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INTRODUCTION OF TROPICAL AND SUBTROPICAL
FRUIT AND NUT TREES
TO
TUTUILA, AMERICAN SAMOA

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ABSTRACT

A disparity exists between the number of fruit tree species that can thrive in American Samoa and the number of fruit tree species now present. This study was undertaken to introduce new tropical and subtropical fruit and nut trees to the Territory, evaluate their performance, and distribute them to the public. Tree seedlings were planted at 60, 120, and 360 meter elevations to determine the effects of climate and soil type on growth rate, time of flowering, yield, and pest incidence. Growth rate, yield, and susceptibility to pests were similar at all sites, but trees at the 360 m elevation generally bore fruit weeks to months before trees at the 60 m elevation. The tree species have the potential to grow well anywhere in the Territory and to fit in well with traditional agricultural methods.

In an effort to improve the economy, food self-sufficiency, and diet of American Samoans, a pilot project was begun in 1984 to introduce 25 species of tropical and subtropical fruit and nut trees, representing 13 Families, on Tutuila, the largest and most populous of the Territory's 7 islands

The objectives were to obtain information on the adaptability of the newly introduced trees; determine the effects of micro-climate on such characteristics as growth rate, time of flowering, and yield; document the prevalence of pests and diseases; and evaluate the market demand for the produce.

Because, administratively, the study was limited to 5 years, and most trees require 5 or more years from planting to first fruiting, the final objective, that is, evaluating market demand, was not met. However, the study is continuing on an informal basis with the objective of propagating the more popular and prolific tree species through air-layering and other means for distribution to the public.

This report describes the potentials and the constraints for growing several fruit tree species in American Samoa.

MATERIALS AND METHODS

Tropical and subtropical fruit and nut seedlings were obtained from the Western Samoa Department of Agriculture and from Frankie's Nursery, 95-139 Kapawa Place, Mililani Town, HI 96789, in December, 1984. The latter were air-freighted to American Samoa by Hawaiian Airlines. Because of the heavy Christmas holiday traffic, many seedlings perished and others were severely

stressed while awaiting shipment in Hawaiian Airline's Honolulu warehouse. A list of the tree species for the study is given in Tables 1 and 2

Six sites were chosen for establishing these mixed species orchards based on differences in elevation, soil type, and topography (Figure 1). Trees were planted on a rectangular grid at a 6.1 m x 7.3 m (20 ft x 24 ft) spacing using temporarily idled laborers from the local Van Camp tuna cannery, a subsidiary of the Ralston Purina Company. Because of the loss of seedlings during shipment, not all species were planted at each site (Table 3).

The trees were initially fertilized using a single 9 g tablet of 18-8-3 slow-release fertilizer containing magnesium (Agriform Forest Starter Tablets, A.H. Hummert Seed Co., 2746 Chouteau Avenue, St. Louis, MO 63103), then again 2 years later using 2 tablets per tree

Soon after the 6 sites were established it became apparent that manpower and other resource limitations would confine observations to 3 sites only sites B, C, and D at 120 m, 360 m, and 60 m elevations, respectively. Detailed maps were drawn in December, 1986 of surviving trees (Figures 2, 3, and 4)

Between May, 1985 and December, 1988, 5 to 7 measurements of tree growth in height and in girth (circumference) were recorded, along with information about flowering, fruiting, yields, pests, vigor, and other characteristics

RESULTS AND DISCUSSION

Growth rates in height (m yr^{-1}) and in circumference (cm yr^{-1}) for all trees at the 3 sites are given in Table 4. By far the fastest growing trees at any elevation belonged to the Annonaceae Family and included rollinia and soursop. These trees were among the first to bear fruit, also. Perhaps because of their rapid growth, rollinia and soursop trees were susceptible to

lodging; several were toppled by the wind at each site. Figure 5 shows the growth rates for soursop trees at the 3 sites. A one-way analysis of variance (ANOVA) indicates no significant differences in either height or circumference growth rates at the 3 elevations.

Similarly, Figure 6 shows the height growth rates for all citrus trees at the 3 sites. A one-way ANOVA again indicates there is no significant difference in growth rates at the 3 elevations. No corresponding comparison in the circumference growth rates was done because of the difficulty in obtaining consistent and reliable measurements of girth in these profusely branching tree species.

The wampi is the slowest growing tree among the citrus, but there is no particular species that stands out for its rapid growth

Fruit trees generally require 3 to 10 years from planting to fruiting, depending upon the species and the environment. Table 5 lists 12 of the 25 species introduced into American Samoa in 1985 that were fruiting by 1989, that is, within 4 years after planting. Generally, trees at the highest elevation fruited weeks to months before those at the lowest elevation. However, yields seemed comparable at any elevation. Yields ranged from a few fruits (black sapote, grapefruit, and tamarind) to several dozen (acerola cherry, carambola, and rollinia) on seasonally producing trees. The soursop ('sasa lapa' in Samoa), however, consistently produced a dozen or more fruits year-round.

Table 6 lists several insect pests which attack the foliage or the fruit of several tree species, particularly citrus trees. By far the most destructive pest is the Fruit-piercing moth (Othreis fullonia). On one carambola

tree at site D, virtually every of dozens of fruit was ruined by this moth, which is also a major pest of tomato, green pepper, and eggplant.

In addition to the insect pests listed in Table 6, four species of fruit flies are present in the Territory: Dacus distinctus, D. kirki, D. obscurus, and D. xanthodes (Tamiya, et al., 1985). Though these have not been observed to attack fruit trees at the 3 sites, they remain potentially serious pests, particularly if American Samoa ever becomes a fruit exporter.

The thrust of this fruit tree project is now propagation and distribution of trees to homeowners and farmers. Samoans traditionally incorporate trees such as coconut (Cocos nucifera) and breadfruit (Artocarpus communis Forst.) around their homes and in taro (Colocasia esculenta (L.) Schott) and banana (Musa spp.) plantations. Introducing these tropical and subtropical fruit trees could be successfully achieved any place in the Territory. The fruits could be used for personal consumption and sold in the market to offset the Territory's dependency on imported, temperate climate fruits.

Meanwhile, studies will continue to induce flowering in trees not yet fruiting and in finding low input, low cost means of controlling pests

ACKNOWLEDGEMENTS

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REFERENCE

Tamiya, A.N., R.M. Kobayashi, R.K. Kunishi, and W. Snell, 1985. Personal Communication to A. Vargo.

Table 1. List of tropical and subtropical fruit and nut trees planted on Tutuila, American Samoa. List is alphabetized by common name.

COMMON NAME	BOTANICAL NAME	FAMILY
CARAMBOLA	<i>Averrhoa carambola</i> L.	Oxalidaceae
CHERRY, ACEROLA	<i>Malpighia glabra</i>	Malpighiaceae
CHERRY, SURINAM	<i>Eugenia uniflora</i>	Myrtaceae
DURIAN	<i>Curio zibethinus</i> (L.) Murr.	Bombacaceae
GRAPEFRUIT	<i>Citrus paradisi</i> Macf.	Rutaceae
GRUMICHAMA	<i>Eugenia dombeyi</i>	Myrtaceae
JACKFRUIT	<i>Artocarpus integra</i>	Moraceae
LEMON	<i>Citrus limon</i> (L.) Berm.f.	Rutaceae
LIME	<i>Citrus aurantiifolia</i> (Christmann) Swingle	Rutaceae
LONGAN	<i>Euphoria longan</i> (Lour.) Steud.	Sapindaceae
LOQUAT	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Rosaceae
LYCHEE	<i>Litchi chinensis</i> Sonn.	Sapindaceae
MACADAMIA	<i>Macadamia integrifolia</i>	Proteaceae
ORANGE, SWEET	<i>Citrus sinensis</i> (L.) Osbeck	Rutaceae
PUMMELO	<i>Citrus grandis</i> (L.) Osbeck	Rutaceae
RAMBUTAN	<i>Nephelium lappaceum</i> L.	Sapindaceae
ROLLINIA	<i>Rollinia delisiosa</i> , Safford	Annonacea
SAPOTE, BLACK	<i>Diospyros ebenaster</i> Retz.	Ebenaceae
SAPOTE, WHITE	<i>Casimiroa edulis</i> Llave and Lex.	Rutaceae
SOURSOP	<i>Annona muricata</i> L.	Annonaceae
SUGAR APPLE	<i>Annona squamosa</i> L.	Annonaceae
TAMARIND	<i>Tamarindus indica</i> L.	Leguminoseae
WAMPI	<i>Clausena lansium</i> (Lour.) Skeels	Rutaceae

Table 2. List of tropical and subtropical fruit and nut trees. The list is alphabetized by Family.

COMMON NAME	BOTANICAL NAME	FAMILY
ROLLINIA	Rollinia delisiosa, Safford	Annonaceae
SOURSOP	Annona muricata L.	Annonaceae
SUGAR APPLE	Annona squamosa L.	Annonaceae
DURIAN	Durio zibethinus (L.) Murr.	Bombacaceae
SAPOTE, BLACK	Diospyros ebenaster Retz.	Ebenaceae
TAMARIND	Tamarindus indica L.	Leguminosae
CHERRY, ACEROLA	Malpighia glabra	Malpighiaceae
JACKFRUIT	Artocarpus integra	Moraceae
CHERRY, SURINAM	Eugenia uniflora	Myrtaceae
GRUMICHAMA	Eugenia dombeyi	Myrtaceae
CARAMBOLA	Averrhoa carambola L.	Oxalidaceae
MACADAMIA	Macadamia integrifolia	Proteaceae
LOQUAT	Eriobotrya japonica (Thunb.) Lindl.	Rosaceae
GRAPEFRUIT	Citrus paradisi Macf.	Rutaceae
LEMON	Citrus limon (L.) Berm.f.	Rutaceae
LIME	Citrus aurantiifolia (Christmann) Swingle	Rutaceae
PUMMELO	Citrus grandis (L.) Osbeck	Rutaceae
SAPOTE, WHITE	Casimiroa edulis Llave and Lex.	Rutaceae
SWEET ORANGE	Citrus sinensis (L.) Osbeck	Rutaceae
WAMPI	Clausena lansium (Lour.) Skeels	Rutaceae
LONGAN	Euphoria longan	Sapindaceae
LYCHEE	Litchi chinensis	Sapindaceae
RAMBUTAN	Nephelium lappaceum L.	Sapindaceae
SAPODILLA	Manilkara zapota	Sapotaceae

Table 3. The types and numbers of tropical and subtropical fruit and nut trees planted at 6 sites on Tutuila, American Samoa. Sites are identified in Figure 1.

COMMON NAME	SITES						TOTALS
	A	B	C	D	E	F	
CARMABOLA	2	2	0	2	1	1	8
CHERRY	3	2	1	2	1	1	10
DURIAN	0	0	0	2	1	0	3
GRAPEFRUIT	2	1	0	3	1	1	8
GRUMICHAMA	2	0	0	2	1	1	6
JACKFRUIT	0	0	0	1	0	0	1
LEMON	3	2	1	0	2	2	10
LIME	0	2	1	5	1	1	10
LONGAN	0	0	1	0	1	0	2
LOQUAT	0	0	2	2	1	0	5
LYCHEE	0	1	2	1	0	0	4
MACADAMIA	0	0	2	0	2	3	7
ORANGE, BLOOD	3	1	0	2	1	1	8
ORANGE, MANDARIN	4	1	2	4	2	4	17
ORANGE, NAVEL	0	0	0	1	0	1	2
POMPEMOUS	0	0	1	1	1	0	3
PUMMELO	1	2	2	7	1	1	14
RAMBLTAN	0	0	0	1	0	0	1
ROLLINIA	2	1	3	3	1	1	11
SAPODILLA	1	0	2	3	1	1	8
SAPOTE, BLACK	2	1	2	2	1	1	9
SAPOTE, WHITE	2	1	1	1	1	0	6
SOURSOP	3	4	1	7	1	1	17
SUGAR APPLE	0	1	0	0	1	1	3
TAMARIND	0	1	0	1	1	0	3
WAMPI	1	1	1	2	1	1	7
TOTALS	31	24	25	55	25	23	183

Table 4.

Growth rates in height (m yr^{-1}) and in circumference (cm yr^{-1}) for all three sites. Data are arranged by elevation (ELEV), given in meters, and are sorted according to growth rate in height. Growth rates represent the differences between the first and the last measurements over 4 years.

TREE NAMES	GROWTH RATES	ELEV
REAL MACADAMIA	0	360
SAPODILLA	0	360
DOMBET	0.05	360
LYCHEE	0.05	360
SAPODILLA	0.15	360
WANGI	0.15	360
WHITE SAPOTE	0.15	360
SURINAM CHERRY	0.30	360
BLACK SAPOTE	0.30	360
MAKIAH MACADAMIA	0.30	360
LOJAT	0.36	360
LYCHEE	0.36	360
TAHITI LIME	0.45	360
POMPLEMUS	0.45	360
CHANDLER PUMPELO	0.54	360
LONGAN	0.54	360
METER LEMON	0.54	360
DINAWA TANGERINE	0.54	360
ROLLINIA	0.63	360
ROLLINIA	0.72	360
BLACK SAPOTE	0.76	360
CHANDLER PUMPELO	0.90	360
DANSA TANGERINE	0.91	360
SOURSOP	0.92	360
ROLLINIA	1.37	360
DOMBET	0.13	120
WANGI	0.16	120
SUGAR APPLE	0.25	120
WHITE SAPOTE	0.26	120
BLACK SAPOTE	0.38	120
TAHITI LIME	0.40	120
BLOOD ORANGE	0.42	120
CARAMBOLA	0.50	120
DOMBET	0.50	120
SURINAM CHERRY	0.50	120
SURINAM CHERRY	0.50	120
TAMARIND	0.50	120
CARAMBOLA	0.58	120
LISSON LIME	0.58	120
METER LEMON	0.58	120
LISEON LEMON	0.67	120
SOURSOP	0.75	120
SOURSOP	0.75	120
CHANDLER PUMPELO	0.84	120
LYCHEE	0.84	120
SOURSOP	1.01	120
CHANDLER PUMPELO	1.01	120
DINAWA TANGERINE	1.09	120
PINK GRAPEFRUIT	1.09	120
SOURSOP	2.02	120
ROLLINIA	2.83	120
DOMBET	0	60
SAPODILLA	0.18	60
WANGI	0.28	60
PINK PUMPELO	0.33	60
FATCHILD PUMPELO	0.37	60
WANGI	0.37	60
LISSON LIME	0.47	60
SAPODILLA	0.47	60
AISJAO	0.56	60
CHANDLER PUMPELO	0.56	60
SOURSOP	0.56	60
WASHINGTON MAYEL	0.56	60
SOURSOP	0.60	60
LIME	0.65	60
SAPODILLA	0.65	60
CHANDLER PUMPELO	0.75	60
MINEOLA TANGERINE	0.75	60
MINEOLA TANGERINE	0.75	60
SOURSOP	0.75	60
PINK GRAPEFRUIT	0.84	60
PINK PUMPELO	0.84	60
ACEROLA CHERRY	0.90	60
SURINAM CHERRY	0.90	60
LISSON LIME	0.94	60
LISSON LIME	0.94	60
LYCHEE	0.94	60
MAKIAH GRAPEFRUIT	0.94	60
DINAWA TANGERINE	0.94	60
PINK GRAPEFRUIT	0.94	60
SOURSOP	0.94	60
BLACK SAPOTE	1.03	60
BLOOD ORANGE	1.03	60
BANGUTAN	1.03	60
SOURSOP	1.03	60
SOURSOP	1.03	60
WHITE SAPOTE	1.03	60
LIME	1.12	60
SOURSOP	1.12	60
TAMARIND	1.12	60
DURIAN	1.21	60
CARAMBOLA	1.22	60
DINAWA TANGERINE	1.22	60
PINK PUMPELO	1.22	60
POMPLEMUS	1.22	60
BLACK SAPOTE	1.31	60
BLOOD ORANGE	1.31	60
CHANDLER PUMPELO	1.31	60
DURIAN	1.31	60
LOJAT	1.31	60
ROLLINIA	1.31	60
LOJAT	1.36	60
CARAMBOLA	1.41	60
JACKFRUIT	1.74	60
ROLLINIA	1.81	60
ROLLINIA	4.68	60

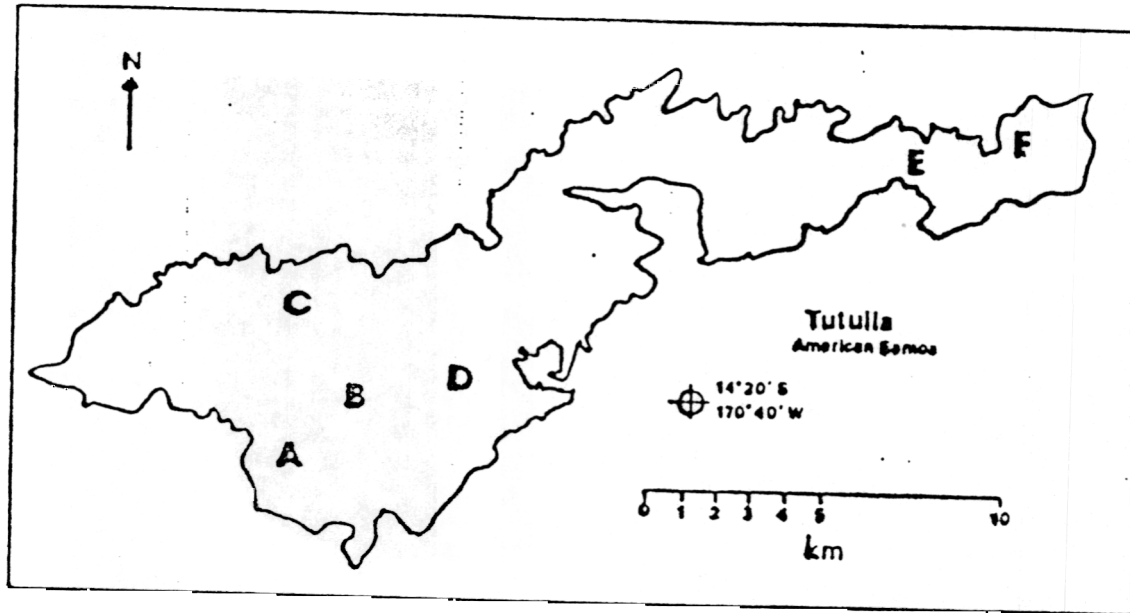
Table 5. Tropical and subtropical fruit trees, planted in 1985, that were bearing by 1989.

<u>TREE</u>
Acerola Cherry
Black Sapote
Carambola
Grapefruit, Marsh
Grapefruit, Pink
Lemon, Lisbon
Rollinia
Sapodilla
Soursop
Surinam Cherry
Tamarind
Tangerine, Okinawa

Table 6. Pests of fruit trees. These pests were observed at all 3 tropical and subtropical fruit orchard sites on Tutuila, American Samoa.

<u>TREE</u>	<u>PEST</u>
Carambola	fruit-piercing moth (<u>Othreis fullonia</u>)
Citrus	fruit-piercing moth (<u>Othreis fullonia</u>) hemispherical scale (<u>Saissetia coffeae</u> (Walker)) leafminer (<u>Phyllocnistis citrella</u> (Stnt.)) snow scale (<u>Unaspis citri</u>) white fly (<u>Dialerodes citri</u>)
Loquat	rose beetle (<u>Adoretus versutus</u>)
Lychee	rose beetle (<u>Adoretus versutus</u>)
Rambutan	rose beetle (<u>Adoretus versutus</u>)
Soursop	mealybug (<u>Ferrisia virgata</u> (Cockerell))?

Figure 1. Planting sites for the tropical and subtropical fruit and nut trees on Tutuila, American Samoa.



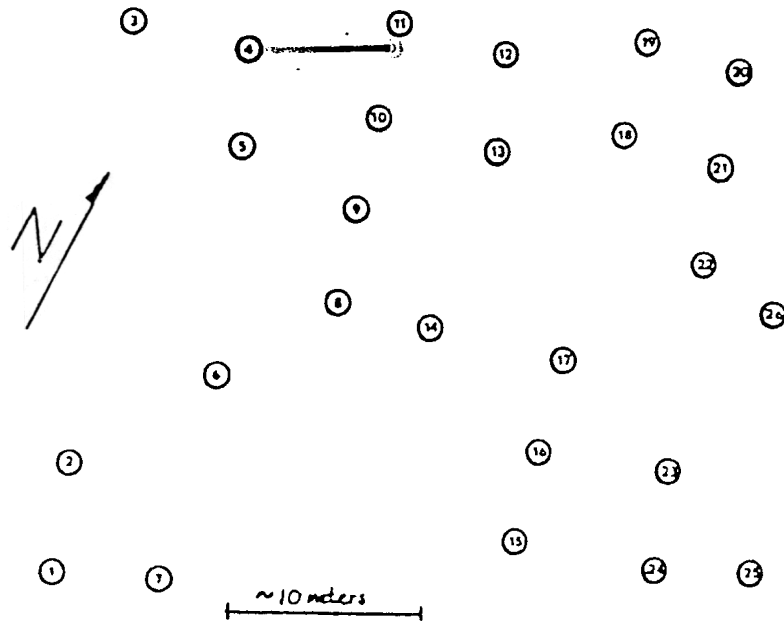
SITE	COOPERATOR	VILLAGE	PLANTING DATE	ELEVATION (m)
A	Melila Percell	Lec	04 MAR 1985	50
B	Tovia Tuli	Ma	27 FEB 1985	120
C	Sosene Asifoa	AO	07 FEB 1985	360
D	Land Grant Prgm.	Ma	19 FEB 1985	60
E	Elisapeta Liligi	Fac	26 FEB 1985	150
F	Fia Tiapula	AO	23 MAY 1985	100

SITE	SOIL	TOPOGRAPHY
A	Udic Eutrandept, clay loam	level
B	Typic Dystrandept, silty clay loam	level
C	Typic Dystrandept, silty clay loam	20 degrees
D	Typic Hapludoll, stony silty clay loam	6 degrees
E	Typic Hapludoll, silty clay	30 degrees
F	Lithic Hapludoll, silty clay	40 degrees

Figure 2. Planting map of tropical and subtropical fruit trees at site B: Tovia Tuli Plantation, Olovalu, Tutuila, American Samoa, 120 m elevation.

FRUIT TREES: TOVIA TULI PLANTATION, OLOVALU

TOPOGRAPHY: LEVEL MAP DRAWN: DEC 4 1986



1. Rollinia
2. Tamarind
3. Soursop
4. Dombey
5. White Sapote
6. Soursop
7. Soursop
8. Black Sapote
9. Soursop
10. Longan
11. Dombey
12. Chandler Pumelo
13. Chandler Pumelo
14. Tahitian Lime
15. Lisbon Lemon
16. Okinawa Tangerine
17. Kajang
18. Lisbon Lemon
19. Blood Orange
20. Pink Grapefruit
21. Surinam Cherry
22. Wampi
23. Meyer's Lemon
24. Sugar Apple
26. Surinam Cherry
26. Kajang

Figure 3. Planting map of tropical and subtropical fruit trees at site C: Sosene Afoa Plantation, Aoloau, Tutuila, American Samoa, 360 m elevation.

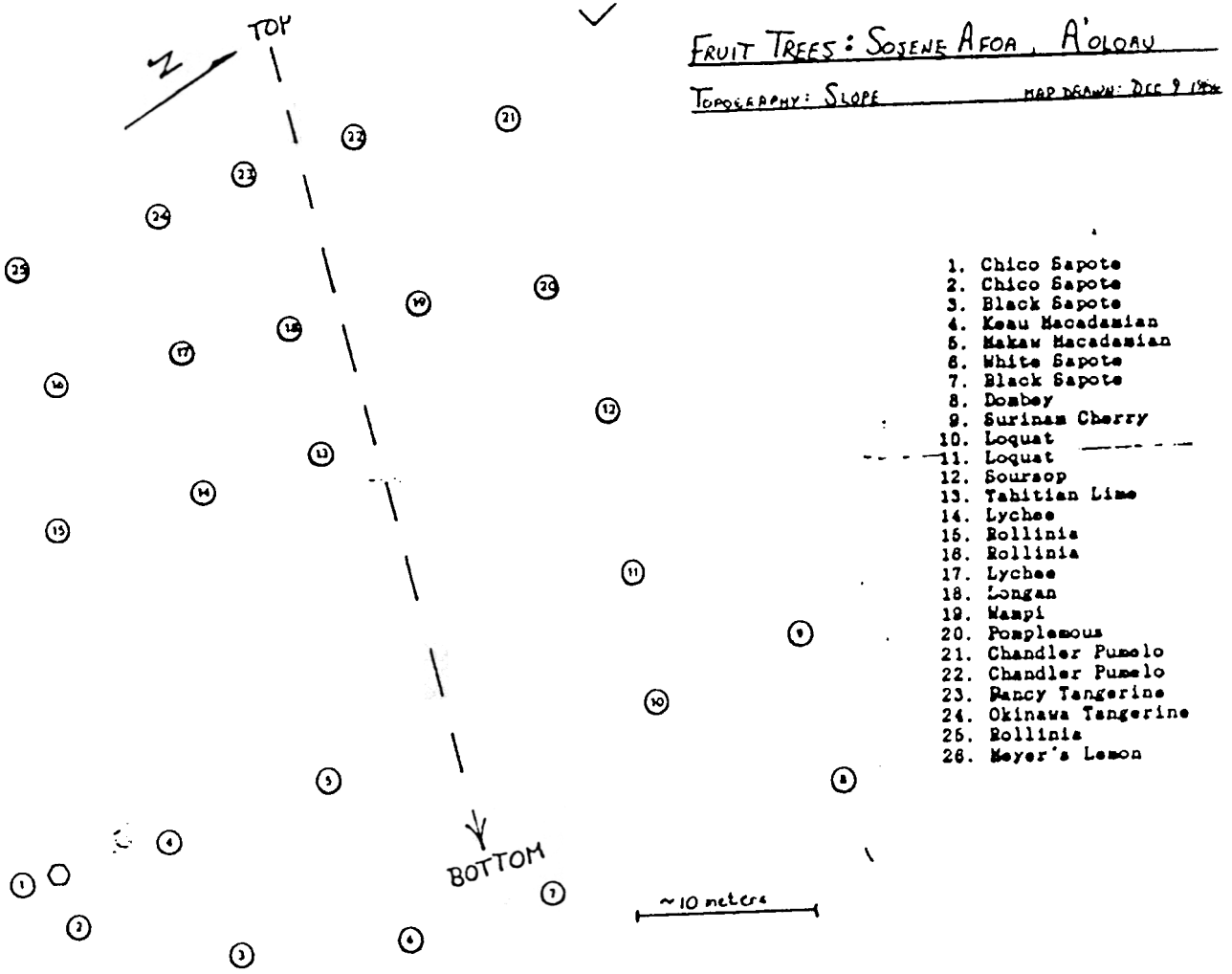


Figure 4. Planting map of tropical and subtropical fruit trees at site D: Land Grant Program Agricultural Experiment Station, Malaeimi, Tutuila, American Samoa, 60 m elevation.

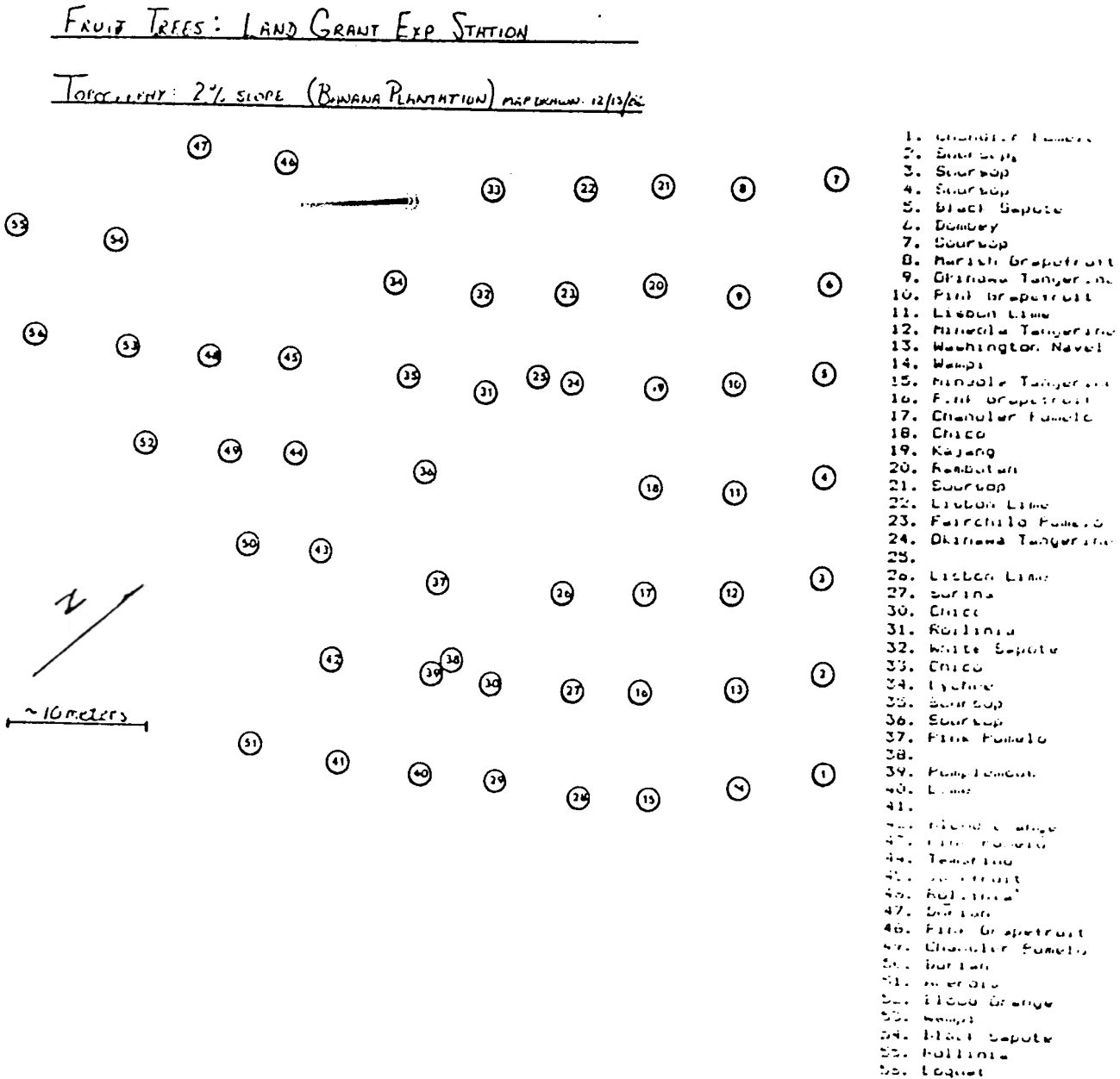


Figure 5. Growth rates in height (m yr^{-1}) and in circumference (cm yr^{-1}) for soursop trees at the three sites. Growth rates are the differences between the initial and the final measurements, taken 4 years apart.

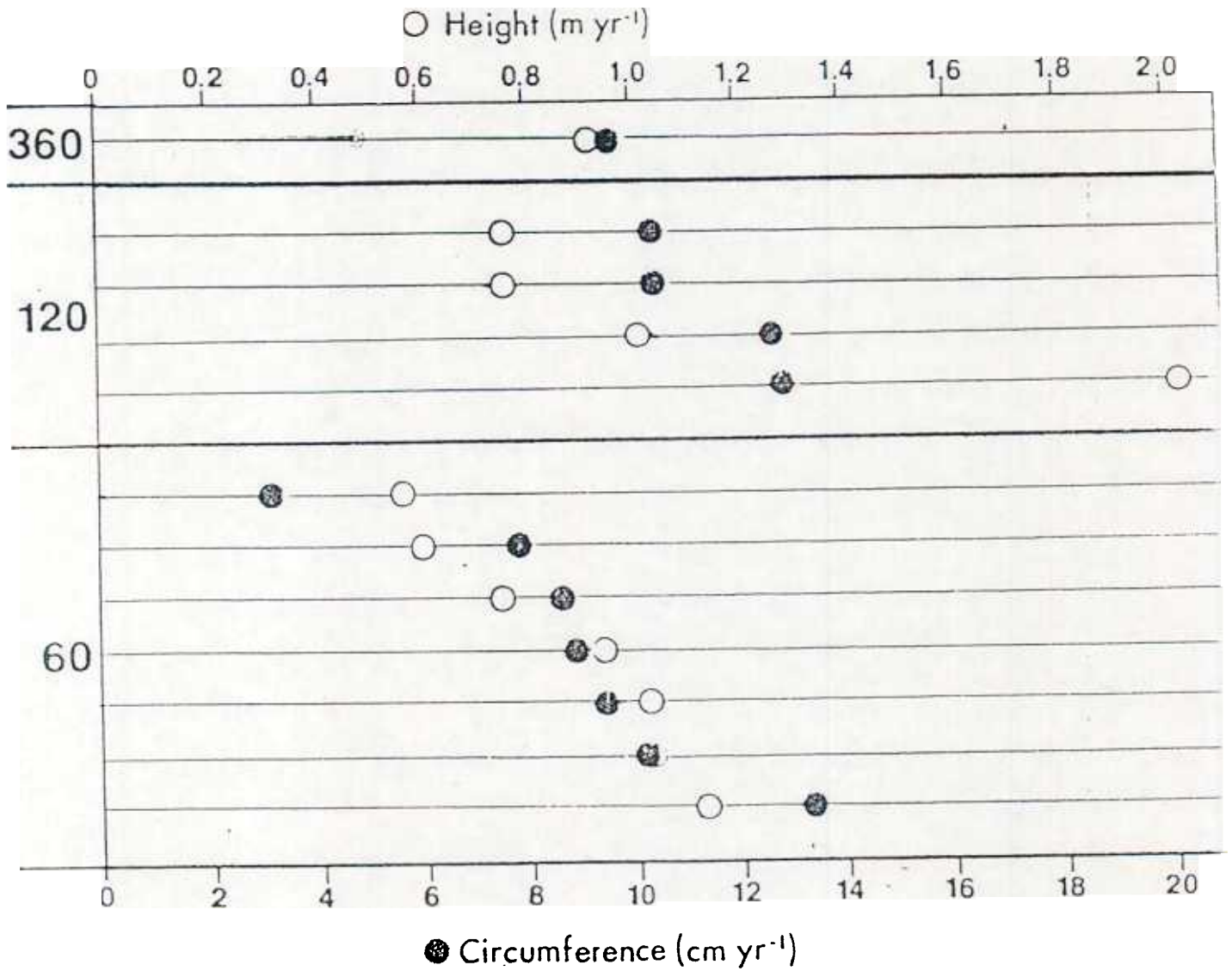


Figure 6. Height growth rates (m yr^{-1}) of citrus trees at the three sites

