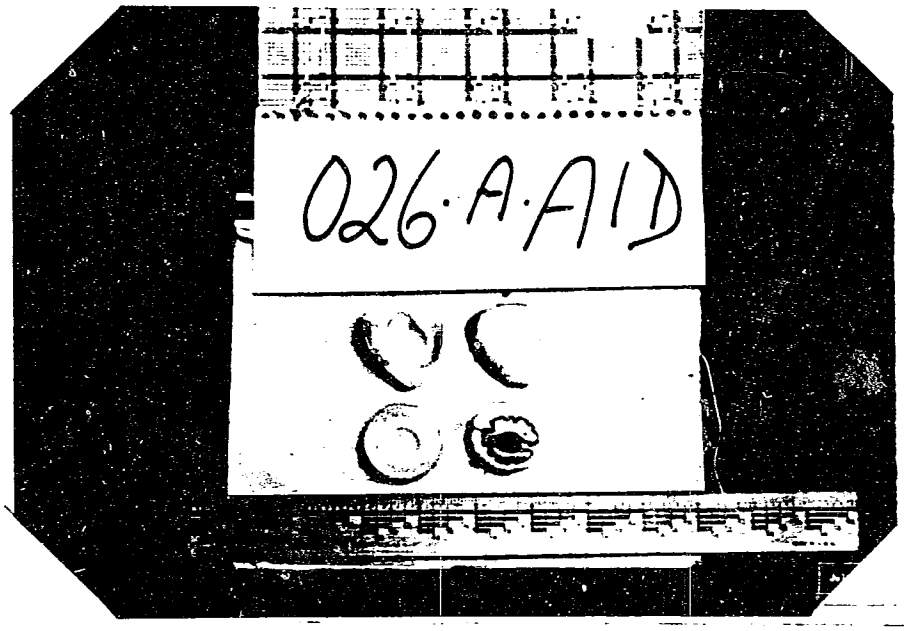
026-AID



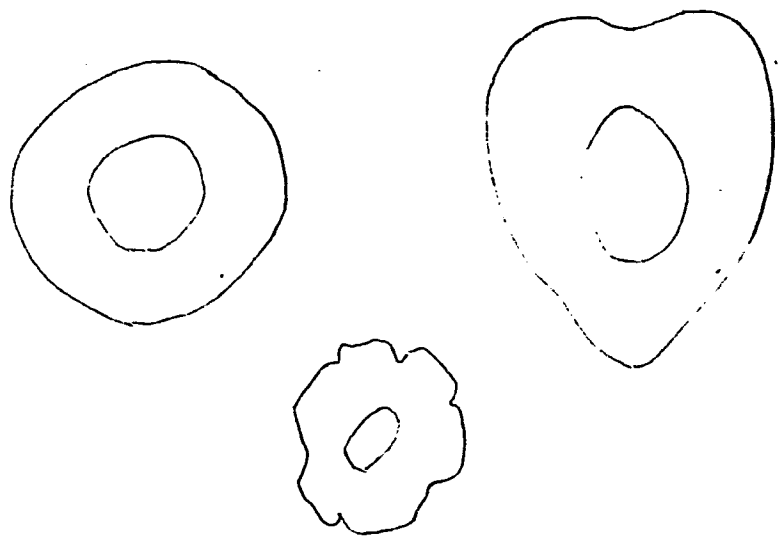
025-AID



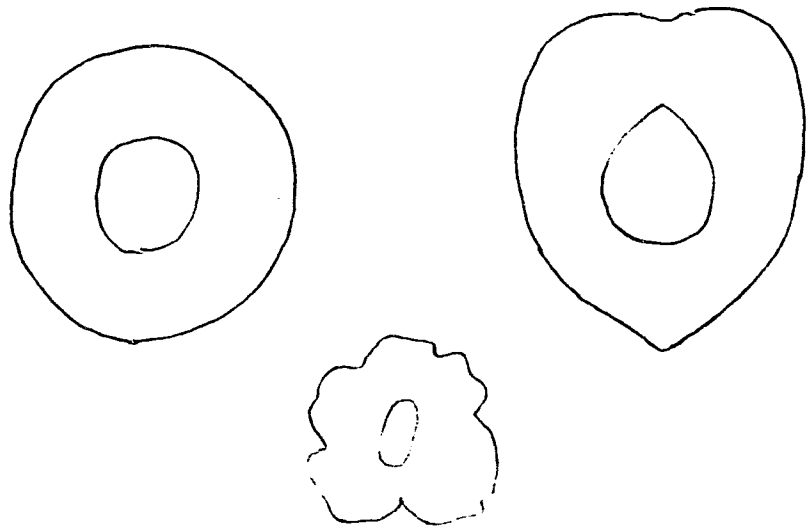
026-AID



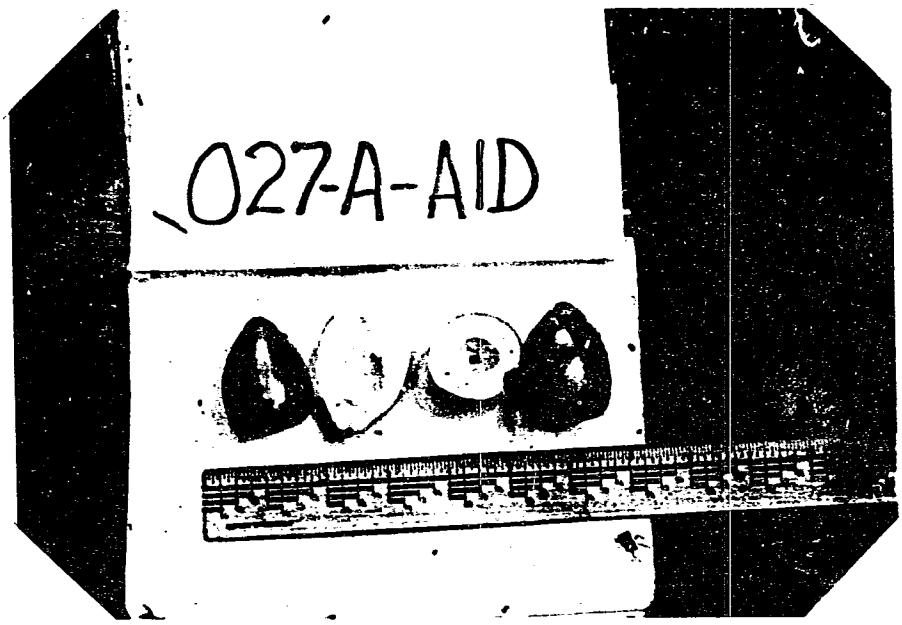
027-AID



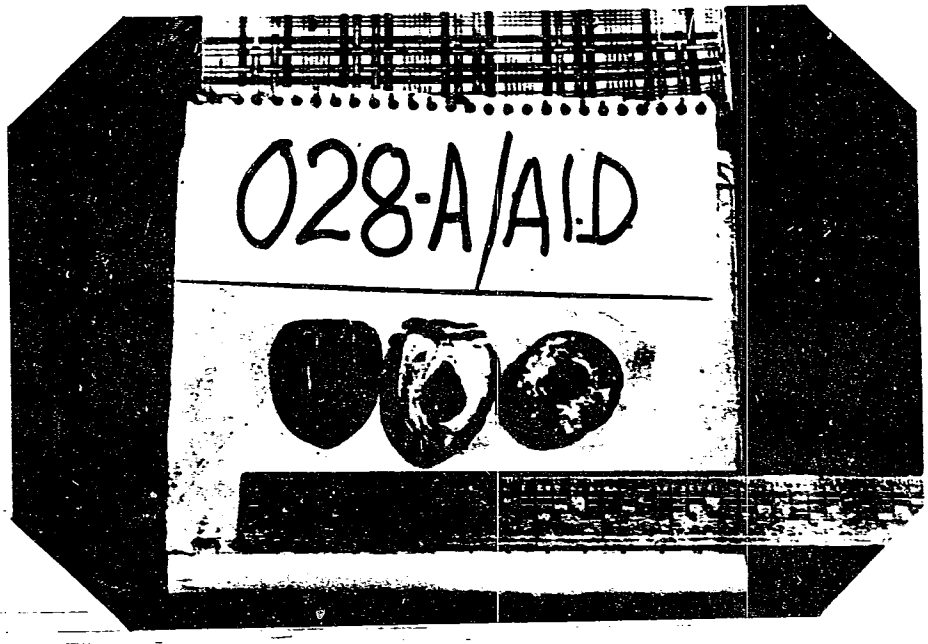
028-AID



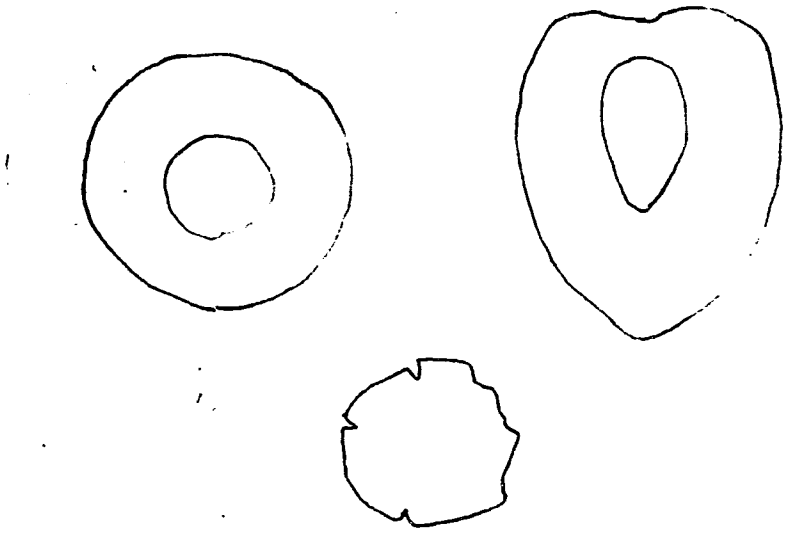
027-AID



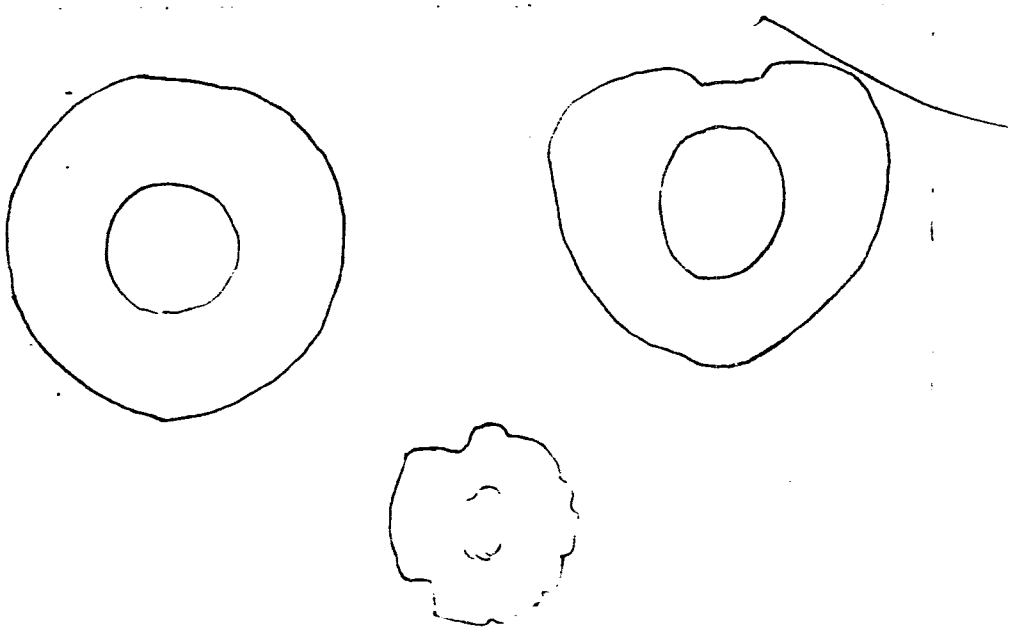
028-AID



029-AID



030-AID

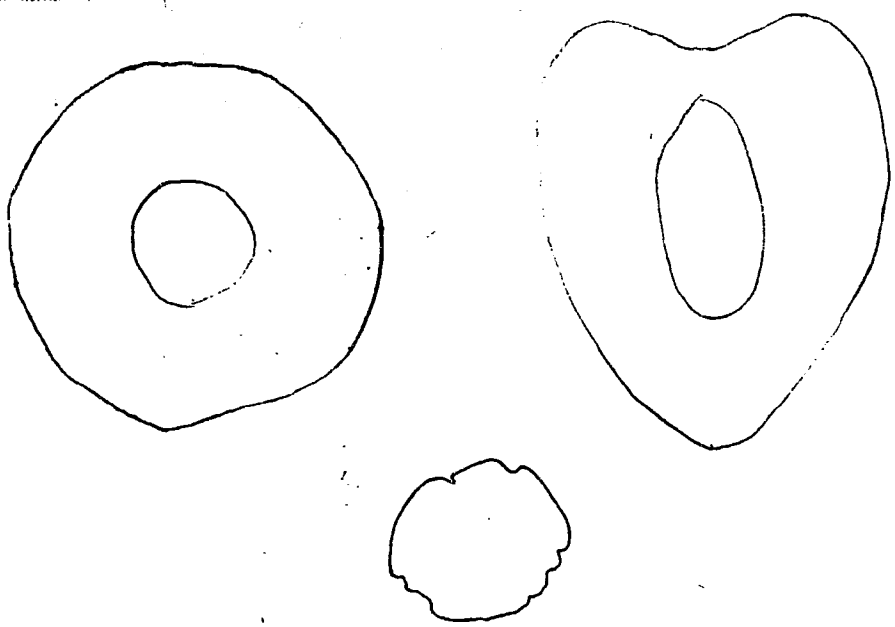


029-AID

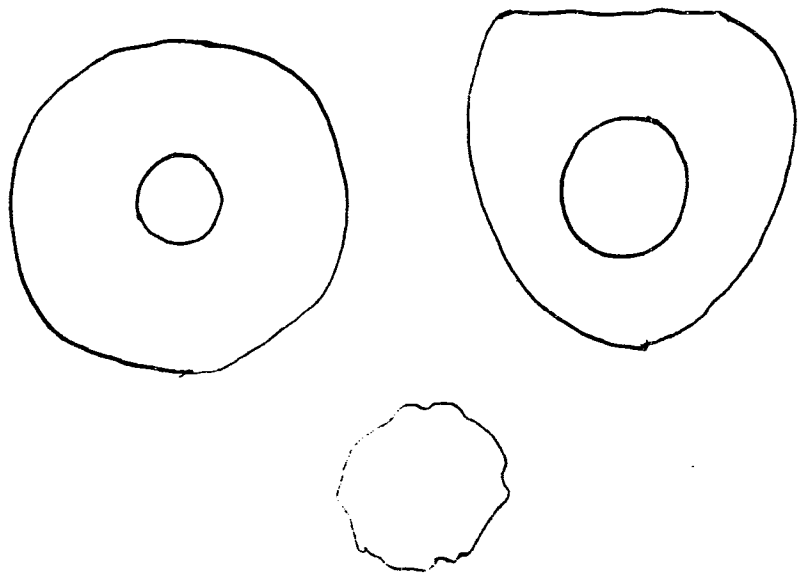
Negative severely underexposed

030-AID

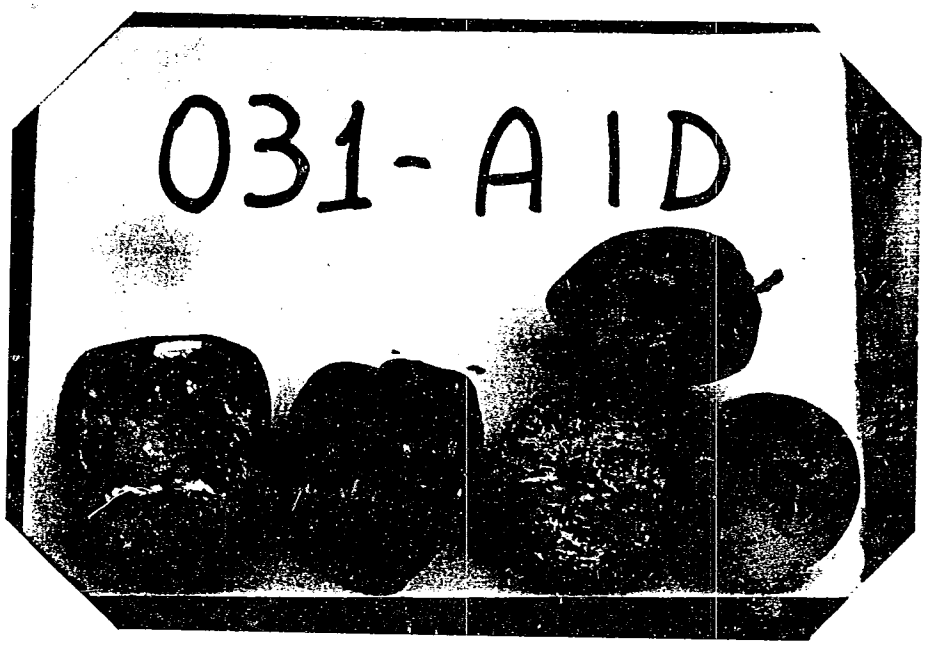
031-AID



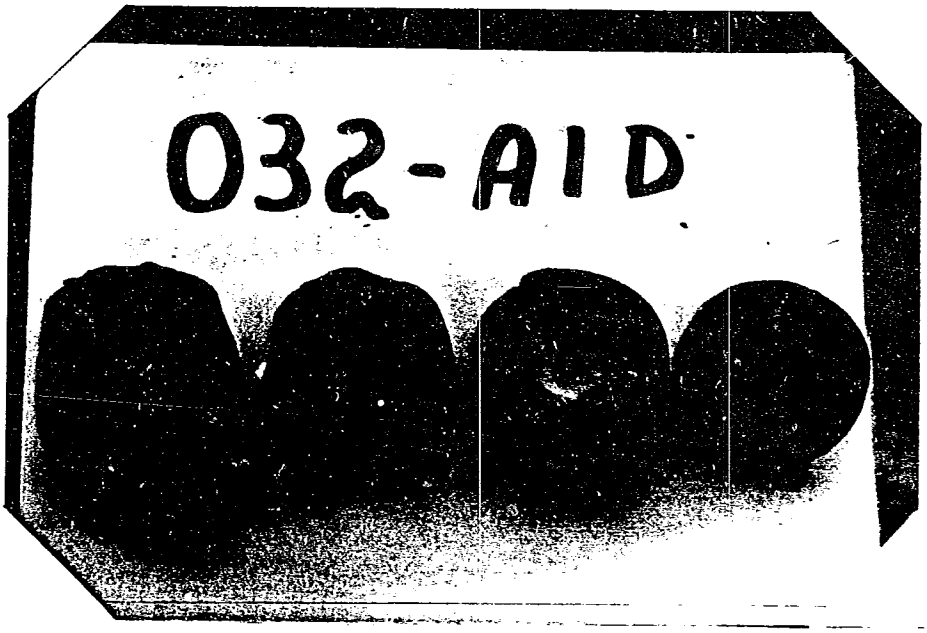
032-AID



031-AID



032-AID



went to the village of Nogueira on the far side of the Lake of Tefé. The harvest season was also far advanced in this area so that only 3 biased collections were made (031-AID to 033-AID). One of these was an extremely large bunch (403 fruit), although the fruit was watery and rather fibrous. The second group of 3 collectors visited the main plantation district of the town of Tefé. Following the advice of EMATER-AM/Tefé, this group collected 7 biased samples from two plantations. By careful observation, enquiries to the owners and observations at other localities in Tefé, it was possible to collect rather diverse material, perhaps more diverse than that obtained by the experimental sampling method. This is because the collectors could observe their first sample and then ask to collect something different; observe their first two samples and ask for other differences; etc. Perhaps biased collecting in this manner would be more efficient than the experimental sampling method.

Two interesting samples were collected in this area: 026-AID presented albino (white) fruit, pulp and calyx. The bunches were rather small but the fruit were well formed, free of disease and pest attack, with a relatively high fruit to flower ratio. 022-AID presented partially albino fruit, pulp and calyx. These fruits presented red and white stripes on the skin, in the pulp and on the calyx. Again, bunches were small but the fruit were well formed. Probably these materials will not prove to be very interesting in plant breeding but are of interest as examples of genetic variability.

Collection data IV, Outlines and Photos 023-AID through 033-AID give some idea of the population characteristics of the peach palm in the Tefé area. The bunch size, in terms of fruit number, is intermediate between those of Benjamin Constant and Fonte Boa. However, fruit size is smaller than in Fonte Boa. In general, the quantity of fiber is medium to high; oil content becomes a common trait, although not yet at high levels; really starchy fruit are absent; and spinelessness on the trunk is less evident (only one of the sampled trees).

5. Coari, AM, BR. Lat. 4°5'S; Long. 63°8'W.

In Coari the harvest season on the "varzea alta" (the periodically innundated Humic Gley soils of the river flood-plain) was already past, as an initial reconnaissance showed. The second day the group went to the Santa Fé agricultural colony, at the mouth of the Lake of Mamiá, about 2 hours

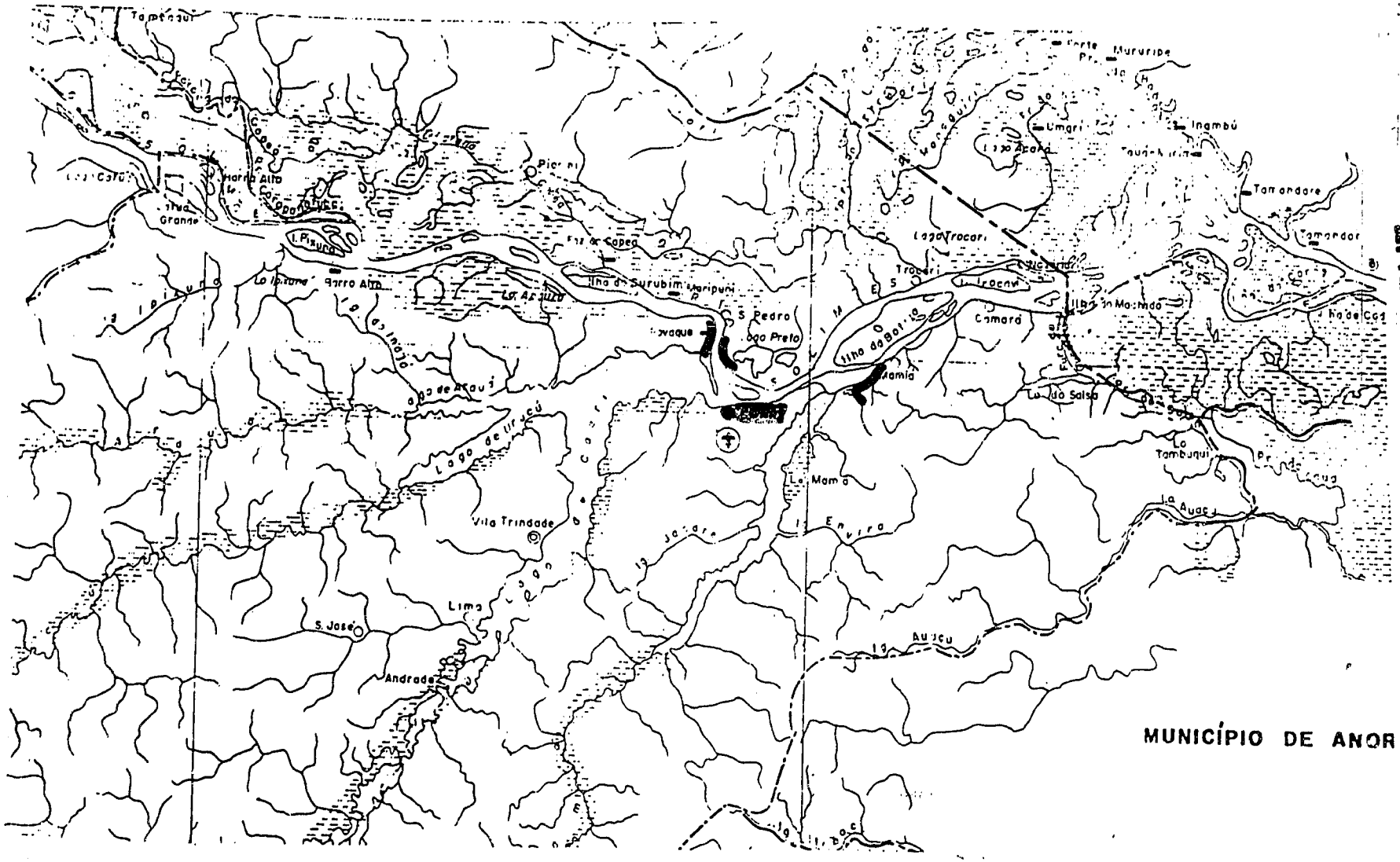
downriver from Coari. Here, on the "terra firme", the season was drawing to a close but the farmers who agreed to guide us in the colony maintained that some areas still had sufficient bunches to allow experimental sampling.

Upon arriving at the farm of Sr. Filomeno, we discovered a very large concentration of quite variable individuals. Therefore, the 20 trees with enough fruit were used as a basis to randomly choose 4 trees for sampling (034-AID through 037-AID). At the next farm, a much smaller concentration (33 trees) had 6 trees in fruit, of which 2 (038-AID and 039-AID) were randomly choosen for sampling. After these two farms no further concentrations were found with more than one or two trees in fruit, so that the randomizing factor became simply the finding of trees with enough fruit. Thus the experimental design for sampling was used for the first 60% of the material collected, although Clement and Mora Urpí commented that simply finding bunches available is quite a random event.

The material collected at Colonia Santa Fé was similar to that collected in Tefé, so that one may suppose that they belong to the same regional population, or race. See Collection data V, Outlines and Photos 034-AID through 043-AID. The size of the bunches is similar to that of Benjamin Constant in weight (6 kg as compared to 6.5 kg), while being similar to that of Fonte Boa in fruit number (173 as compared to 176). This obviously means a much smaller fruit size in Coari, 32 gr as compared to 101 gr in Benjamin Constant and 47 gr in Fonte Boa. As in Tefé, the quantity of oil has increased in this population, with 3 samples being described as oily. However, the Coari material would appear to be somewhat less fibrous than in Fonte Boa and Tefé, with some samples presenting very little fiber. Also, many samples are described as starchy, suggesting that this character is more important than fiber in these samples. Mesocarp adherence to the seed is also different in this population, being much more adherent than in the Fonte Boa or Benjamin Constant material. Percentage mesocarp to fruit has also decreased slightly in Coari: 91% as compared to 93% in Fonte Boa and 96% in Benjamin Constant.

Another difference between the peach palm population of Coari and the other areas used in experimental sampling is in the size of the leaves. In Coari, leaflet number averaged 241, leaflet length 72.5 cm and width 3.6 cm, which gives a leaf area estimate of 3.7 m^2. In Fonte Boa these same

Map showing areas visited in Coari, AM, during the first expedition



BEST AVAILABLE DOCUMENT

Collection data V

Experimental Statistical Sampling of Peach Palm in Coari, AM, BR (see Appendix 2 for explanation)

Character	Sample-	034	035	036	037	038	039	040	041	042	043	$\bar{x}$	SD	CV
Tree														
1. Spine density in $5cm^2$	1.	11	4	7	12	1	0	9	4	5	0	5.3	4.37	82.51
2. Medium size of spines (mm)	2.	19	22	30	34	15	-	28	25	40	-	26.6	8.14	30.60
3. Trunk DBH (mm)	3.	137	158	156	194	185	197	170	175	178	169	171.9	18.30	10.64
4. Trunk color	4.	3	5	3	5	4	4	3	4	4	5	-	-	-
5. Length of 5 internodes (cm)	5.	109	116	81	84	94	98	108	82	53	89	91.4	18.17	19.88
6. Height of first bunch produced (mm)	6.	-	-	-	-	-	-	-	-	-	-	-	-	-
Leaf														
7. Number of leaves	7.	-	14	11	15	18	18	17	19	17	16	16.1	2.47	15.35
8. Number of leaflets	8.	227	248	239	242	235	245	269	220	228	260	241.3	15.11	6.26
9. Medium length of leaflets (mm)	9.	800	653	770	766	600	820	847	680	730	580	724.6	92.57	12.78
10. Medium width of leaflets (mm)	10.	45	41	32	30	26	37	38	48	35	31	36.3	6.93	19.09
11. Spines on leaf petiole	11.	3	0	3	3	0	1	3	0	3	0	-	-	-
12. Spines on leaflet blade	12.	0	3	0	0	0	0	0	0	0	0	-	-	-
* Leaf area/leaf (m^2)	*	4.76	3.87	3.43	3.24	2.14	4.33	5.05	4.18	3.39	2.72	3.71	0.91	24.39
* Leaf area/tree (m^2)	*	-	54.17	37.75	48.62	38.46	77.98	85.78	79.51	57.72	43.59	58.18	18.49	31.79
Bunch														
13. Spines on spathe	13.	4	3	4	3	3	3	3	4	3	5	-	-	-
14. Length of bunch stalk (mm)	14.	300	310	350	260	390	460	350	400	320	330	347	57.36	16.53

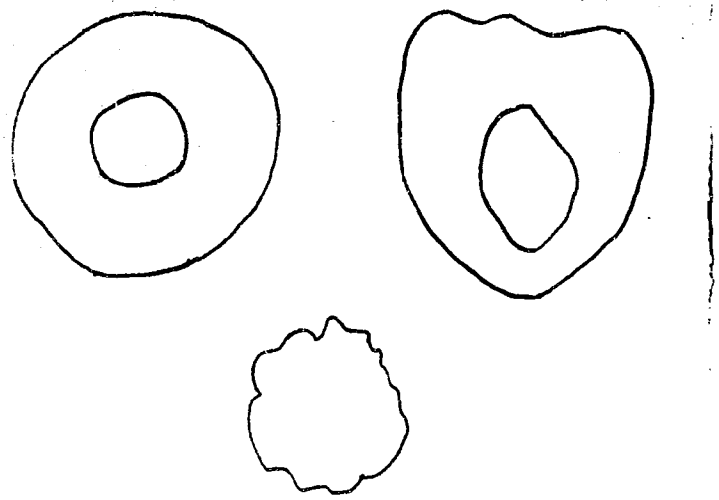
Experimental Statistical Sampling of Peach Palm in Ceari, AM, BR.

Character (continued)	Sample-	034	035	036	037	038	039	040	041	042	043	$\bar{x}$	SD	CV
Bunch (continued)														
15. Length of bunch rachis (mm)	15.	230	480	310	330	290	310	270	380	330	420	335.	73.67	21.99
16. Total number of spikelets	16.	51	44	52	52	40	50	52	54	48	49	49.2	4.26	8.67
17. Number of fruited spikelets	17.	51	44	45	52	34	49	51	51	44	39	46	5.98	13.00
18. Percentage of fruited spikelets	18.	100	100	86.5	100	85	98	98.1	94.4	91.7	79.6	93.3	7.35	7.88
19. Total bunch weight (gr)	19.	4820	7700	5530	3640	2560	6860	10050	104	30	4460	6014	2683.66	44.62
* Rachis weight (gr)	*	400	580	500	500	570	1010	340	890	590	1130	-	-	-
Fruit														
20. Number of fertil fruits	20.	195	325	179	93	64	145	212	243	100	178	173.4	77.79	44.86
21. Number of parthenocarpic fruits	21.	0	0	0	0	0	2	0	0	0	0	-	-	-
22. Fertil fruit outline (see anex)	22.	-	-	-	-	-	-	-	-	-	-	-	-	-
23. Longitudinal diameter of 22 (mm)	23.	42	32	43	45	50	47	47	43	43	39	43.1	4.98	11.55
24. Max. transversal diameter of 22 (mm)	24.	34	34	38	45	42	44	42	40	40	32	39.1	4.48	11.47
25. Ratio 24/23	25.	0.81	1.06	0.88	1.0	0.84	0.94	0.89	0.93	0.93	0.82	0.91	0.08	8.73
26. Compare form with standards	26.	-	-	-	-	-	-	-	-	-	-	-	-	-
27. Calyx outline (see anex)	27.	-	-	-	-	-	-	-	-	-	-	-	-	-
28. Compare form with standards	28.	-	-	-	-	-	-	-	-	-	-	-	-	-
29. Mature fruit color (skin)	29.	3(5)	3	3(5)	3	3	3	3	3	3	1	-	-	-
30. Sequence of color change in maturation	30.	2	3	3	1	-	3	1	2	1	3	-	-	-
31. Skin brilhance	31.	5	5	5	5	5	5	5	5	3	3	-	-	-

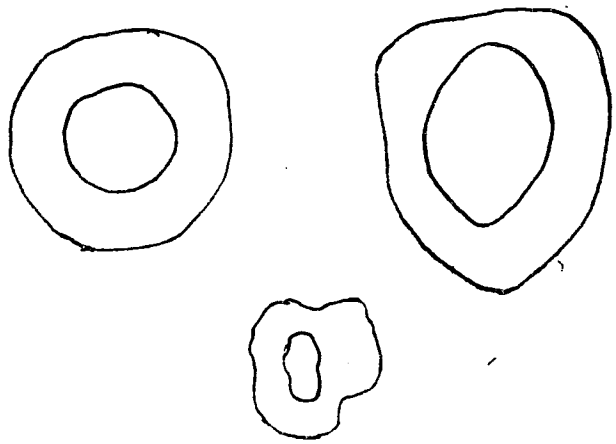
Experimental Statistical Sampling of Peach Palm in Coari, AM, BR

Character (continued)	Sample—	034	035	036	037	038	039	040	041	042	043	$\bar{x}$	SD	CV
Fruit (continued)														
32. Cracks in skin	32.	1	0	0	0	0	0	1	1	0	0	-	-	-
33. Distribution of skin cracks	33.	2	-	-	-	-	-	2	2	-	-	-	-	-
34. Presence of skin blemishes	34.	0	0	0	0	0	0	0	0	0	0	-	-	-
35. Medium weight of fertil fruits (gr)	35.	22.6	21.9	28.1	33.8	31.1	39.8	45.8	39.3	34.9	18.7	31.6	8.81	27.87
36. Medium weight of parthen. fruits (gr)	36.	-	-	-	-	-	21	-	-	-	-	-	-	-
37. Percentage of fertil fruits	37.	100	100	100	100	100	98.6	100	100	100	100	-	-	-
38. Percentage of parthenocarpic fruits	38.	0	0	0	0	0	1.4	-	-	-	-	-	-	-
Mesocarp														
39. Color of raw mesocarp	39.	5	2/5	2	2/5	5	5	5	5	5	2	-	-	-
40. Texture of raw mesocarp	40.	1	3(4)	1(3)	2	4(2)	4	3(4)	3(4)	2	2(1)	-	-	-
41. Adherance of seed to mesocarp	41.	4	3	5	5	7	5	5	3	3	5	-	-	-
42. Medium weight of mesocarp (gr)	42.	19.6	19.6	25.7	31.8	28.3	35.6	42.5	36.6	32.5	16.4	28.9	8.50	29.41
43. Percentage mesocarp/fruit weight	43.	86.7	89.5	91.5	94.1	91.0	89.4	92.8	93.1	93.1	87.7	90.9	2.49	2.74
Seed														
44. Seed outline (see anex)	44.	-	-	-	-	-	-	-	-	-	-	-	-	-
45. Medium weight of seed (gr)	45.	3	2.3	2.4	2	2.8	4.2	3.3	2.7	2.4	2.3	2.7	0.64	23.40
46. Percentage seed/fruit weight	46.	13.3	10.5	8.5	5.9	9	10.6	7.2	6.9	6.9	12.3	9.1	2.49	27.41

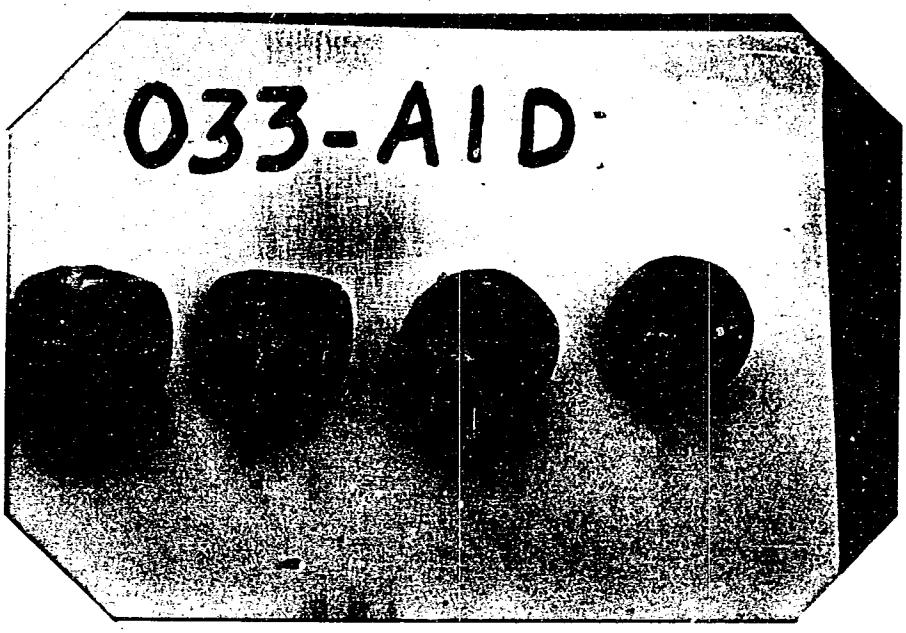
033-AID



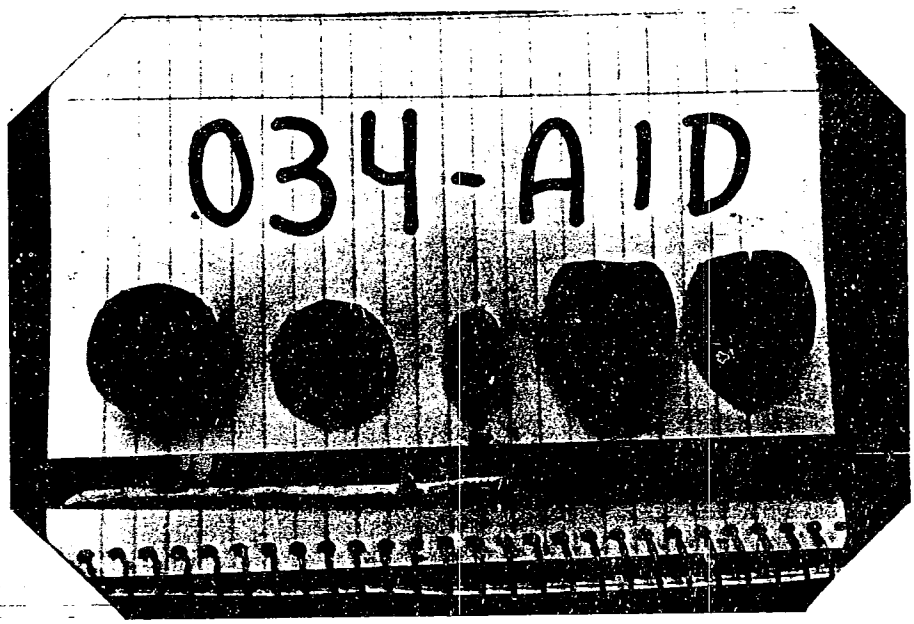
034-AID



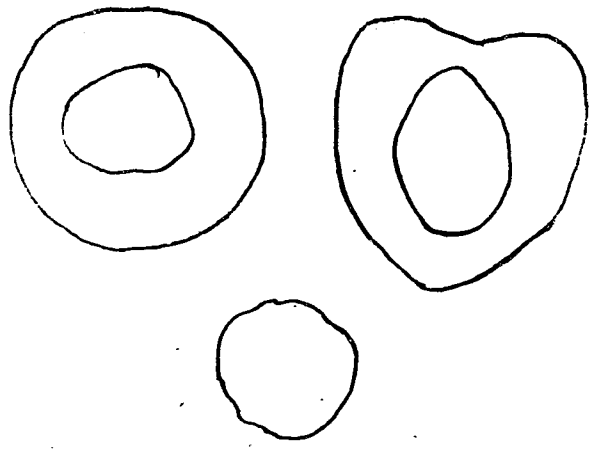
033-AID



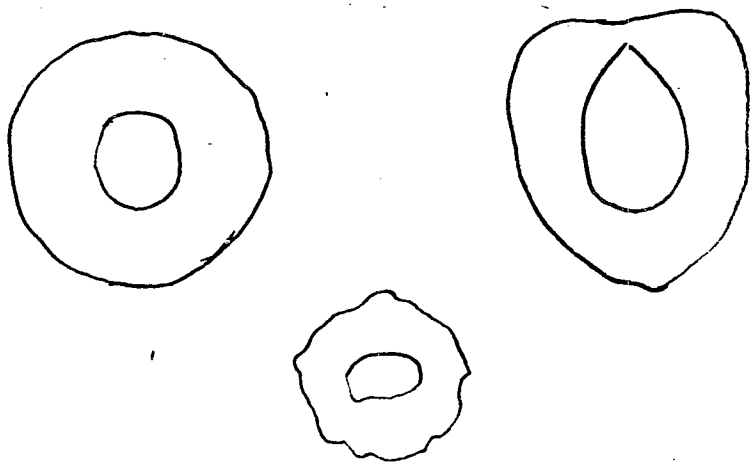
034-AID



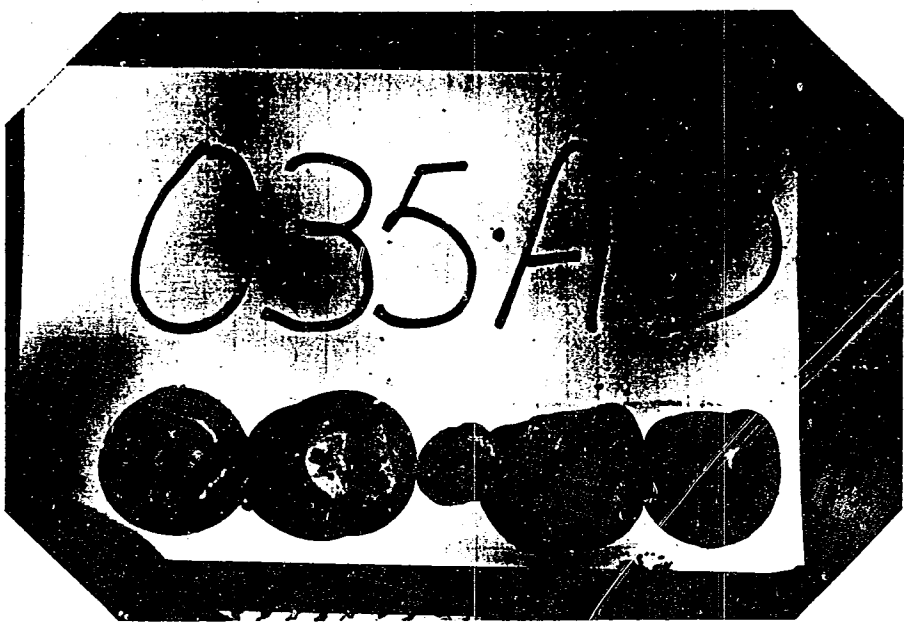
035-AID



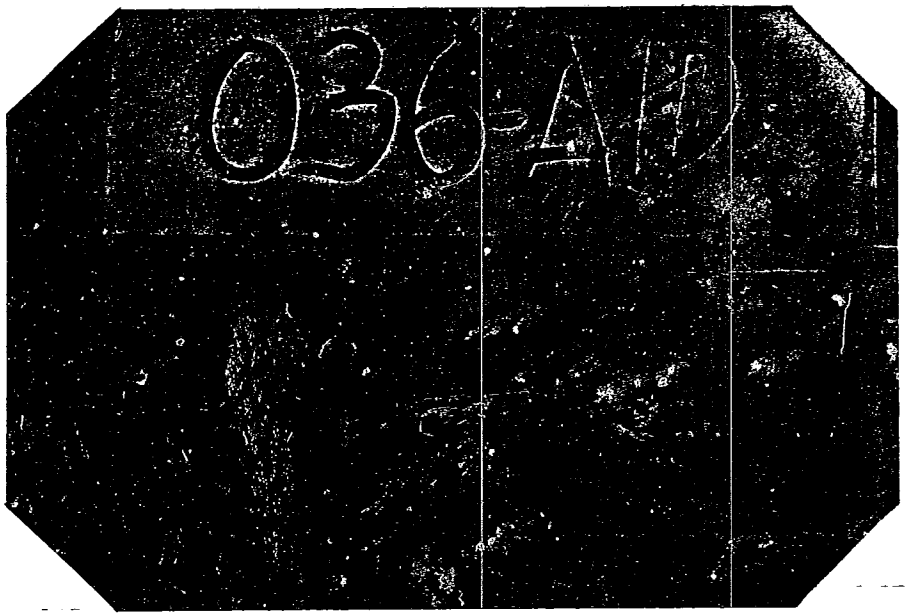
036-AID



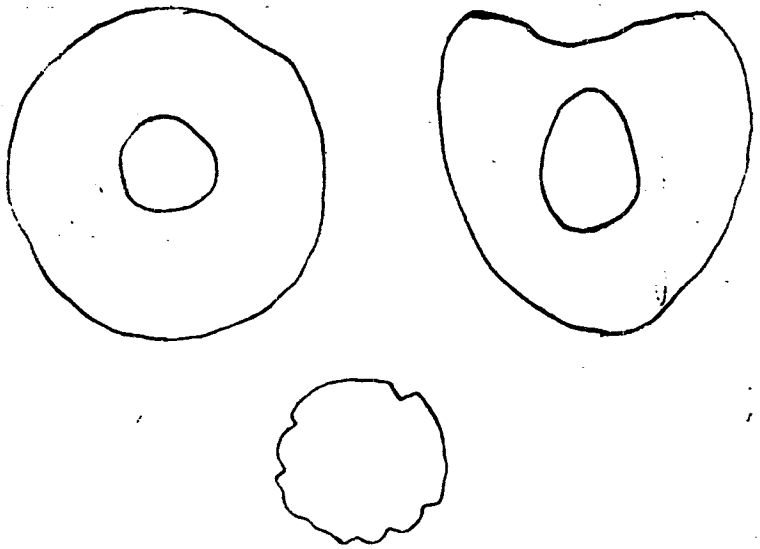
035-AID



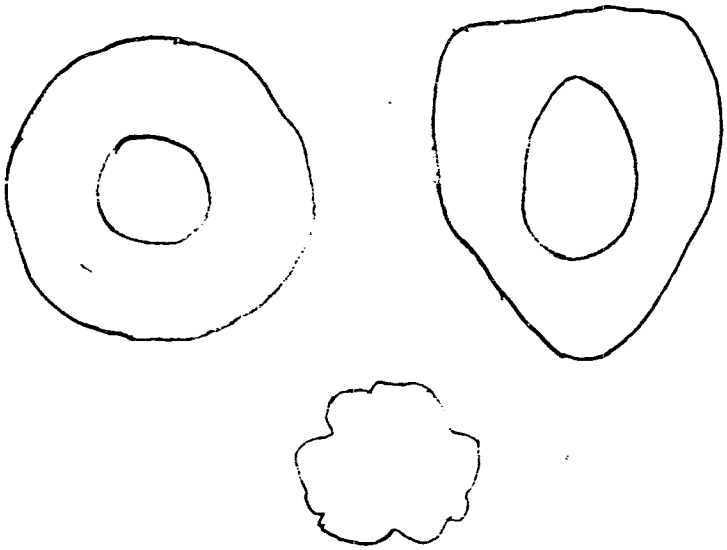
036-AID



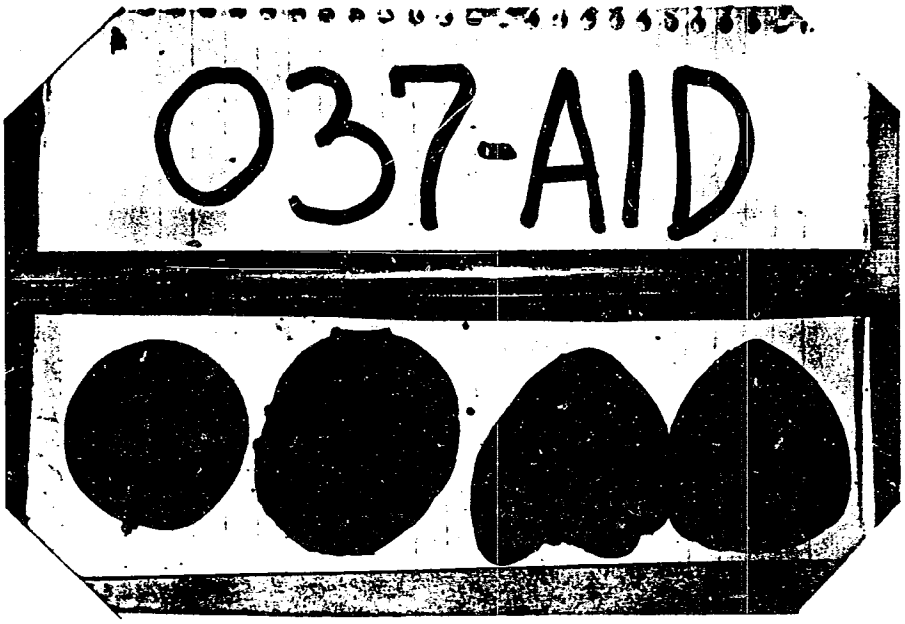
037-AID



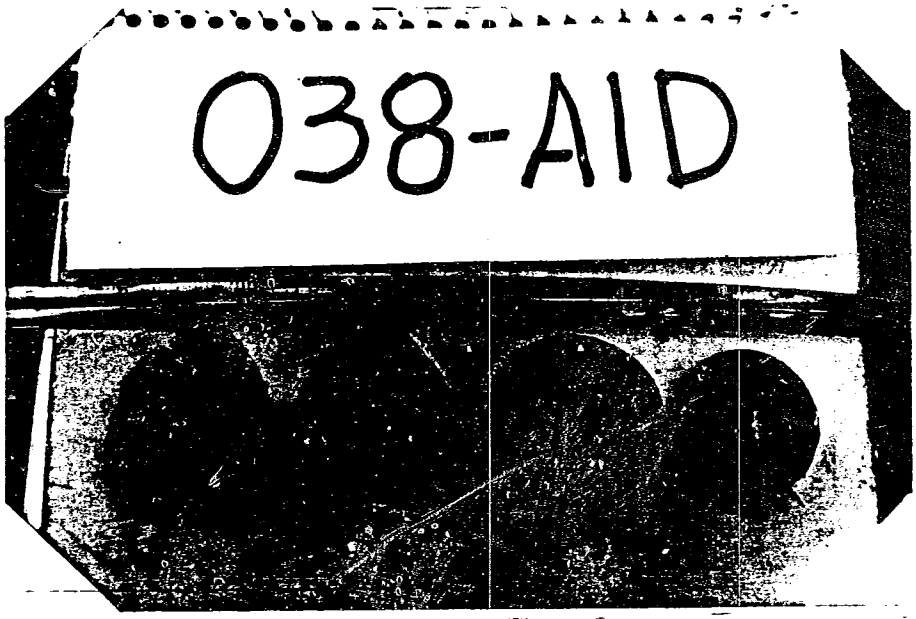
038-AID



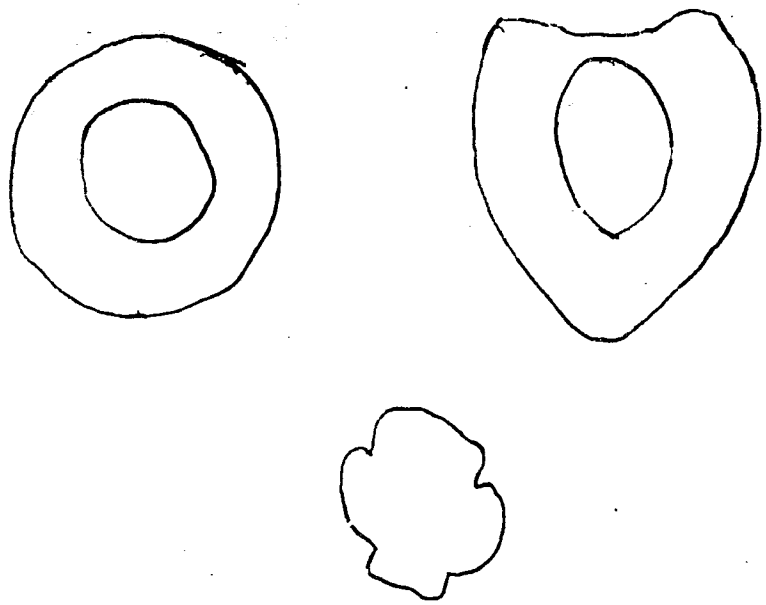
037-AID



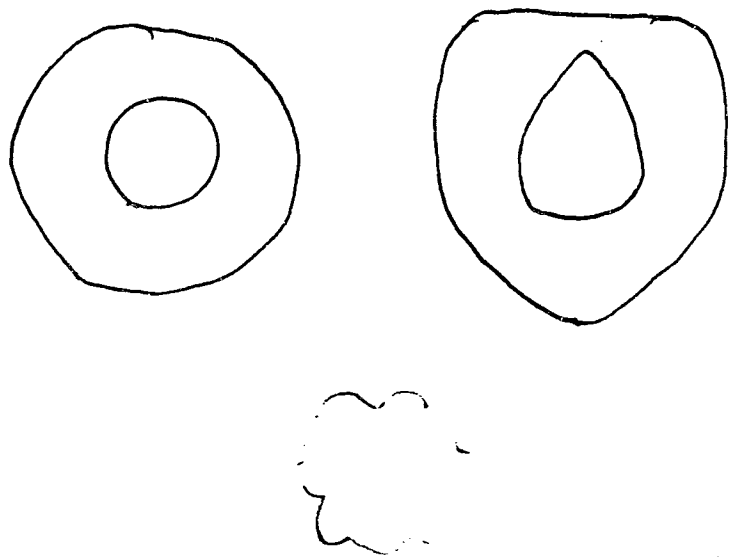
038-AID



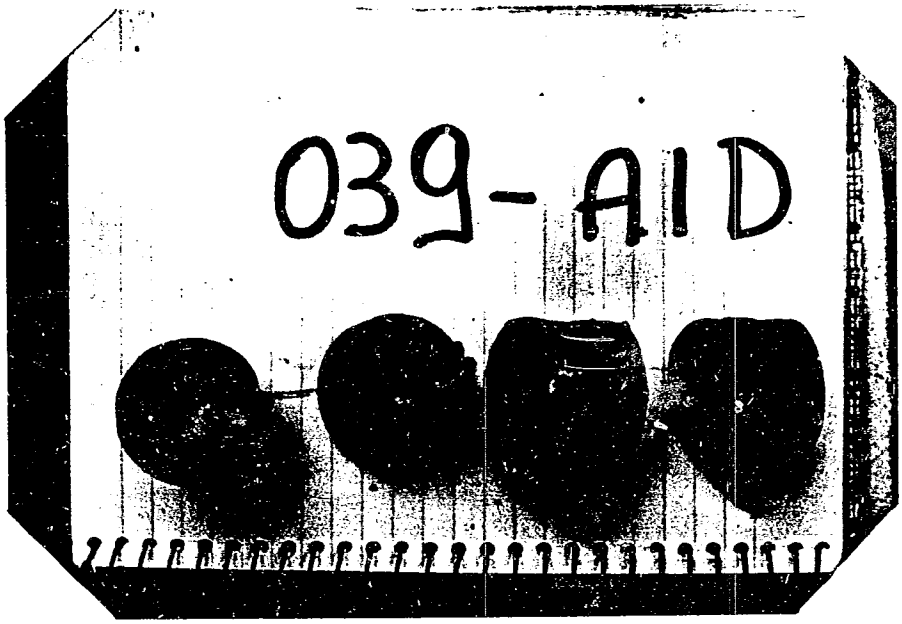
039-AID



040-AID

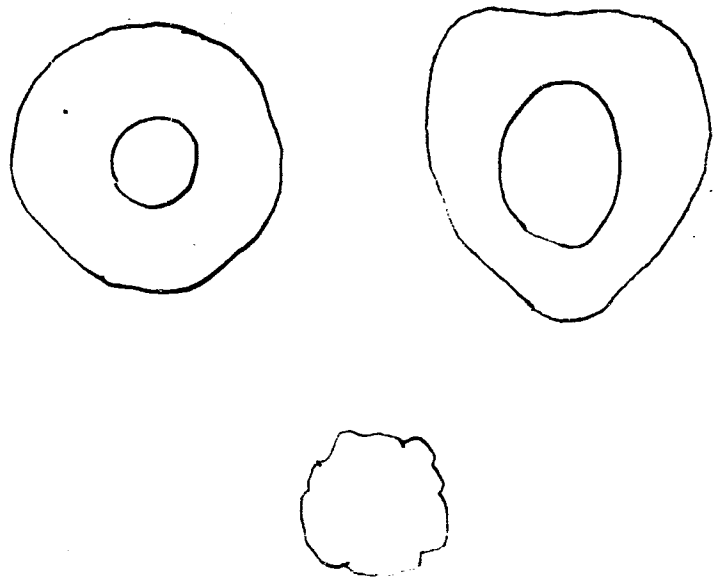


039-AID

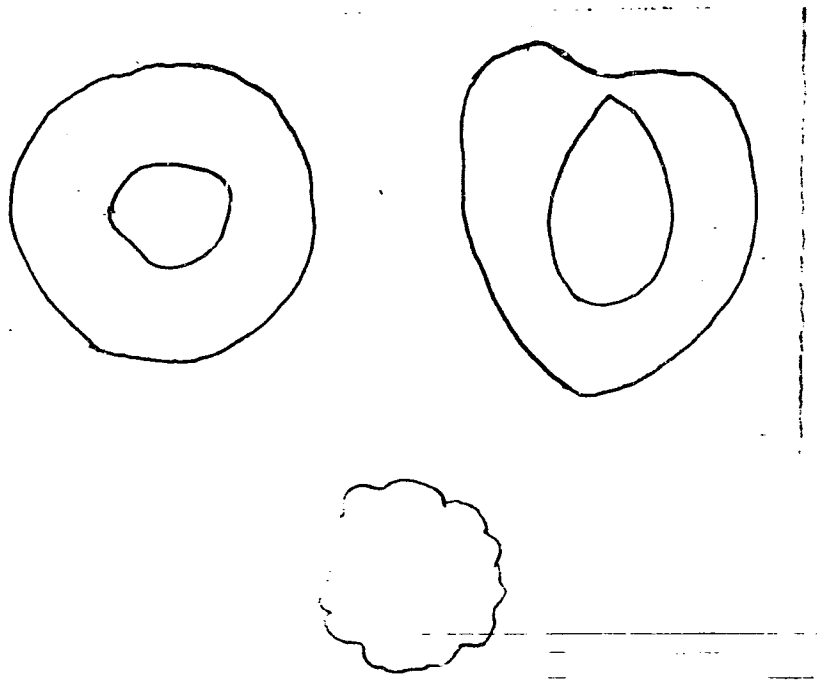


040-AID

041-AID



042-AID



041-AID

042-AID

measurements are 219, 82.4 cm, 3.8 cm and 3.9 m², respectively, while in Benjamin Constant they are 222, 81.1 cm, 3.8 cm and 4.0 m², respectively. This slightly smaller leaf area may be a factor in the overall diminished production in the Coari population.

6. Manacapuru, AM, BR. Lat. 3°17'S; Long. 60°38'W

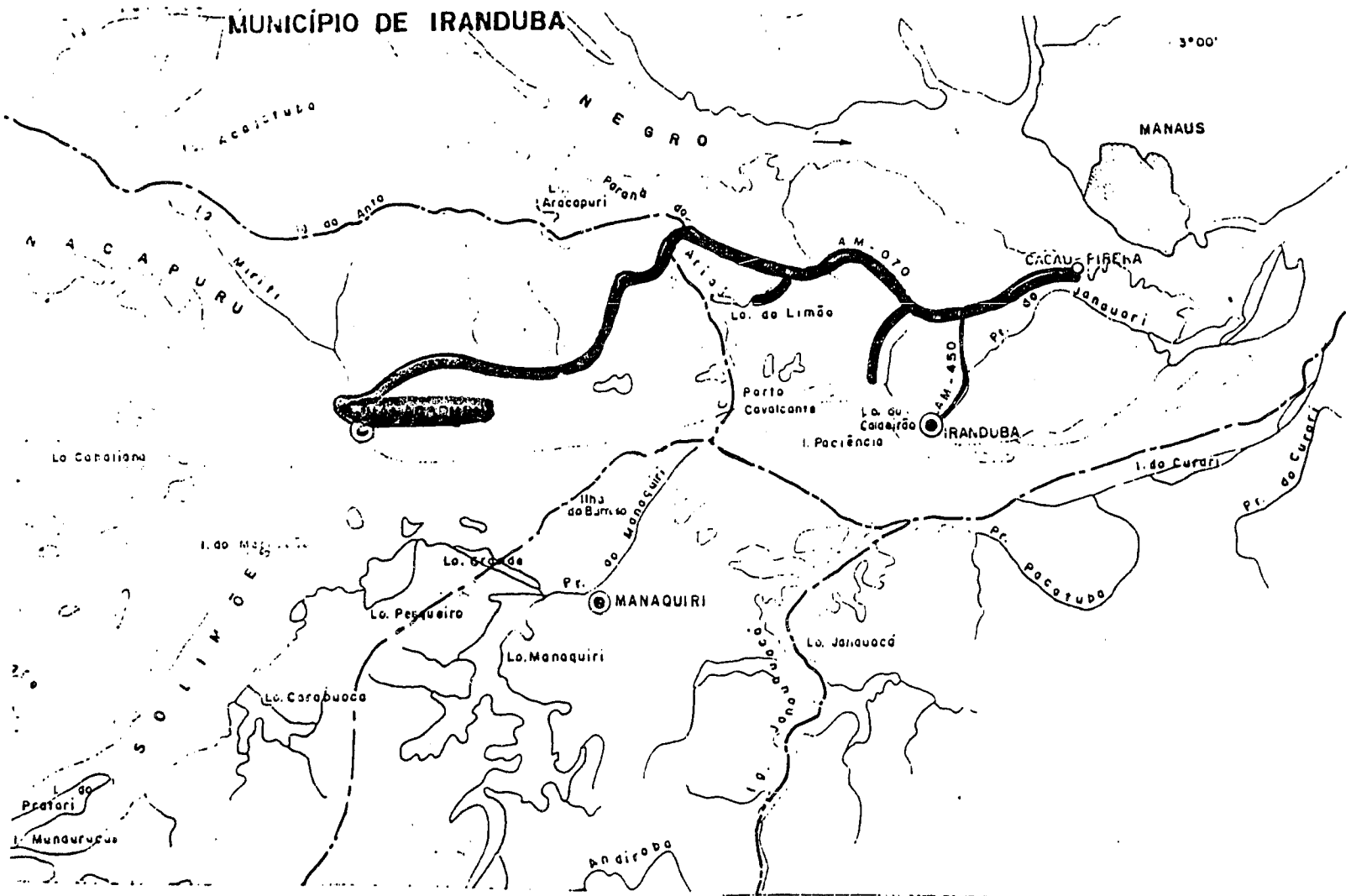
Because of the impossibility of obtaining river transport from Coari to Manacapuru, the team travelled directly to Manaus, returning a day later to Manacapuru by road. In this area the rainy season had not yet started, being, in late January, four months overdue. In central Amazonia the dry season normally extends from June to September, with occasional rains (less than 100 mm/month) during this period. From late September to January the rains become more frequent, after which (February to April) the rainy season is at full force, tapering off in May. However in 1982, extending into 1983, the rainy season continued from June to March. This drastic drought reduced or eliminated agricultural production throughout the affected region. Peach palm was as affected as any other perennial crop, with most production falling or drying on the tree, or with diminished fruit size.

On the Manaus-Manacapuru road very little production was observed and only one tree had sufficient fruit for a biased collection (044-AID). This, and the other trees observed, were very similar to those from the populations observed in Coari and Tefé. In general, fruit were smaller and fruit number/bunch also reduced, although both of these characters suffered a strong environmental influence due to the drought.

7. Itacoatiara, AM, BR. Lat. 3°8'S; Long. 58°24'W

This town had not had any rain since October, 28, 1982. In the town not one tree was found with fruit. At the Rondon agricultural colony there was much more material, although not enough for an experimental collection. The first day's reconnaissance showed the great effect of the dry season and also found a very interesting mutant peach palm (045-AID), which had variagated fruit becoming almost uniformly red-orange upon maturity. The fruit was also much wider than long (see outline and photos). Most curious was the node/internode spine distribution. In all other trees observed the spines occupy nearly all the space between the

Map showing areas visited in Manacapuru, AM, during the first expedition

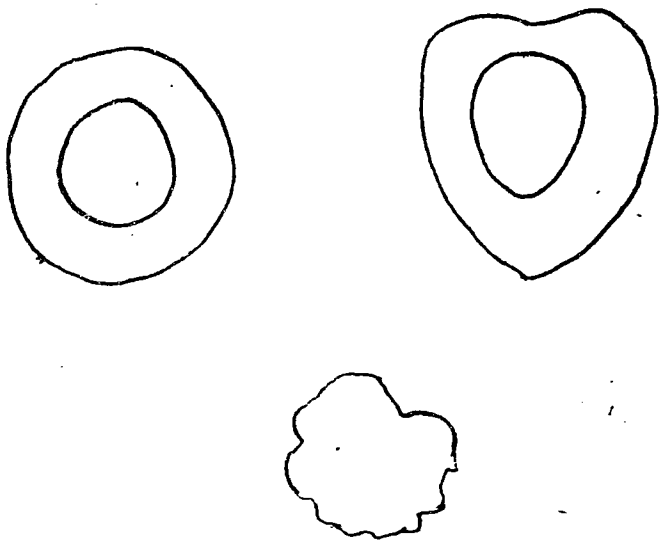


Collection data VI

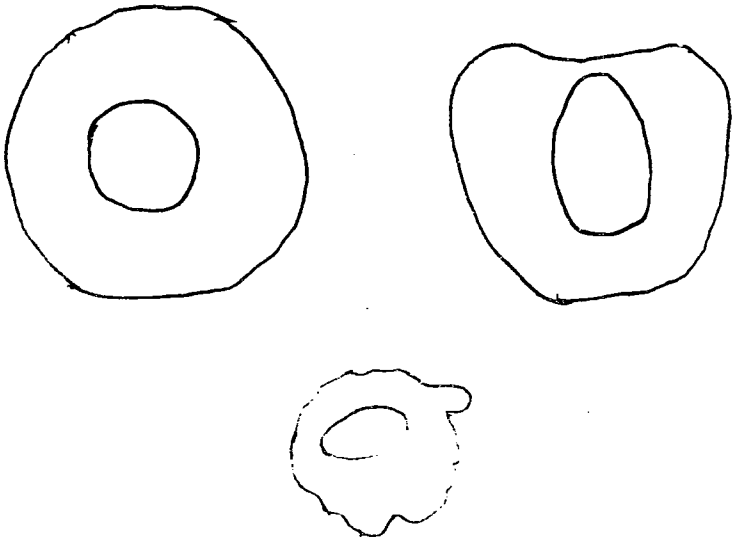
Biased Sampling of Peach Palm in Manacapuru, AM, BR (see Appendix 1 for explanation)

Character//	Sample-	044
1. Spine density on trunk	1.	5
2. Bunch number/trunk	2.	6
3. Fruit number/bunch	3.	-
4. Mature fruit color	4.	2
5. Cracks in skin of fruit	5.	0
6. Pulp color intensity	6.	5
7. Seed position in fruit	7.	3
8. Quantity of fiber	8.	4
9. Texture of raw pulp	9.	4

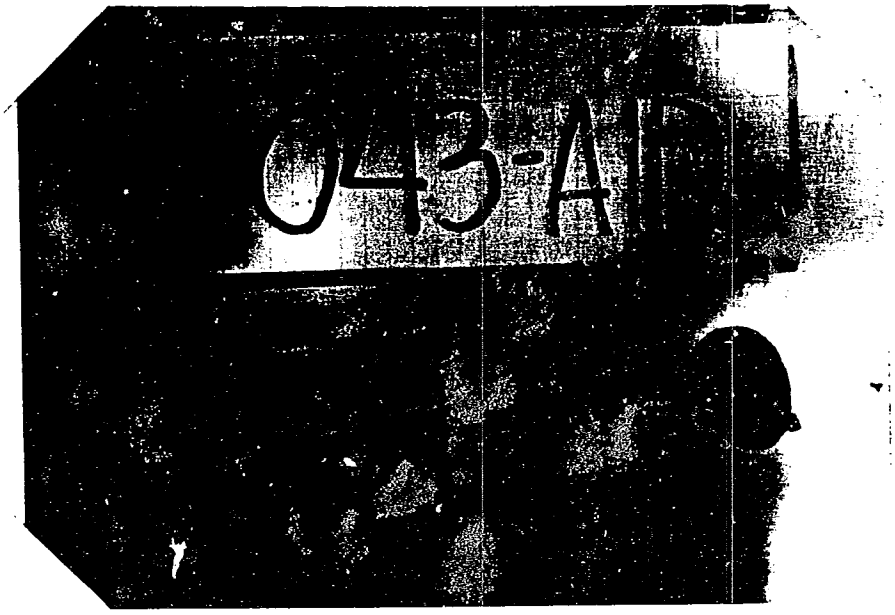
043-AID



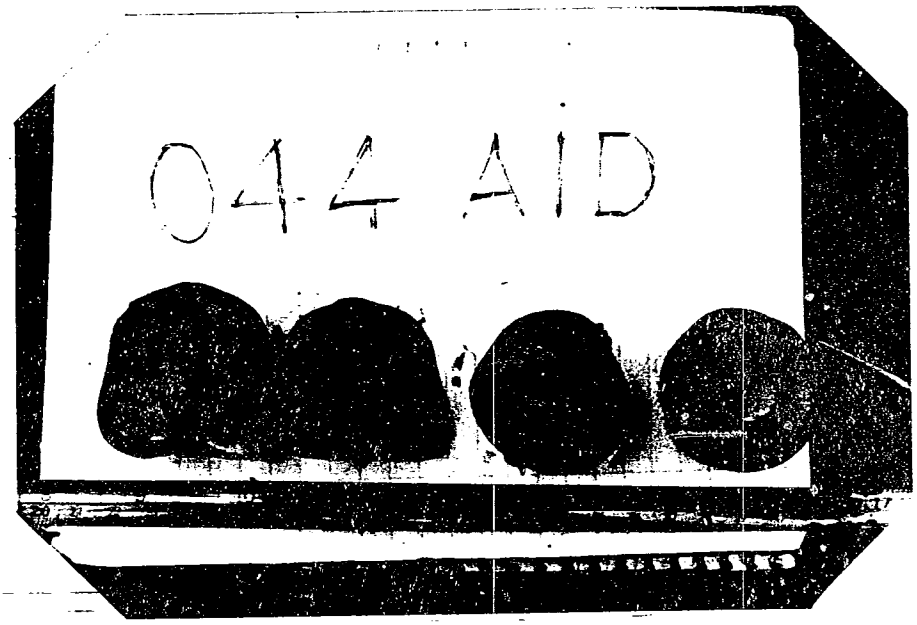
044-AID



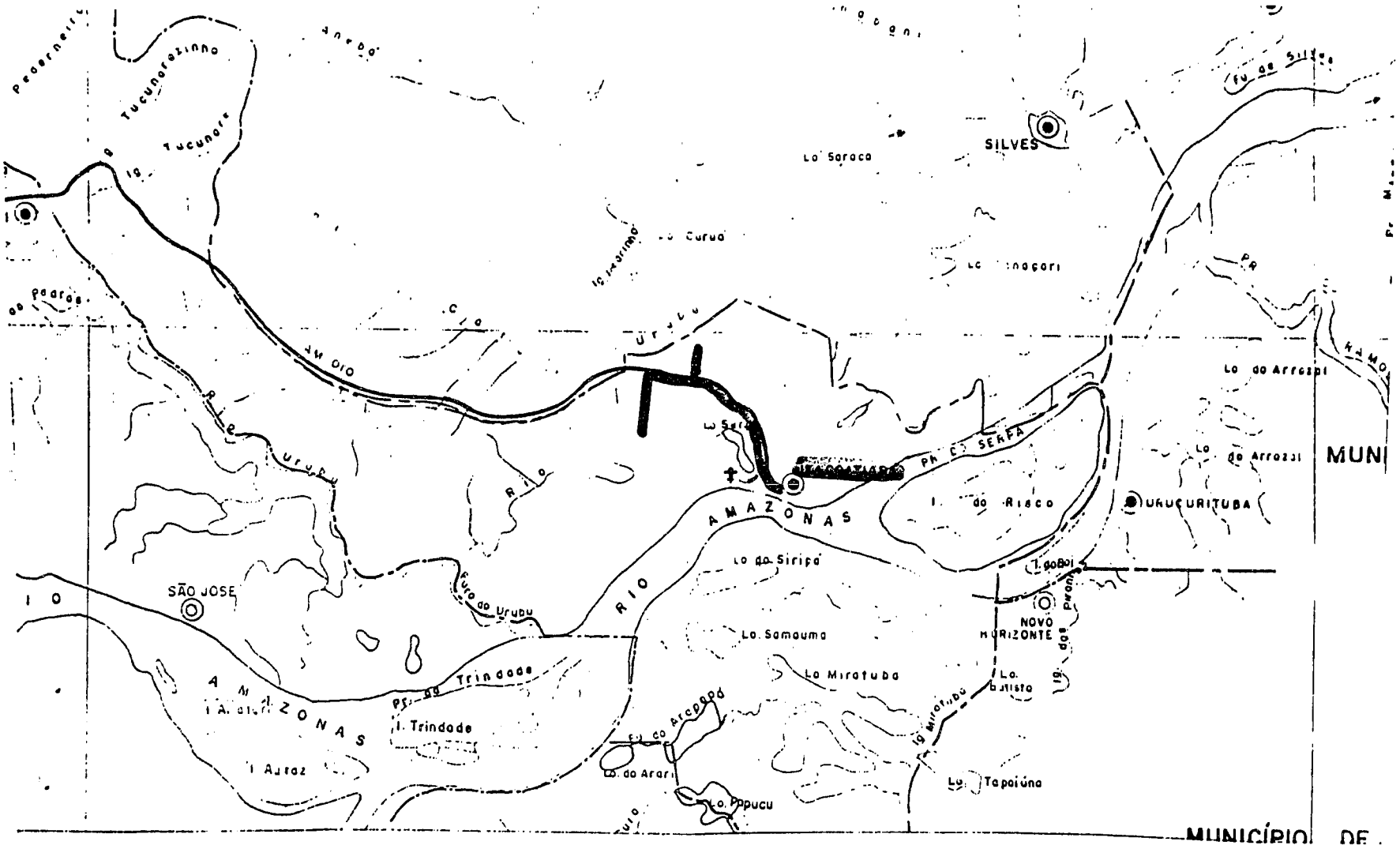
043-AID



044-AID



Map showing areas visited in Itacoatiara, AM, during the first expedition

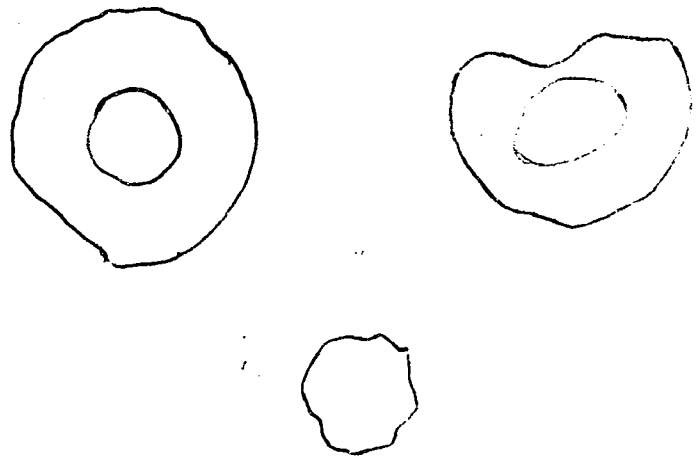


Collection data VII

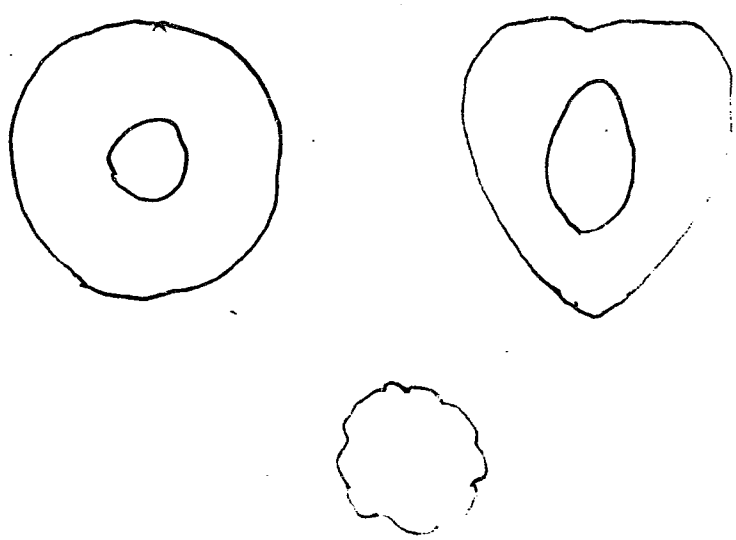
Biased Sampling of Peach Palm in **Itacoatiara, AM, BR (see Appendix 1 for explanation)**

Character//	Sample-	045	046	047	048	049	$\bar{x}$	SD	CV
1. Spine density on trunk	1.	7	1	5	0	5			
2. Bunch number/trunk	2.	5	6	12	15	8	9.2	4.21	45.73
3. Fruit number/bunch	3.	112	101	138	351	199	180.2	102.75	57.02
4. Mature fruit color	4.	2	2	1	2	2			
5. Cracks in skin of fruit	5.	0	0	0	0	0			
6. Pulp color intensity	6.	3	5	3	5	5			
7. Seed position in fruit	7.	3	5	7	6	5			
8. Quantity of fiber	8.	5	5	5	5	5			
9. Texture of raw pulp	9.	3	7	7	5	5			

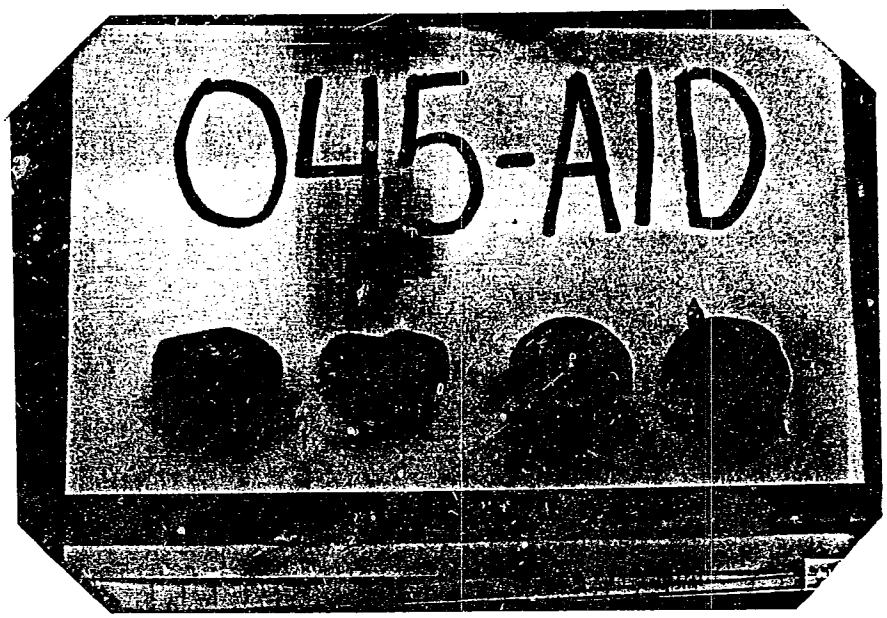
045-AID



046-AID

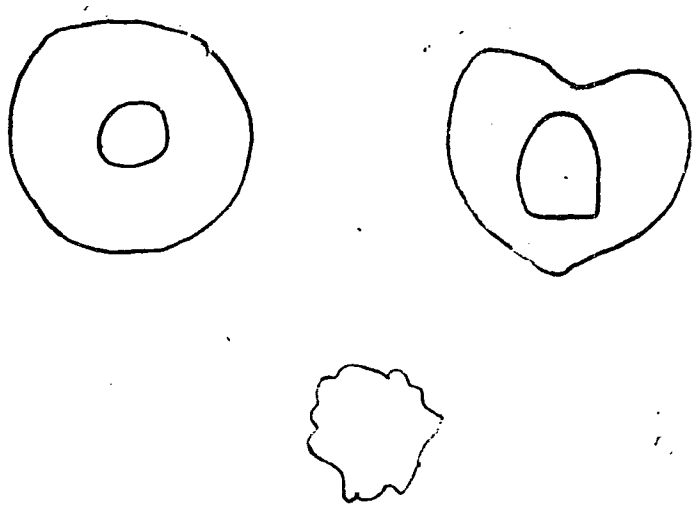


045-AID

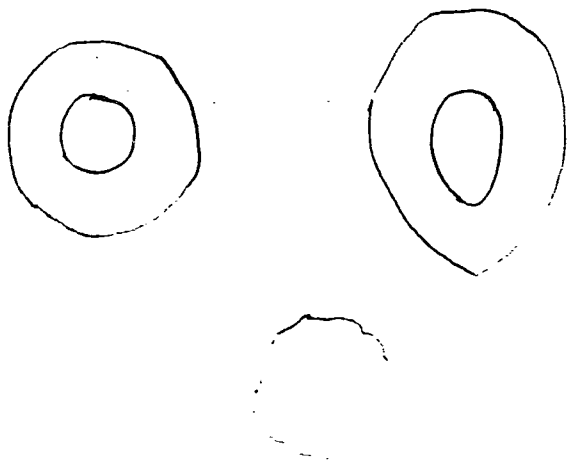


046-AID

047-AID



048-AID



047-AID

048-AID

negative severely underexposed

insertion of two adjacent leaves, leaving a small area (2 cm to 6 cm) just below each insertion that is free of spines. In this tree this area was so much expanded that the area with spines was reduced to only 2 to 5 cm, leaving the rest of the area spineless. In other words, the reverse of the normal situation.

On the second day four more biased collections were made in the Colonia Rondon. Although the group attempted to find variability, there was very little available, and the farmers' information suggested that the Colonia Rondon (and perhaps all of the Itacoatiara population) is extremely uniform. See Collection data VII, Outlines and Photos (045-AID through 049-AID.

Although the dry season probably affected fruit set the number of fruit/bunch was high (180), which compares favorably with Coari (173) and Fonte Boa (176) and is higher than in Tefé (126). Tree 048-AID was especially interesting because, even in this unseasonably dry season, it produced 15 large bunches, the one sampled containing 351 fruit. All samples had fruit with relatively large amounts of fiber and from some to fairly high concentrations of oil. There were occasional trees with spineless trunks.

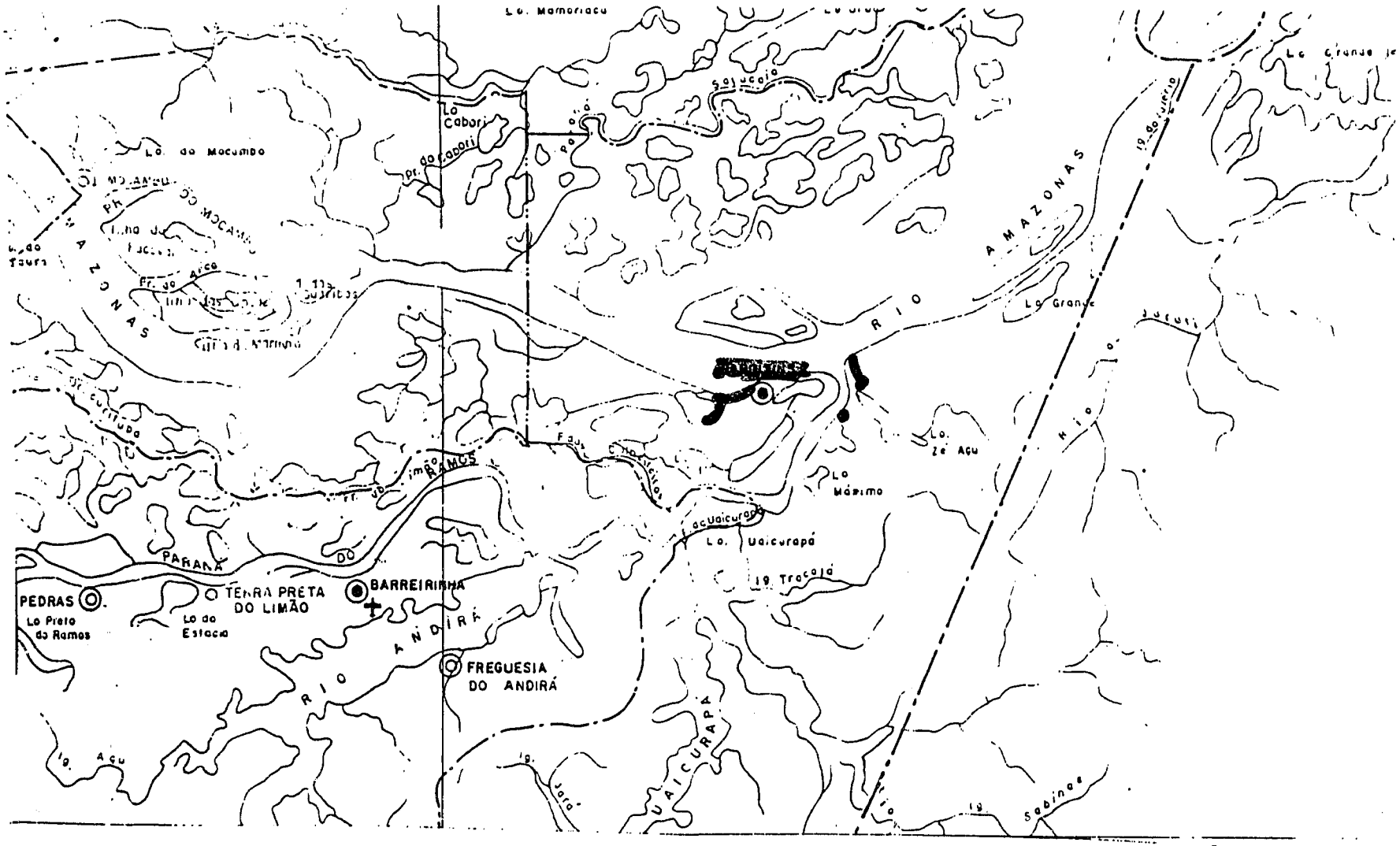
8. Parintins, AM, BR. Lat. 2°34'S; Long. 56°44'W

Parintins had also suffered severely from the drought. In town only one fruiting tree was found(050-AID). Reconnaissance on the island and another nearby island failed to produce any peach palm fruits, and in fact, there were very few trees in evidence except in the town itself. The one sample collected was very similar to those collected in Itacoatiara, AM, and in Alenquer, PA, suggesting that this area also forms part of the regional population that has its western limits near Manacapuru, AM.

9. Alenquer, PA, BR. Lat. 1°56'S; Long. 54°48'W

The night before the day the group arrived in Alenquer, Pará state, the first rain in 2 months fell heavily. In the town no peach palm trees with fruit were found. On the second day the group took the Alenquer, PA, to Obidos, AM, highway. At km 58 the Fazenda Uirapuru had a plantation of about 400 trees, planted at spacing of about 6 by 6 meters. The plantation was formed from seed obtained from the Alenquer market, so that one assumed that this plantation

Map showing areas visited in Parintins, AM, during the first expediton

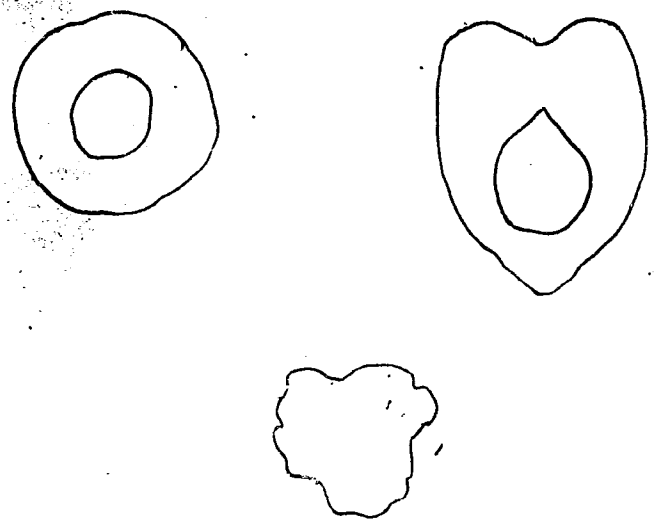


Collection data VIII

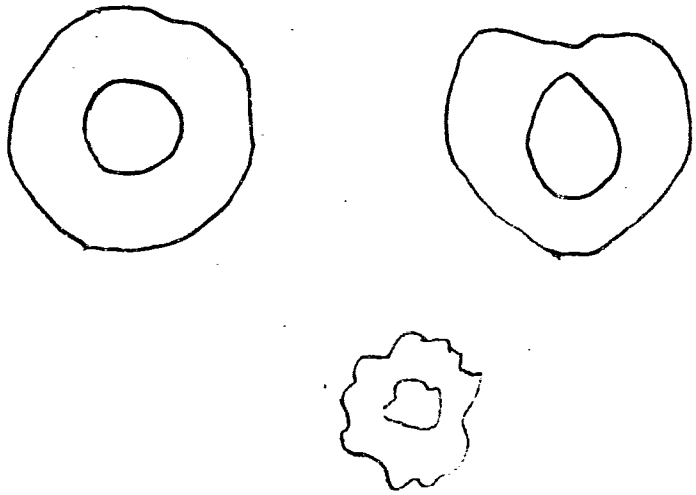
Biased Sampling of Peach Palm in **Parintins, AM, BR** **(see Appendix 1 for explanation)**

Character//	Sample-	050
1. Spine density on trunk	1.	3
2. Bunch number/trunk	2.	12
3. Fruit number/bunch	3.	90
4. Mature fruit color	4.	3
5. Cracks in skin of fruit	5.	0
6. Pulp color intensity	6.	5
7. Seed position in fruit	7.	5
8. Quantity of fiber	8.	3
9. Texture of raw pulp	9.	3

049-AID



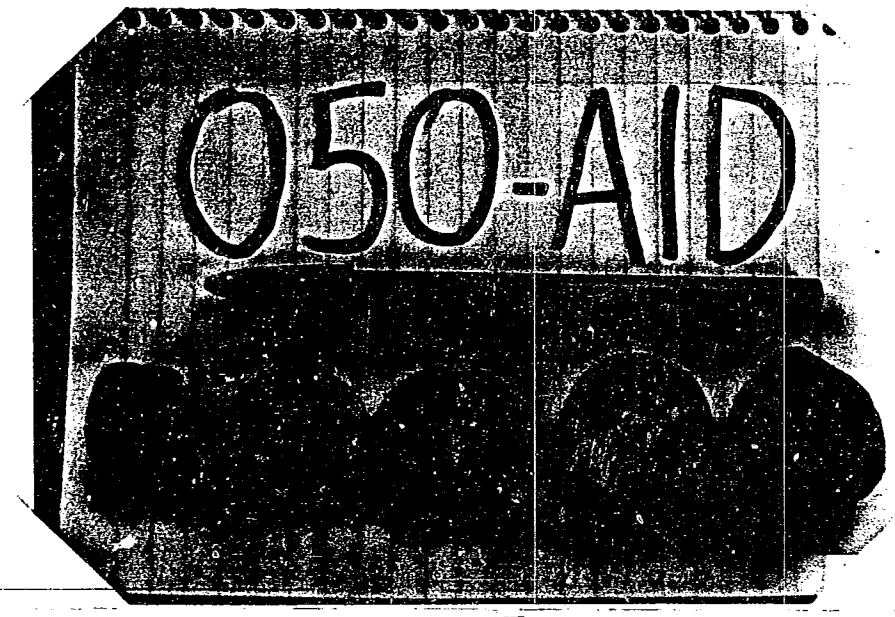
050-AID



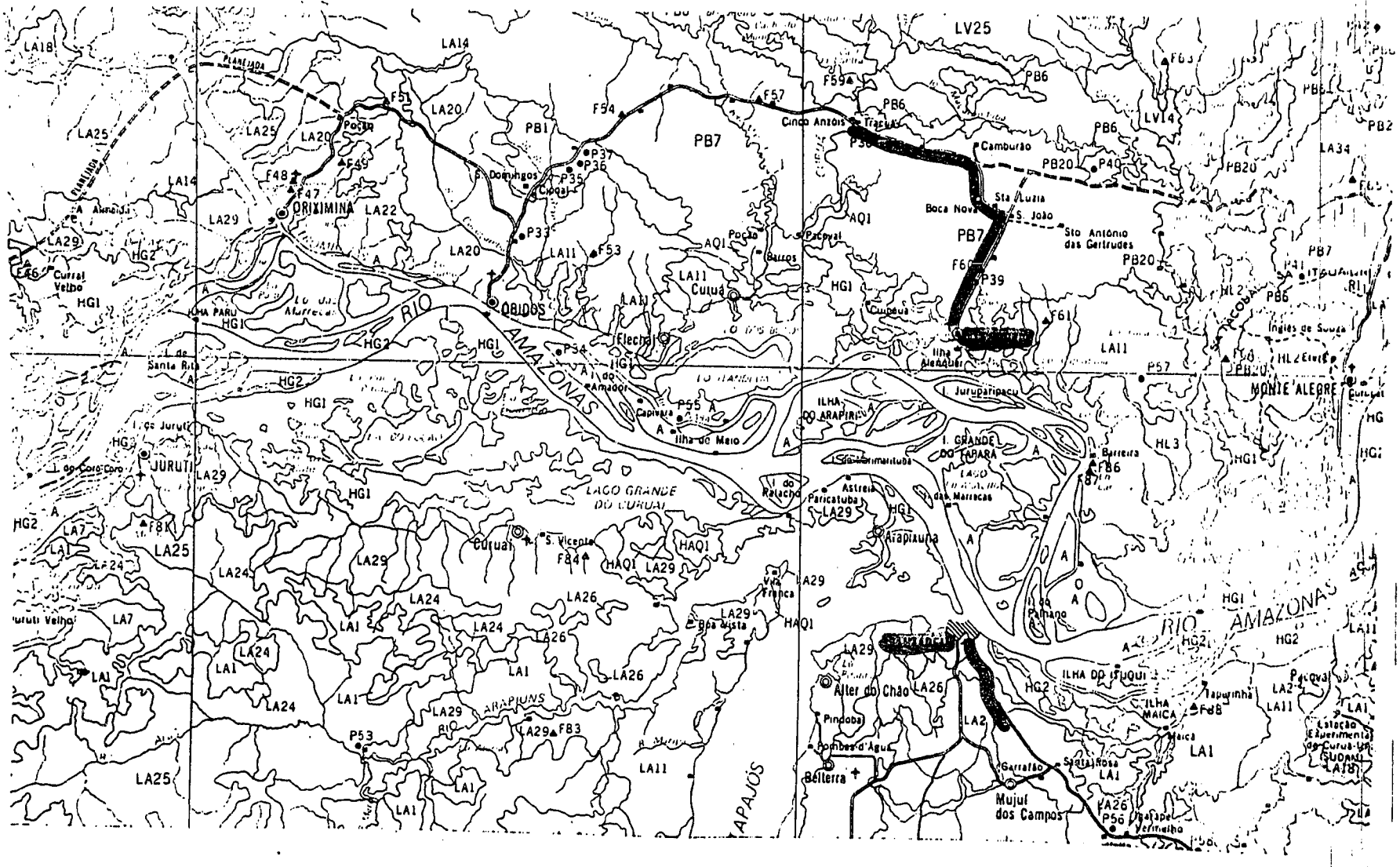
049-AID

negative severely underexposed

050-AID



Map showing areas visited in Alenquer and Santarém, PA, during the first expedition

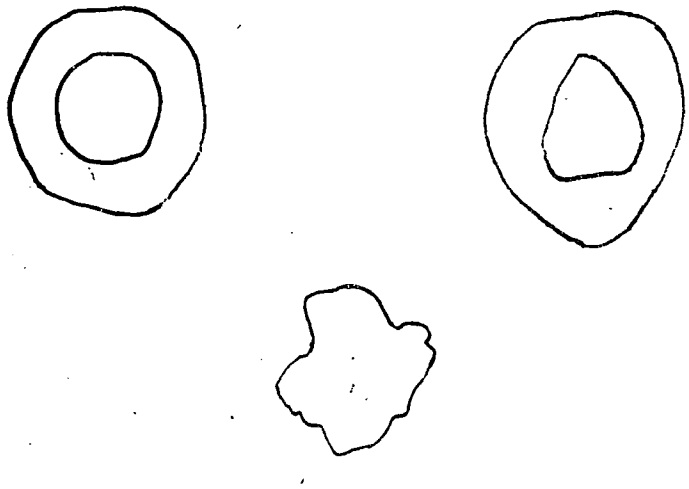


Collection data IX

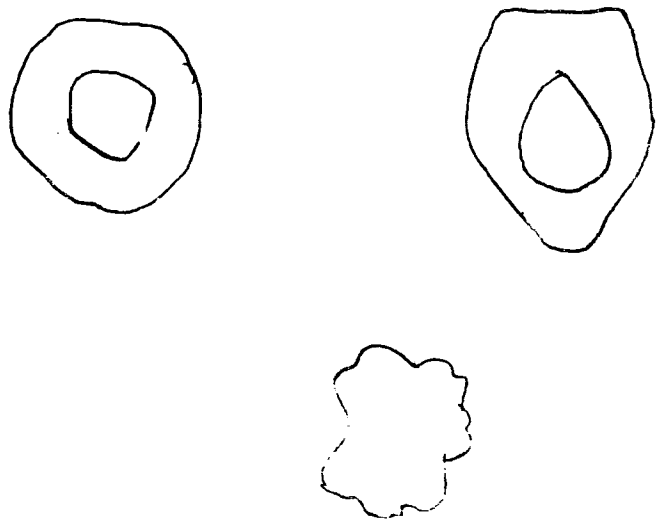
Biased Sampling of Peach Palm in **Alenquer, PA, BR** (see Appendix 1 for explanation)

Character//	Sample-	051	052	053	054	055	056	057			
1. Spine density on trunk	1.	7	5	7	5	7	7	7			
2. Bunch number/trunk	2.	8	12	11	9	8	5	8	8.7	2.29	26.26
3. Fruit number/bunch	3.	80	159	203	124	155	156	82	137	44.66	32.60
4. Mature fruit color	4.	2	2	2	1	1	3	2			
5. Cracks in skin of fruit	5.	0	0	0	0	0	0	0			
6. Pulp color intensity	6.	5	5	5	3	3	4	7			
7. Seed position in fruit	7.	5	7	7	5	5	5	5			
8. Quantity of fiber	8.	7	6	7	7	7	7	7			
9. Texture of raw pulp	9.	5	5	3	5	5	5	5			

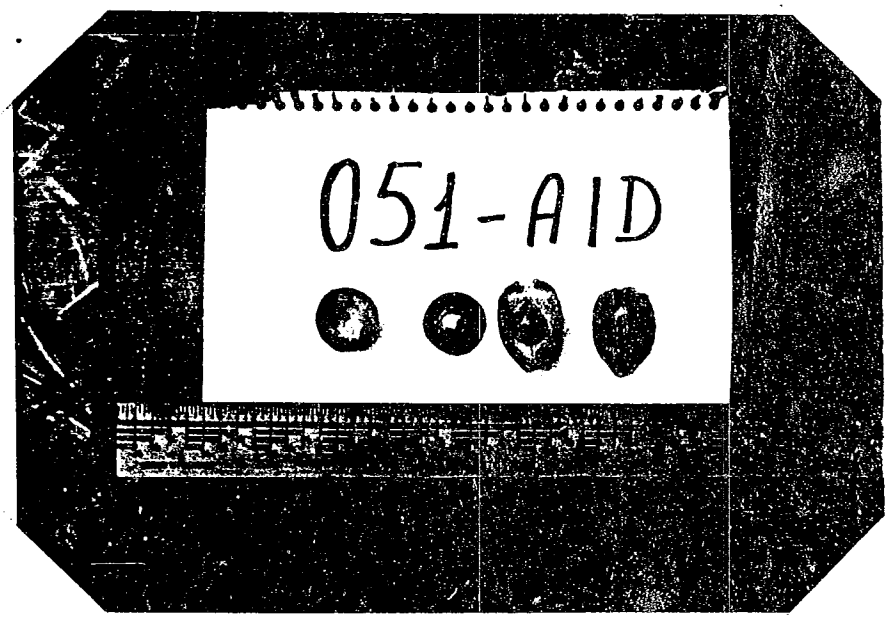
051-AID



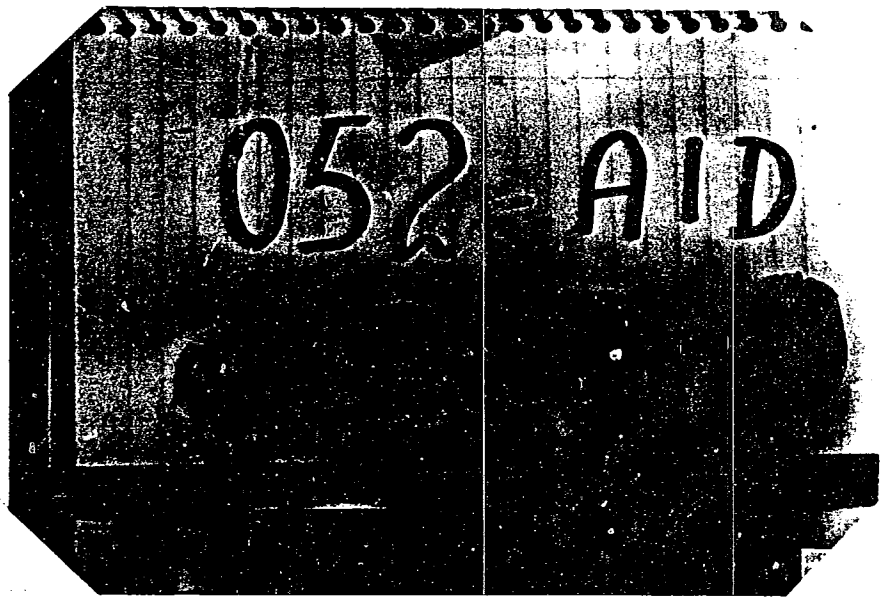
052-AID



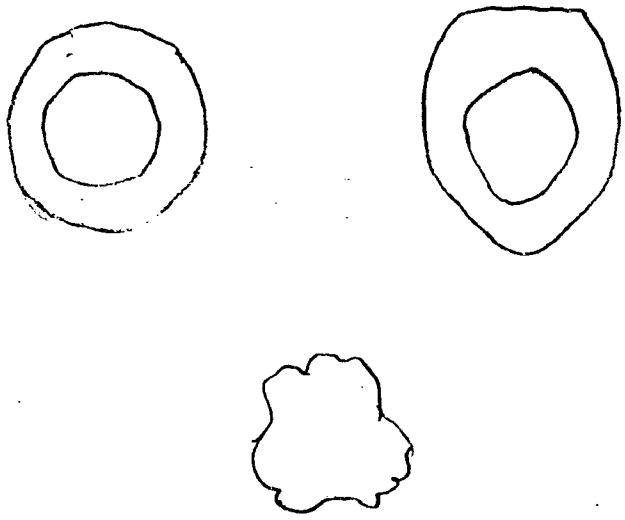
051-AID



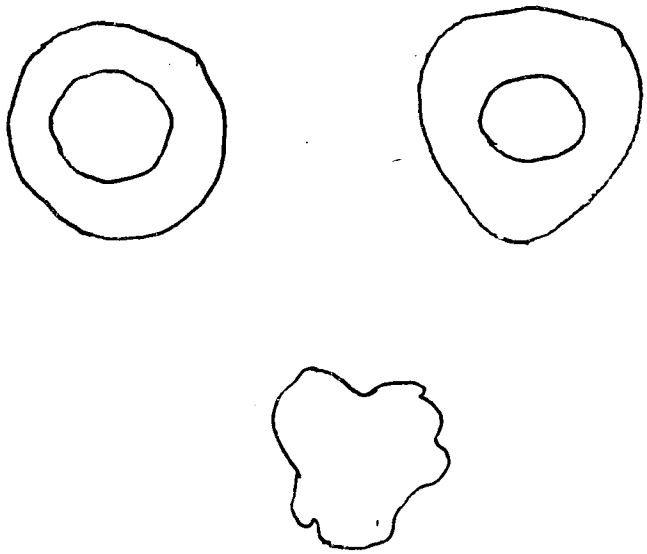
052-AID



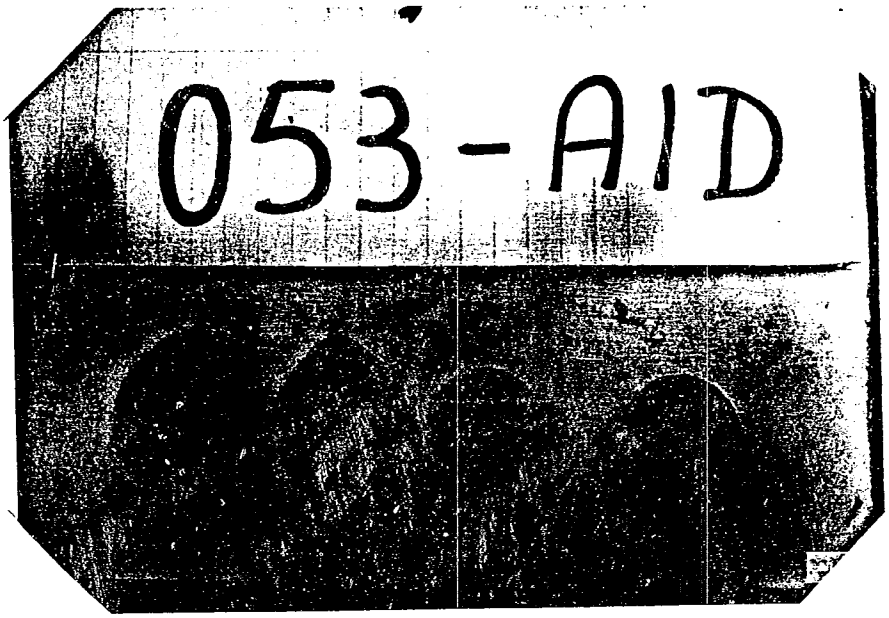
053-AID



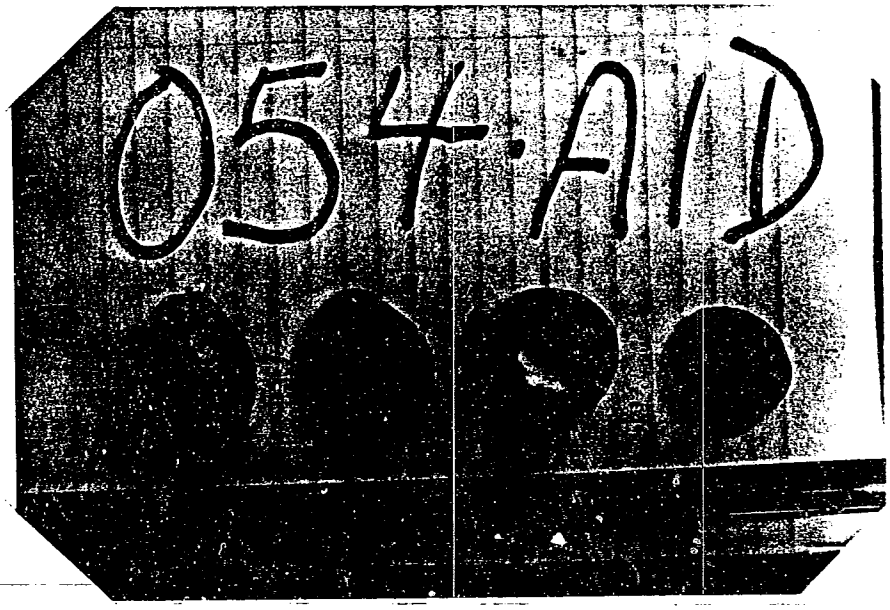
054-AID



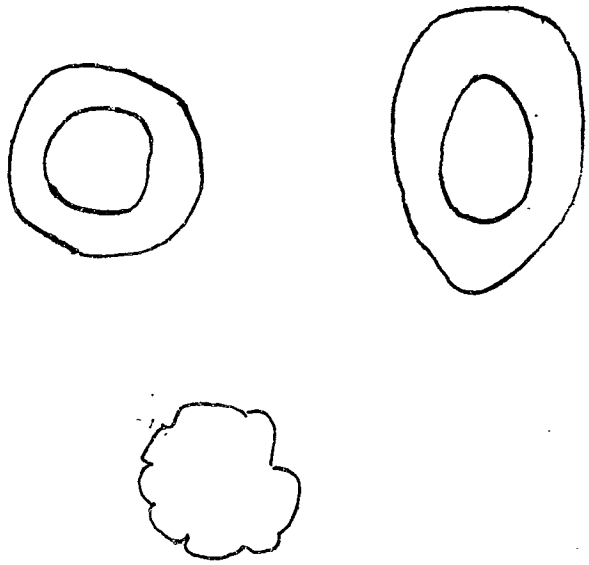
053-AID



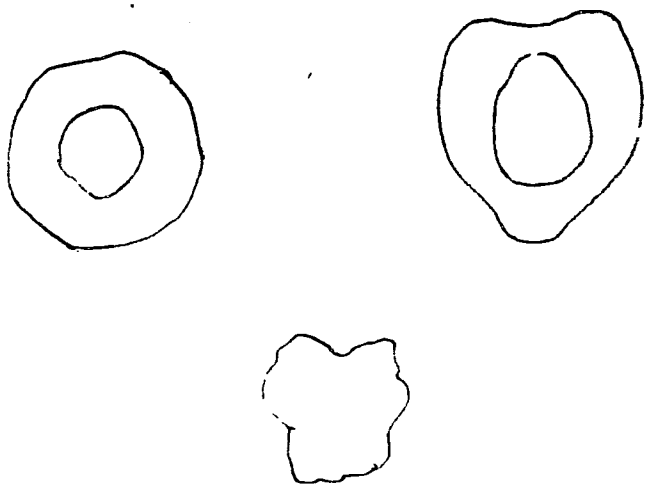
054-AID



055-AID

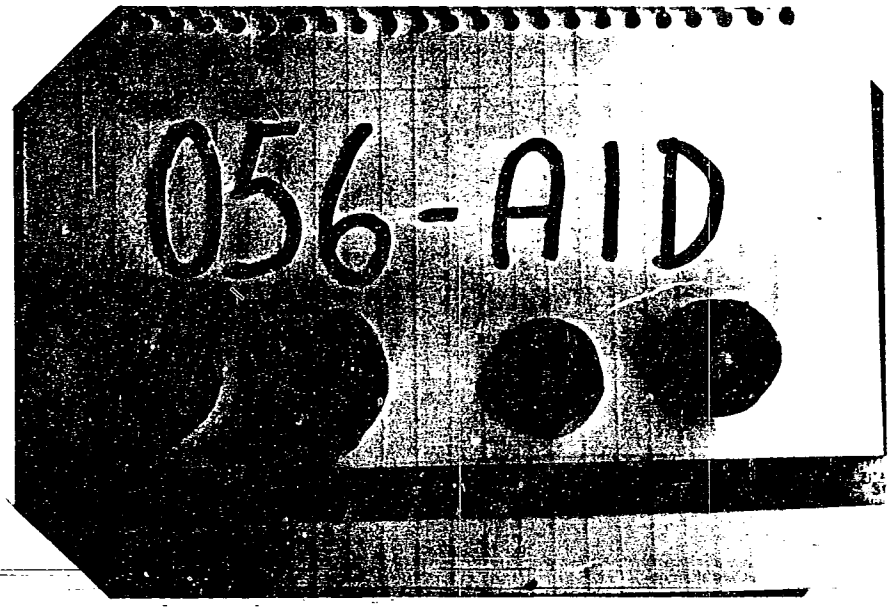


056-AID



055-AID

056-AID



represented a portion of the local population. However, because of the apparently restricted genetic base and the relative uniformity of the samples collected, it was decided not to attempt an experimental collection. During the return trip to Alenquer no further trees with fruit were found, so that only this small collection was made. See Collection data IX, Outlines and Photos 051-AID through 057-AID.

This small population had a fair fruit number/bunch (137), between that of Tefé (126) and Coari (173), although it was probably affected by the drought. Also, in the trees with fruit, bunch number was reasonable to high. All the fruit were extremely fibrous, generally somewhat oily, several having a good flavour. Although very fibrous, the fibers were soft enough not to be disagreeable. No trees were observed, either at the plantation nor any where else in Alenquer, with the spineless trait. However, all the spines were relatively thin and flexible.

After collecting in Alenquer, PA, the group crossed the Amazon river to Santarém, PA, at the mouth of the Tapajós river. With the cooperation of EMATER-PA the group was able to visit several farms along the Santarém-Cuiabá highway. Not one tree was found with fruit. Several farmers mentioned that they had never heard of spineless peach palm.

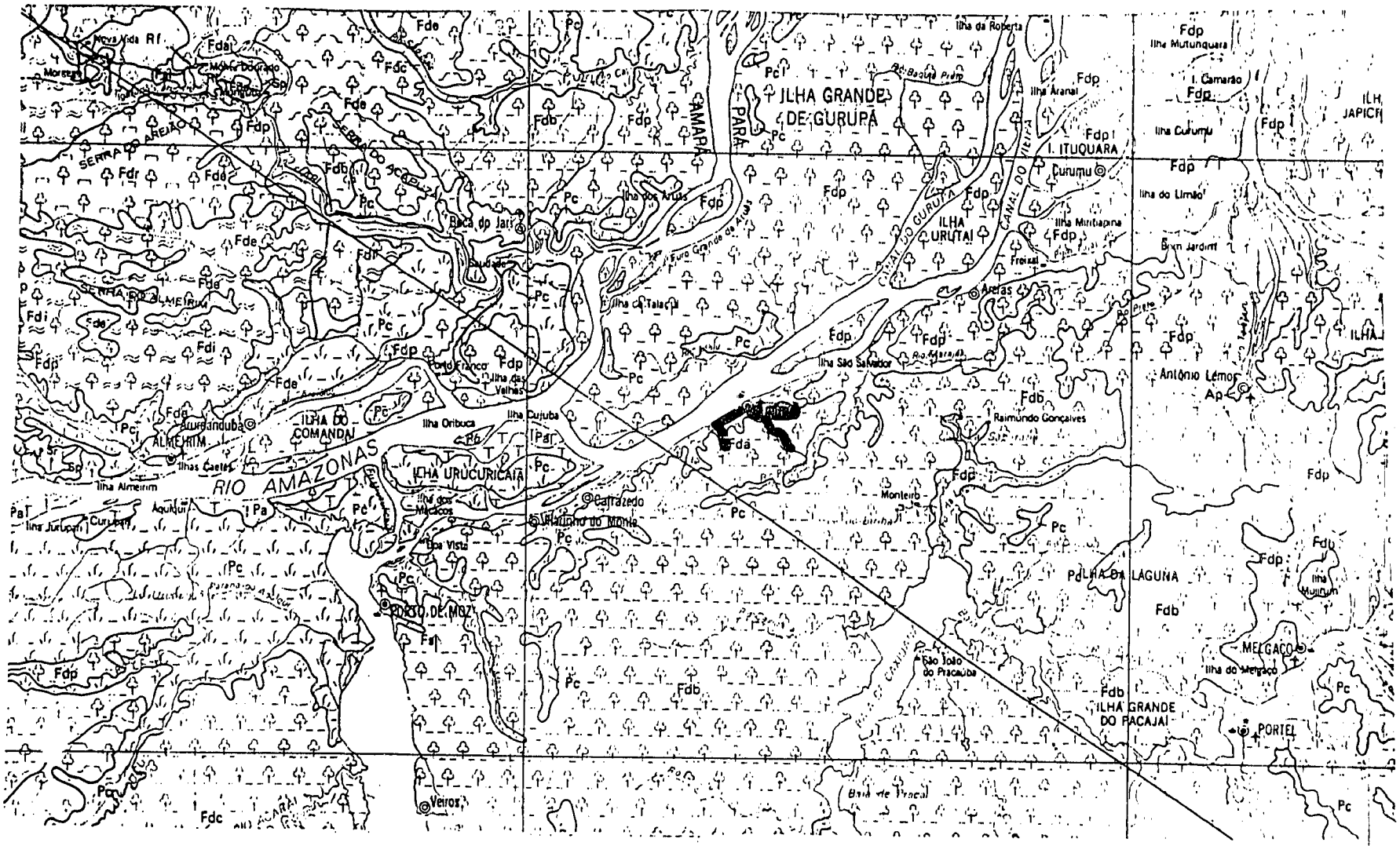
10. Gurupá, PA, BR. Lat. 1°25'S; Long. 51°40'W

Gurupá, Pará state, is just below the mouth of the Xingú river and was choosen instead of Porto de Moz because of facility in transport and because it is reputed to have more peach palm. This area was also suffering from severe drought and very few trees in the town had any fruit, and none had enough for a collection.

On the first afternoon the group went to the Igarapé Gurupá-mirim, where one tree was found with sufficient fruit (058-AID). On the second day the team visited the agricultural settlements of Bacá and Brasília, where 1 and 2 trees, respectively, were found in fruit. All the samples collected were similar to those found in Alenquer, PA, and in general to all those found east of Manacapuru, AM. See Collection data X, Outlines and Photos 058-AID through 061-AID.

Again, fruit number/bunch was reasonable (108), although lower than anywhere else in this regional population; this may, however, have been due to the drought. No trees with

Map showing areas visited in Gurupá, PA, during the first expedition

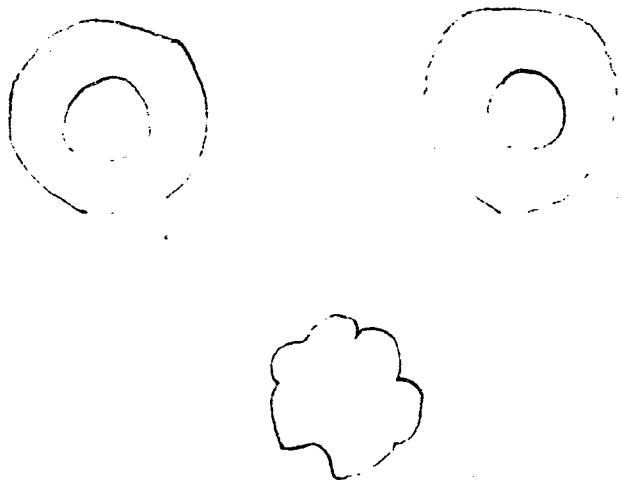


Collection data X

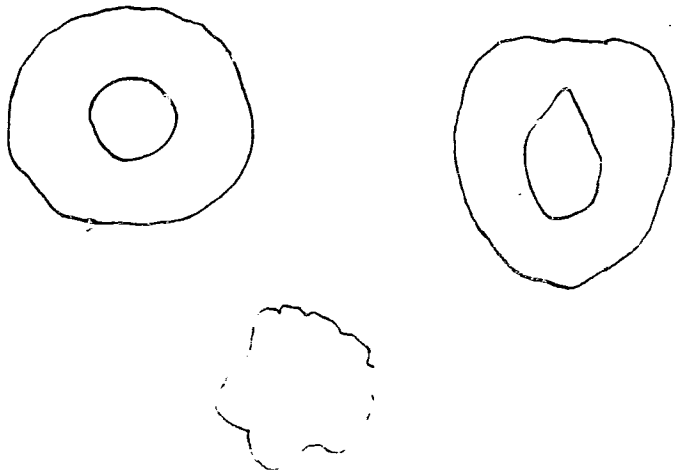
Biased Sampling of Peach Palm in **Gurupá, PA, BR (see Appendix 1 for explanation)**

Character//	Sample-	058	059	060	061	x	SD	CV
1. Spine density on trunk	1.	3	5	5	5			
2. Bunch number/trunk	2.	8	6	6	4	6	1.63	27.22
3. Fruit number/bunch	3.	117	75	132	108	108	24.12	22.34
4. Mature fruit color	4.	2	2	2	3			
5. Cracks in skin of fruit	5.	0	1	0	1			
6. Pulp color intensity	6.	5	5	5	3			
7. Seed position in fruit	7.	5	4	5	5			
8. Quantity of fiber	8.	7	7	7	7			
9. Texture of raw pulp	9.	3	7	5	3			

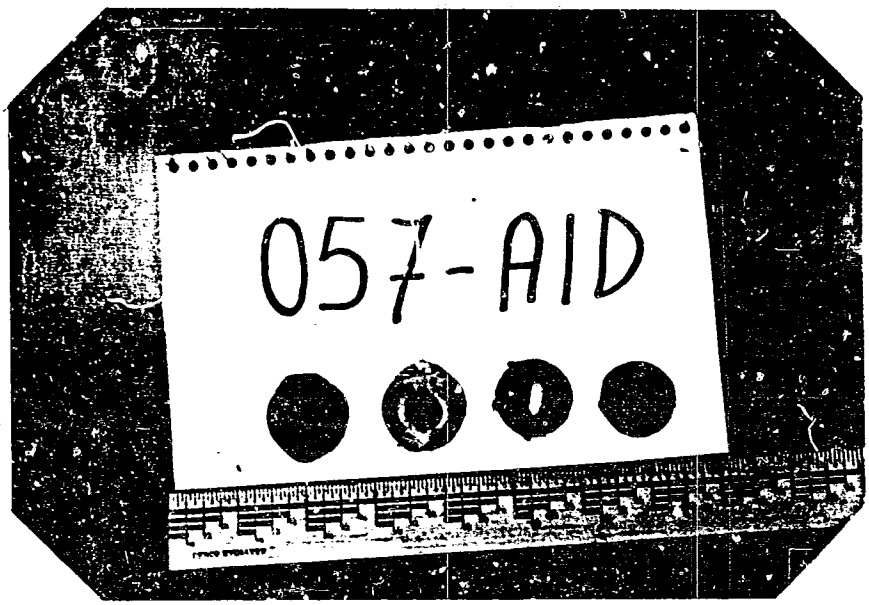
057-AID



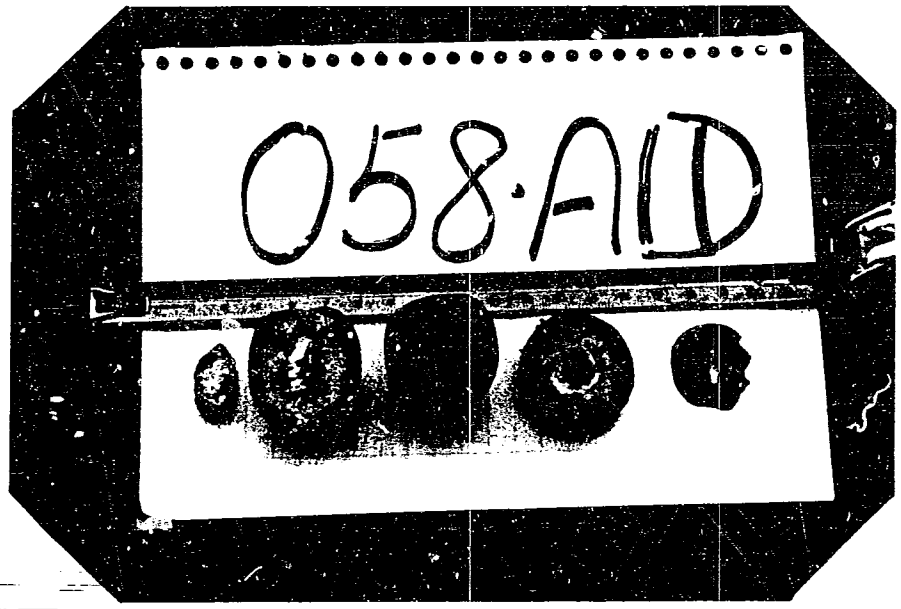
058-AID



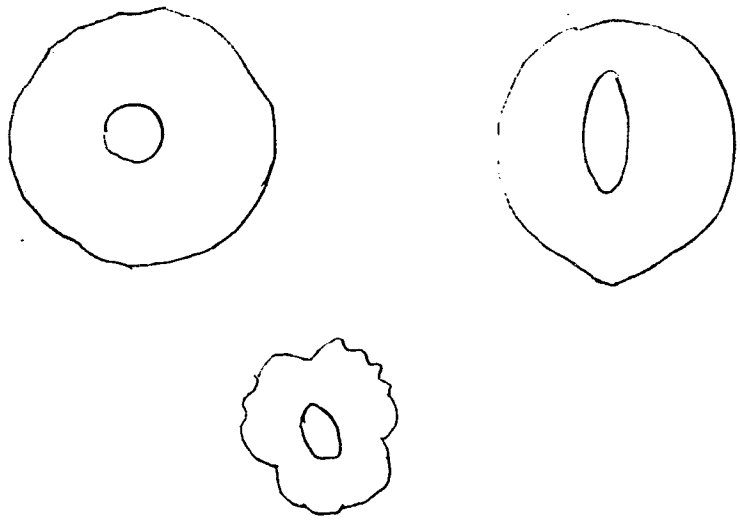
057-AID



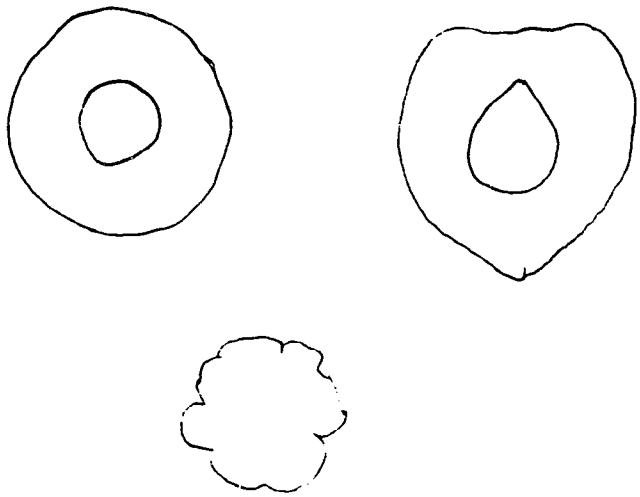
058-AID



059-AID

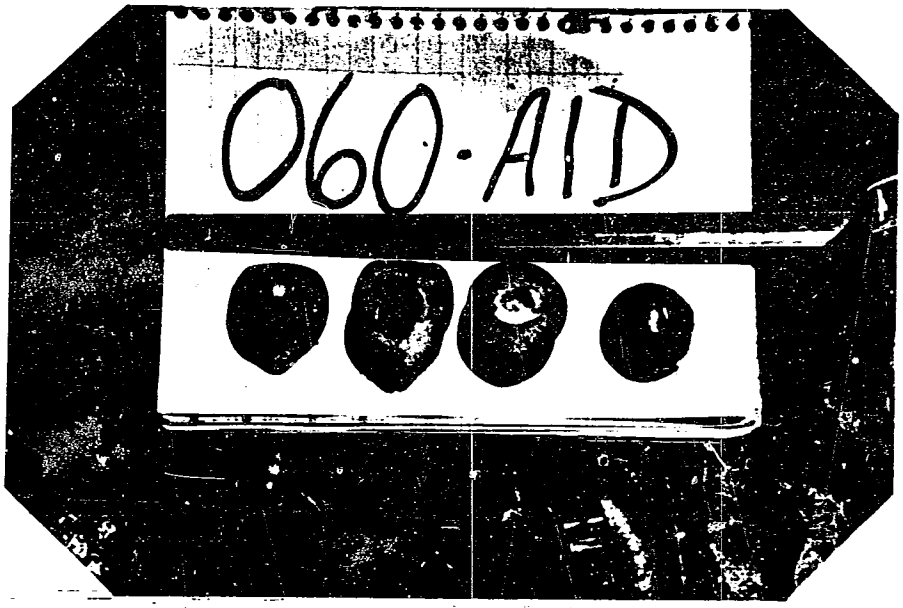


060-AID

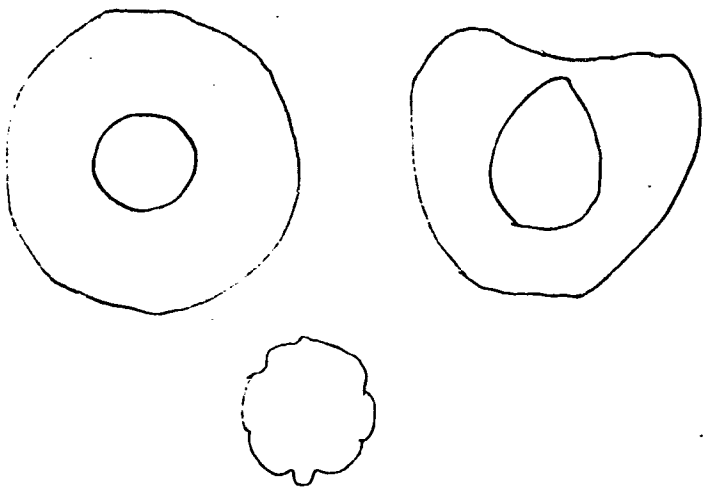


059-AID

060-AID



061-AID



061-AID

spineless trunks were found. All samples were very fibrous, although the fiber did not seem to be tough. Two samples (059-AID and 060-AID) seemed to be somewhat oily.

11. Belém, PA, BR. Lat. 1°28'S; Long. 48°30'W

From Gurupá it proved impossible to get to Cametá, PA, before the deadline for ending the expedition, so that the group flew to Belém. In Belém there were very few bunches available in the markets and those seen were very similar to all previous material seen in Pará and eastern Amazonas. The price was exorbitant (Cr$ 3.000/bunch = US$ 10.70).

V. THE BOTANICAL COLLECTIONS

The botanist J. Tadeu de Medeiros Costa and the woodsman and practical botanist Dionisio F. Coelho accompanied the first expediton to collect Bactris, which is poorly represented in Brazilian and world herbaria; to collect Bactris gasipaes where possible during the experimental sampling; and to observe and collect other palms when time permitted. Frequently these two botanists worked with or near the peach palm collectors and as frequently worked as a separate group. Their Bactris collections and observations were as follows:

1. Tabatinga/Benjamin Constant, AM
   - 1.1. Bactris gasipaes H.B.K. - Terra Firme
   - 1.2. B. concinna Martius - " "
   - 1.3. Bactris sp. (Yuyba group) - " "
   - 1.4. Bactris sp. (Maraja group) - " "
   - 1.5. Bactris cf riparia Martius - Flood- plain
   - 1.6. Bactris cf concinna Martius - " "
   - 1.7. Bactris sp. (Yuyba group) - " "
   - 1.8. Bactris sp. (Maraja group) - " "
2. Fonte Boa, AM
   - 2.1. B. gasipaes H.B.K. - Terra Firme
   - 2.2. B. elegans Barbosa-Rodrigues - " "
   - 2.3. Bactris cf riparia Martius - Flood- plain
3. Tefé, AM
   - 3.1. B. gasipaes H.B.K. - Terra Firme
   - 3.2. B. bifida Martius - " "
   - 3.3. B. pectinata Martius - " "
   - 3.4. B. integrifolia Martius - " "
   - 3.5. Bactris sp. (Maraja group) - " "
   - 3.6. Bactris cf riparia Martius - " "
4. Coari, AM
   - 4.1. B. gasipaes H.B.K. - " "
   - 4.2. Bactris sp. (equal to 1.4.) - " "
   - 4.3. B. concinna Martius - Flood-plain
5. Manacapuru, AM
   - 5.1. B. gasipaes H.B.K. - Terra Firme
   - 5.2. Bactris cf riparia Martius - Flood-plain
6. Itacoatiara, AM
   - 6.1. B. gasipaes H.B.K. - Terra Firme

6.2. B. simplicifrons Martius - Terra Firme
6.3. Bactris aff pectinata Martius - " "
6.4. Bactris sp. (Yuyba group) - " "

7. Parintins, AM
7.1. B. gasipaes H.B.K. - Terra Firme

8. Alenquer, PA
8.1. B. gasipaes H.B.K. - Terra Firme
8.2. Bactris sp. (equal to 6.4.) - " "

9. Gurupá, PA
9.1. B. gasipaes H.B.K. - Terra Firme

10. Belém, PA
10.1. B. gasipaes H.B.K. - Terra Firme
10.2. B. dahlgreniana Glassman - " "

The last collection (10.2.) was from a tree planted by Huber in 1906 at the Museu Paraense Emilio Goeldi, from the collection he had made in Acre state 2 years previously and that had been identified as Guilielma microcarpa Huber. This last collection was the only species found that is closely related to B. gasipaes.

Observations by Costa suggest that Guilielma may really be different enough from Bactris to stand on its own as a separate genus, as Martius suggested. However, since only 2 species of Bactris (Guilielma) have so far been collected, these observations may be somewhat premature.

VI. OBSERVATIONS ON POPULATIONS OF PEACH PALM IN THE BRAZILIAN AMAZON

Dr. J. Mora Urpí has worked for many years attempting to define and differentiate the various regional populations of peach palm. During this expedition Mora Urpí made the following suggestions:

Along the Amazon River, in the Brazilian Amazon, there appear to be 3 regional populations, that may be distinct enough to call "races". There are also 2 centers of hybridization in and around the region's two largest urban centers, Manaus and Belém.

Race nº 1: This race is present in the extreme west of the Brazilian Amazon. During this expedition this race was observed at Tabatinga and Benjamin Constant, but the transition area between it and race 2 was not observed. This transition, either gradual or abrupt, occurs somewhere between Benjamin Constant and Fonte Boa. The main area of occurance of this first race is located outside of Brazil, in northeastern Peru and southeastern Colombia.

This race seems to be perfectly definable geographically and genetically, and presents appreciable variation within the observed limits. Perhaps it will be possible to further sub-divide it after more intensive study. Future electrophoretic investigation may prove the validity of this race.

The most obvious characteristics of this race are:

1. Large to very large fruit size
2. Very starchy mesocarp
3. Mesocarp generally very dry
4. Low quantity of oil in mesocarp
5. Low quantity of fiber in mesocarp
6. Mesocarp generally very firm
7. Mesocarp generally light colored (low carotene)
8. Seed generally free or semi-free from mesocarp
9. Pericarp does not peel easily
10. Parthenocarpic fruits large to very large
11. Fruit size within bunch very uniform
12. Calyx colored in mature fruit
13. Bunches generally very open (loose)
14. Leaves relatively short
15. Leaflets relatively narrow
16. Very susceptible to fruit borers
17. Very susceptible to mites (<u>Retracus johnstoni</u> ?)

The last two characteristics are important because of the great economic importance of the damage caused by these two pests. They also reflect biochemical differences between race nº 1 and the others mentioned here.

Race nº 2: This race is present in the western Brazilian Amazon, observed from Fonte Boa to Manacapuru. From its western transition zone, west of Fonte Boa, this race extends to an eastern transition zone near Manacapuru. The origins of this population are not easy to identify, requiring further expeditions to define the transition zones and possible origins. One possibility is that this race penetrated the Amazon river along the major southern or northern tributaries, which are the Juruá and Purus rivers in the south and the Japurá in the north.

As is the case with race nº 1, this second race seems to be rather easily definable geographically, morphologically and genetically. It is clearly different from race nº 1, with somewhat less variation within it than is the case of race nº 1, although it may be possible to sub-divide this race also.

The most obvious characteristics of this race are:

1. Medium to small fruit size
2. Mesocarp frequently somewhat watery
3. Mesocarp of intermediate firmness
4. Oil quantity intermediate to high in mesocarp
5. Mesocarp texture smooth
6. Fiber quantity intermediate to high in mesocarp
7. Fiber rather fine
8. Mesocarp intense rose to orange color (high carotene)
9. Pericarp peels easily
10. Seed semi-free to rather adherent to mesocarp
11. Parthenocarpic fruit small
12. Calyx generally green in mature fruit
13. Bunches rather compact
14. Fruit size with bunch variable
15. Leaves relatively short
16. Leaflets less narrow
17. Leaflets somewhat leathery
18. Apparently immune to fruit borer
19. Less susceptible to mites (*Retracus johnstoni* ?) than race nº 1

Race nº 3: This race is present in the central and eastern Brazilian Amazon, observed from Itacoatiara, AM, to near Belém, PA. In Rio Preto de Eva, AM (close to Manaus),

the fruit are very similar to those from Chaparé, Bolivia, except for the green calyx, which in Bolivia is nicely colored. Thus, one may suppose that this population is an extention of the Bolivian peach palm, which has been identified in the past as Bactris insignis Mart. However, confirmation of this suppositon must await exploration of the Madeira river, from its mouth near Itacoatiara up through the states of Rondonia and Acre and into Bolivia.

Again, there is considerable variation within the race, although it also appears to be easily defineable geographically, morphologically and genetically.

The most obvious characteristics of this race are:

1. Small to very small fruit
2. Mesocarp varies from watery to dry
3. Oil quantity variable, some very high
4. Fiber quantity high
5. Fiber rather fine
6. Mesocarp generally orange (high carotene)
7. Pericarp peels easily
8. Seed very adherent to mesocarp
9. Parthenocarpic fruit small
10. Calyx always green in mature fruit
11. Bunches rather to very compact
12. Leaves relatively short
13. Leaflets narrow
14. Internodes very long, petiole scar very wide
15. Apparently immune to fruit borer
16. Reasonable resistence to mites (Retracus jonnstoni ?)

Population nº 4: This center of hybridization occurs in and close to Manaus, AM. It is characterized by great variability possibly due to hybridization between peach palms from the different regional races, especially nº2 and nº3, and to germplasm imported from other areas.

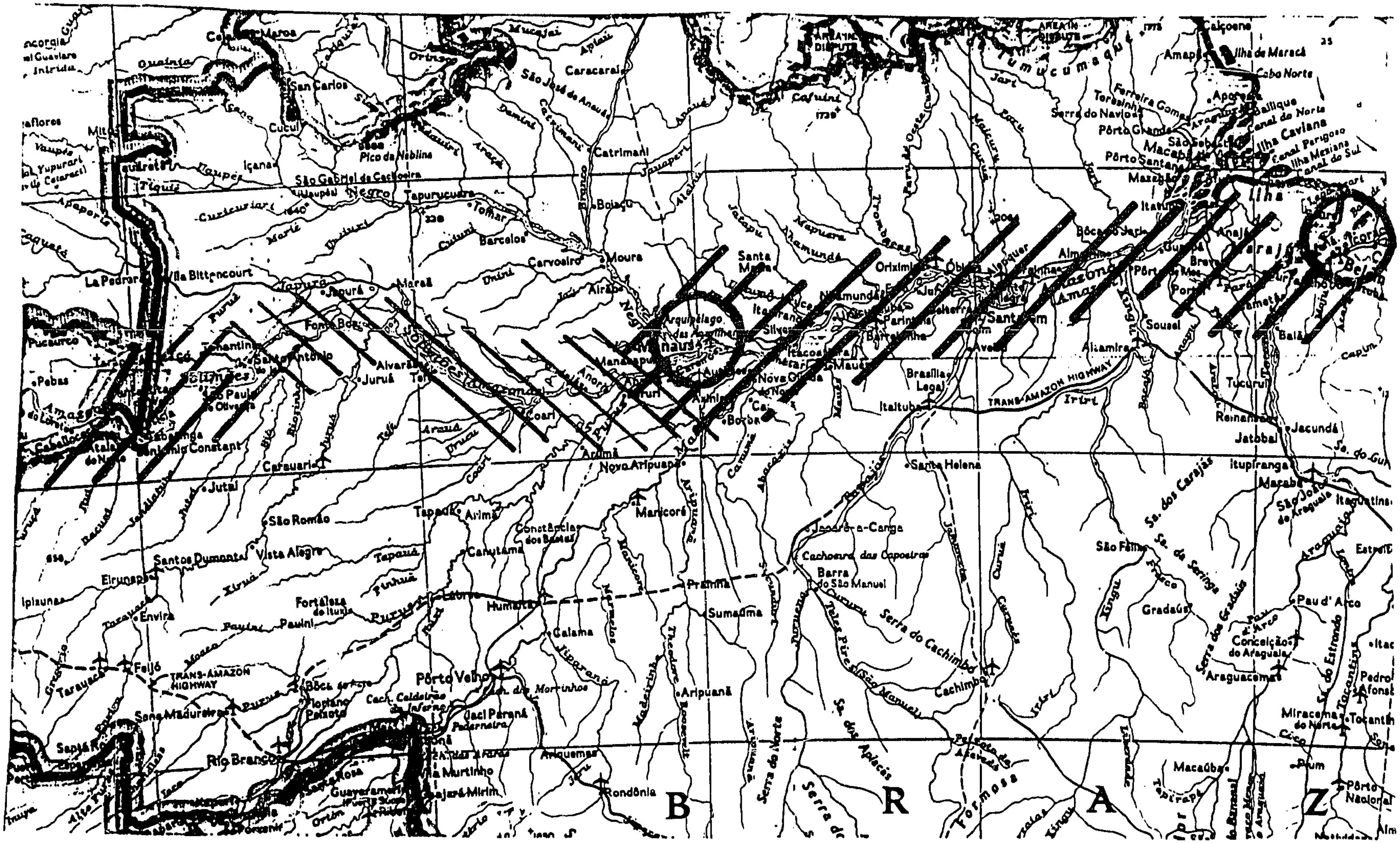
Population nº 5: This center of hybridization occurs in and close to Belém, PA. Although it is an area near the extreme of race nº 3, furthest from race nº 2, there appears to be great variability. Probably most of the introduced material has come from race nº 2.

It would thus appear that the Amazon river in Brazil has not been used continually for the distribution of the different races. The migration of different indian groups are surely the reason for the presence of the different races in the modern distribution and this migration has apparently not been purely west to east, as Bates and Spruce

proposed in the 19th century. The distribution of the races of peach palm, with the migration of different indian groups, would make a very interesting study.

The accompanying map presents the first rough approximation of the peach palm races along the Amazon river in Brazil, as observed by the team of the first expedition.

• Map showing approximate distribution of the peach palm races and hybred populations in the Brazilian Amazon (Mora Urpí)



VII. THE EXPERIMENTAL SAMPLING METHODOLOGY

This methodology was included in this project in an effort to find a way to sample peach palm populations without leaving out material that a breeder would not choose. This is to say that an attempt should be made to avoid biased collecting, so as to obtain a more complete germ plasm collection from any given population. The experiment's objective may be stated as: given that one can not identify all the genes of the species in question, one should attempt to eliminate any bias that arises from the personel prejudices to collect or avoid certain characteristics, which might cause the elimination of unknown genes in low frequency in the population.

Thus a methodology was developed from what little is known about peach palm, to attempt to reduce or eliminate this bias. Although the methodology first developed was statistically adequate, it did not take into account several biological and anthropological factors, such as: 1. pollen dispersal may occur over a maximum distance of 50 to 100 m (Mora Urpí); concentrations of peach palm on one farm may have originated from only one or very few parent plants (Mora Urpí); and frequently the owner will have made a selection for characteristics that he found desireable (Clement).

The original methodology (see Project) was tried in Colonia Bom Jardim, Benjamin Constant, AM, with only very slight modifications (see III.2). However, it was impossible to complete the original sample number of 20, because so much time was devoted to reconnaissance, randomizing the trees to be sampled and relative difficulty of access and distance from one tree to the next. In 51 1/2 man/hours it was only possible to sample 10 trees. B[illegible]se of time limits at all collection sites, this number (10) became the standard. Is this arbitrary number adequate? From the collections made it may be, since none of the populations visited was much more variable than could be sampled in 10 collections during a reconnaissance survey. However, 20 would have given insurance.

Taking into account the observations of Mora Urpí (see above), the second experimental site (Fonte Boa, AM) used a somewhat different methodology. It was found that each farm was far enough apart so that every other one could be defined as a relatively isolated unit in terms of gene flux.

Thus each concentration could be sampled as a sub-unit of the population. Two trees, where possible, were thus sampled from each of these areas, with these trees being choosen at random. This methodology reduced part of the work load, but still took 32 1/2 man/hours, most of which was devoted to describing the samples.

Because this methodology appeared to work rather well, it was also adopted at the third site (Coari, AM). However, at this site there were not enough peach palm with fruit, so that this collection was partially experimental and partially what was available. By chance, during the first 6 collections at this site, no yellow fruited peach palms were sampled, although these were present in fair number.

1. Problems with the methodology:

1.1. Reconnaissance requires a large effort, just to discover if it is possible to sample at the site.

1.2. Generally no firm information is available about the population make-up before-hand, as for example, number of parent plants, their origin, if they were selected, etc.

1.3. Many concentrations or sub-populations have fewer than 10 trees. What to think of their genetic frequencies?

1.4. Frequently concentrations are distant to very distant from each other, and frequently of difficult access, which consumes time.

1.5. Because of time limitations it is impossible to obtain a complete view of any local population, so that it is also impossible to know if the concentrations sampled are representative of the local population.

1.6. It is also imoossible to really decide what is the minimum number of samples to be taken from a concentration or from a local population, given 1.2. and 1.5.

2. Problems with the sampling:

2.1. The list of descriptors was somewhat too extensive for fast sampling and should be revised. However, the information collected is excellent.

2.2. Relying on local collectors often resulted in fruit being scattered all over and occasionally mixing with previously fallen fruit. An attempt should be made to collect whole bunches, even if this should prove more expensive.

2.3. Photographic design of each sample was to

variable.

3. Improvement of the descriptor list

3.1. Eliminate the following descriptors:

nº 2. Medium size of spines (mm)

nº 6. Height of first bunch produced (cm)

nº 31. Skin brilhance

nº 34. Presence of skin blemishes

3.2. Consider the addition of the following descriptors:

1. For nº 21 add: ___ with endocarp; ___ without endocarp.

2. Color of calyx (1. yellow; 2. orange; 3. red; 4. variagated; 5. white; 6. other)

3. Insect attack

4. Fungal attack

5. Rachis weight (gr)

3.3. Reorganize some sections to give a somewhat more logical collecting order to the list.

4. Suggestions

4.1. The experimental methodology should be used in populations that allow its use in an efficient manner. For example: in relatively large plantations where a transect can be used, so as to avoid loss of time with reconnaissance (Mora Urpí).

4.2. When 4.1. is not possible the collection strategy should be based on the "clinical eye" of an experienced peach palm collector(Mora Urpí).

4.3. The "clinical eye" method may be even more valuable for collecting genes in low frequency than the experimental methodology, once it is established that a breeder's bias should be avoided at all costs (Clement).

4.4. Perhaps any walking line through a peach palm population may be considered to be similar to a transect (Pinedo).

4.5. During the beginning and ending of the fruiting season, or during a period of intense harvesting by farmers, the simple finding of a tree with enough fruit to sample is, in itself, a random event. This alone may be a sufficient randomizing factor in many cases (Mora Urpí & Clement).

VIII. THE BIASED SAMPLING METHODOLOGY

This methodology was based on the minimum field descriptor list developed during the 1980 International Peach Palm Genetic Resources meeting in Turrialba, Costa Rica, sponsored by IBPGR, CATIE and GTZ. This descriptor list is extremely easy to use and very fast, however, it does not collect much useable information to define populations in the field. It turns out to be a better plant introduction list than field list. This means that little information can be extracted for analysis until the introduction in the germ plasm bank has grown to production age (about 5 years after collection).

Many of the descriptors from the experimental sampling list appear to have a high genetic correlation.(Mora Urpí). Several of these are relatively easy to obtain and would make useful additions to the list. Other descriptors on the biased list are not descriptive enough, because they bunch together several characteristics, so that these need to be re-thought.

Some additions are:

1. Outline of calyx
2. Presence or absense of leaflet fusion at the base and apex of the leaf
3. Presence of spines on leaflet blade
4. Presence of spines on rachis of leaf
5. Presence of spines on petiole of leaf
6. Presence of spines on spathe
7. Quantity of oil
8. Quantity of starch
9. Quantity of water
10. Color of calyx in mature fruit
11. Number of leaflets
12. Length of leaflets
13. Maximum width of leaflets
14. Length of bunch rachis
15. Total number of spikelets
16. Fertil fruit longitudinal diameter
17. Fertil fruit maximum transversal diameter
18. Fruit weight
19. Mesocarp weight

The desciptor "texture of raw pulp" may be abandoned, as nº 7, 8, and 9 above describe this more adequately when added

to nº 8 from the original biased list (see Appendix I).

Although this extended list will more than double the original short list, it is thought that the increased work will pay off immediately in much more information for use in identifying peach palm populations in the field, rather than having to wait for the germ plasm in the bank to reach maturity.

IX. CONCLUSIONS

The first expedition was a success in various aspects, although less germ plasm was collected than originally planned. The fact that several researchers, with different backgrounds, were able to work together on one species, permitted the development of a strong critical sense about the project and especially the collecting methodologies, which in turn contributed the suggestions that will allow a better collection in 1984.

Aside from the quite valuable germ plasm collected, the first expedition was able to provisionally define 3 regional populations, or races, and 2 populations of great variability that are probably due to hybridization. The western-most race only extends a hundred or so kilometers into Brazil from its major areas of occurence in Peru and Colombia. It is typified by large, very starchy fruit and low fruit number/ bunch. The second race extends from the transitional area between Benjamin Constant and Fonte Boa eastwards to near Manacapuru, AM. It is typified by intermediate to smallish fruit, high fruit number/bunch and high bunch weight. The eastern-most race extends from near Manacapuru to the Belém, PA, area. It is typified by small fruit, high fruit number/ bunch, very fibrous fruit and frequent oiliness. Two hybrid populations occur in and around the urban centers of Manaus, AM, and Belém, PA. In the case of Manaus, it appears to be a transitional zone between the second and eastern-most races, further influenced by importat of germ plasm from other areas. The case of Belém appears to be due to extensive importation of germ plasm into an area of the eastern-most race.

In the western part of the Brazilian Amazon the germ plasm collected appeared to represent rather well the variability found in each area. However, in the eastern part an unseasonable and extreme drought had reduced or eliminated production in all areas visited, so that the regional variability was not easily visible nor collectable. Thus, this region will have to be resampled in order to obtain representative germ plasm. Hopefully INPA and CENARGEN will be able to organize this during the next non-drought normal season.

The two collection methodologies used both presented

several defects as well as several advantages. The experimental sampling methodology proved to be extremely time consuming with respect to selection of the plants to be sampled. Because of possible selection pressures in each concentration of peach palm and because of the short distance of pollen dispersal, alternate methodologies will have to be studied to sample more efficiently. The descriptor list for the experimental sampling proved to be somewhat too long, but did allow for the collection of excellent information for use in population characterization. The biased sampling methodology proved to be extremely rapid in execution but the descriptor list was too short to be of much use in describing populations. In the third and fourth expeditions in 1984 these lists will be modified to improve efficiency in collecting.

In general the first expedition attained its objectives, although it did not collect as much germ plasm as had been planned. There were some problems in the organization, due to lack of knowledge of conditions in some areas, principally in the eastern part of the region. However, these problems did not seriously hamper the expedition, especially when compared to the effect of the drought in the eastern region. The fact that the expedition was composed of a geneticist and a botanist, as well as several agronomists, a biologist and a forester, allowed a much better interpretation of the material collected and the populations visited.

Further study of the collected material, in the phytochemistry laboratory at INPA, the herbarium of the Federal University of Pernambuco, the electrophoresis laboratory at CENARGEN and in the various nurseries and germ plasm banks of the participating countries, should produce much valuable and additional information about this germ plasm and the populations from which it came.

ACKNOWLEDGEMENTS

The expedition participants wish to thank all those who collaborated on this project so that it could attain the level of success that we think it has. Specifically we would like to thank the following people and groups:

Dr. Lidio Coradin, Co-Director of the project, and Dr. Eurico Rocha, of CENARGEN, for their organizational abilities and tireless efforts to get the expedition finances ready for day 1.

Engº Agrº Liberato Viana Barroso, President of EMATER-AM, and all the agronomists and technicians at the local offices of EMATER-AM in Tabatinga, Benjamin Constant, Fonte Boa, Tefé, Coari, Manacapuru, Itacoatiara and Parintins, for their advise and logistic assistence, without which the expedition would not have succeeded.

Engº Agrº Valter Cassiano Ferreira, President of EMATER-PA, and the agronomists and technicians of the local office of EMATER-PA in Santarém, for their advise and logistic assistence.

Engº Agrº Isaías Pereira Guimarães, President of ITERAM, and the technicians of this institute that helped organize the maps for the expedition.

Engº Agrº Wanders B. Chaves Flores, of INPA, for continuing and completing the organization of the second expedition while we collected peach palm.

Appendix 1 - Biased collection descriptor list - explaination

1. The first page of this descriptor list is devoted to passport information and general information and observations. It includes one item on ecology but in general this item is almost always answered as: active farm or backyard.

2. The second page is devoted to fruit descriptors based on the minimum field descriptor list developed at the 1º International Peach Palm Genetic Resources Meeting in 1980. These descriptors are as follows:

   2.1. Spine density on trunk. The descriptor states are subjective, except for the first. These are: 0 - without spines; a 1 to 9 scale where 3 - few; 5 - intermediate; 7 - many.

   2.2. Bunch number/trunk. The number of bunches produced per trunk in the clump (average) during that year or present at that moment.

   2.3. Fruit number/bunch. The number of fruit counted in the bunch collected or in the largest of the bunches collected.

   2.4. Mature fruit color. The descriptor states are not very precise. There are: 1. yellow ; 2. red; 3. others, with space for specification.

   2.5. Cracks in skin of fruit. The descriptor states are: 0. absent; 1. present.

   2.6. Pulp colour intensity. The descriptor states are subjective using a 1-9 scale, where 3 - palid; 5 - intermediate; 7 - red.

   2.7. Seed position in fruit. The descriptor states are subjective using a 1-9 scale, where 3- basal; 5 - central; 7 - apical.

   2.8. Quantity of fiber. The descriptor states are subjective using a 1-9 scale, where 3 - little; 5 - intermediate; 7 - a lot.

   2.9. Texture of raw pulp. The descriptor states are subjective using a 1-9 scale, where 3 - soft; 5 - intermediate; 7 - hard.

   2.10. Two fruit outlines are traced

      a. Longitudinal diameter: showing outline; seed position; seed outline.
      b. Maximum transversal diameter: showing fruit outline; seed position.

Appendix 2 - Experimental sampling collection descriptor list - explaination.

1. The first section of the first page is dedicated to the passaport information. No ecological information is collected on this data sheet.

2. The second section is divided into sub-sections with each containing a list of descriptors. These are as follows:

The Tree.

2.1. Spine density in 5 cm^2. The spines are counted in a 5 cm^2 area on the internode closest to 150 cm above ground level.

2.2. Medium size of spines (mm). All spines from 2.1. are measured and averaged.

2.3. Trunk DBH (mm). Trunk diameter at breast height is taken as a circunference that is then divided by pi in the laboratory.

2.4. Trunk colour. The descriptor states are not precise and range along a 1-9 scale from 1 - white; 3 - grey; 5 - brown; 7 - green.

2.5. Length of 5 internodes (cm). The measurement is taken from the point of insertion of a lower leaf to the same point 5 internodes above.

2.6. Height of first bunch produced (mm). This proved nearly useless, as the owners were either not present or did not remember well.

The Leaf.

2.7. Number of leaves. 2 people counted the leaves of the crown to get a consensus.

2.8. Number of leaflets. All leaflets on one side were counted and multiplied by 2. Occasionally all leaflets were counted.

2.9. Medium length of leaflets (mm). 6 leaflets from the mid-area were measured and averaged. These were the 1st leaflets from the 6th right; 8th left; 10th R; 12 th L; 14th R and 16th L grouping.

2.10. Medium width of leaflets (mm). The maximum width of the same 6 leaflets from 2.9. were averaged.

2.11. Spines on leaf petiole. A 1-9 scale was used with 3 - few; 5 - intermediate; 7 - many.

2.12. Spines on leaflet blade. A 1-9 scale was used as in 2.11.

The Bunch.

2.13. Spines on spathe. A 1-9 scale was used as in 2.11.

2.14. Length of bunch stalk (mm). This was measured from the point of insertion to the first spikelet.

2.15. Length of bunch rachis (mm). This was measured from the first spikelet to the point of the terminal spikelet.

2.16. Total number of spikelets. All developed spikelets were counted.

2.17. Number of fruited spikelets. All spikelets that had fruit at the time of collection were counted.

2.18. Percentage of fruited spikelets. 2.17 divided by 2.16 multiplied by 100.

2.19. Total bunch weight (gr.). The bunch was weighed on a scale that had gradations of 20 gr.

* Rachis weight (gr.). This descriptor was not obtained in the field, rather it was calculated in the lab. Errors in other measurements caused errors in the calculation of this descriptor, so that this has little validity.

The Fruit.

2.20. Number of fertil fruits. All fruit with seed were counted.

2.21. Number of parthenocarpic fruit. All fruit without seed were counted.

2.22. Fertil fruit outline. Two fruit outlines were traced:

a. Longitudinal diameter: showing fruit outline; seed position; seed outline.

b. Maximum transversal diameter: showing fruit outline; seed position.

2.23. Longitudinal diameter of 2.22 (mm). This was measured from the calyx to the apice of fertil fruit. An average of 10 fruit.

2.24. Max. transversal diameter of 2.22 (mm). This was measured where fertil fruit was thickest. An average of 10 fruit.

2.25. Ratio 2.24/2.23.

2.26. Compare form with standards. This descriptor was not used. The standard will be prepared based upon the collections.

2.27. Calyx outline. A randomly choosen calyx was traced.

2.28. Compare form with standards. As in 2.26.

2.29. Mature fruit colour (skin). This descriptor is subjective, since the Munsell Colour Chart for Plant Parts does not contain the necessary colours. The descriptor states are: 1 - yellow; 2 - orange; 3 - red; 4 - white; 5 - brown; 6 - striped; 7 - other.

2.30. Sequence of colour change in maturation. This descriptor seeks to define the sequence of colour change during the maturation process. The descriptor states are: 1. from the fruit base to the apex; 2. from the center to the base and apex; 3. from the apex to the base; 4. irregular.

2.31. Skin brilhance. This descriptor seeks to define the shinyness or brilhance of the fruit skin. The descriptor states use the scale 1 - 9, where 3 - dull; 5 - intermediate; 7 - shiny.

2.32. Cracks in skin. This descriptor seeks to define skin cracks that are genetic in origin. The 2 descriptor states are 0 - absent; 1 - present.

2.33. Distribution of skin cracks. The descriptor states are 1 - basal; 2 - central; 3 - apical; 4 - complete or covering the whole fruit; 5 - irregular.

2.34. Presence of skin blemishes. This descriptor seeks to identify the presence of skin marks that may be genetic (rare), or due to insect or disease. The descriptor states are 0 - absent; scale 1 - 9 with 3 - few; 5 - intermediate; 7 - many.

2.35. Medium weight of fertil fruits (gr.). All fruit are weighed and the average is taken.

2.36. Medium weight of parthenocarpic fruits (gr.). As in 2.35.

2.37. Percentage of fertil fruits.

2.38. Percentage of parthenocarpic fruits.

The Mesocarp.

2.39. Color of raw mesocarp. As in 2.29. with the following descriptor states: 1 - white; 2 - creme; 3 - yellow; 4 - rose; 5 - orange; 6 - red. A combination may also be used.

2.40. Texture of raw mesocarp. A subjective descriptor with the following descriptor states: 1 - watery; 2 - starchy; 3 - oily; 4 - fibrous. The predominate factor or 2 factors are choosen that best describes the fruit.

2.41. Adherance of seed to mesocarp. This descriptor seeks to suggest the degree to which the seed and the mesocarp adhere to one another. The descriptor states are on a 1 to 9 scale where 3 - loose; 5 - intermediate; 7 - firmly adhering.

2.42. Medium weight of mesocarp (gr.). Ten fruit are weighed after removal of the seed and the average is taken.

2.43. Percentage mesocarp/fruit weight. 2.42. divided by 2.35 multiplied by 100.

The Seed

2.44. Seed outline. See 2.22

2.45. Medium weight of seed (gr.). One hundred seed are weighed and the average is taken.

2.46. Percentage seed/fruit weight. 2.45. divided by 2.35 multiplied by 100.