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TARO EXPERIMENT: CULTIVAR AND SPACING TRIAL No. 2

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## ABSTRACT

The effect on corm weight and yield is examined for two local taro (Colocasia esculenta) cultivars, Manu'a and Niu'e, planted at 2ft x 2 ft, 3ft x 3ft and 4ft x 4ft spacings. Both this and an earlier experiment indicate no influence of spacing on corm weight, but yields differ significantly with the inverse of spacing. The Manu'a cultivar is found to outperform the Niu'e cultivar in average corm weight and in yield, but at different degrees between experiments. Optimum yield is realized with a combination of the Manu'a cultivar at the 2ft x 2ft spacing.

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To better serve the farmers and gardeners of American Samoa an aggressive research campaign was launched in 1983 by the newly formed Land Grant Program of the American Samoa Community College. Research focused on variety, fertilizer and spacing trials of vegetables and traditional crops. One experiment, carried out between 21JUN84 and 14JAN85, studied the response of two local taro cultivars planted at three spacings\*. Because that experiment demonstrated a substantial yield increase for the closest spacing and suggested one cultivar may outperform the other, the experiment was repeated to verify those earlier results. This paper describes the outcome of the second taro cultivar/spacing trial.

#### MATERIALS AND METHODS

Using a split-plot design (Figure 1) with 4 replicates (blocks Manu'a and Niu'e taro cultivars (main plots) were planted 3JUN86 at the Land Grant Experimental Station in Malaeimi, American Samoa, at 2ft x 2ft (0.61m x 0.61m), 3ft x 3ft (0.91m x 0.91m) and 4ft x 4ft (1.22m x 1.22m) spacings (subplots). Plant densities were 11, 8 and 6 plants per row for the three spacings, respectively. Each subplot consisted of 3 rows. The plants were fertilized at planting and 3AUG86 with 1 Tbsp (15g) of 12-6-18 fertilizer. The plots were hand-weeded 30OCT86 and the center rows harvested 18DEC86. Where multiple plants occupied a single hole the largest corm was selected. Corms were

\*Navarro, Adriano and Malaeti'a Misa. 1986. Vegetable Research: 1983-1985. Technical Report No. 1. Land Grant Program, American Samoa Community College.

washed and roots, cormels and loose debris removed. Corms were severed from petioles at the topmost leaf scar and weighed on a triple beam balance to the nearest 5g increment. Corms which exceeded the capacity of the balance (610g) were sectioned for separate weighings of their parts and the partial weights summed.

Plants at row ends or adjacent to missing plants usually are excluded from the observations since they do not represent the true spacing. In this experiment, however, all surviving plants in the center row of each subplot were included in the observations. Otherwise, some subplots would have no or one representative corm

## RESULTS AND DISCUSSIONS

A summary of the observations is given in Table 1. An observation is the average corm weight of all corms from the center row of each subplot. The large coefficient of variation for some observations is due to differences in the initial size of the planting material. In Samoa most taro, (including those in this study), is grown by planting "tiapula" setts) in a hole dug with an *oso* (planting stick). Corm weights range from 35g to 985g. Figure 2 shows the frequency distribution of corm weights for cultivars, both separately and combined. The histogram for the combined data shows a roughly normal curve skewed right toward heavier corms. Examination of the individual cultivar histograms shows this skewing is attributed almost entirely to the Manu'a cultivar, reflecting its propensity toward heavier corms. The Niu'e cultivar histogram, however, reveals a tendency

in this cultivar to form corms of light to intermediate weight.

The two parameters of particular interest in this and the earlier experiment are: 1 average corm weight and 2 average yield of cultivars relative to spacing. To obtain the latter data the average corm weight per plant must be multiplied by the number of plants per unit area. Table 2 lists the multiplication factor for each spacing for the unit area of hectare, with an explanation on how they were calculated

Table 3 summarizes the sources of variance for the average corm weight, in grams, of both cultivars at the three spacings. In agreement with the earlier findings no significant difference (at the 5% level exists in average corm weight with regard to spacing. The earlier study did find a significant difference in corm weight between cultivars, with Manu'a being the heavier. However, no significant difference between cultivars is evident from the current data

Mixed findings also occur upon examining the yield data (Tables 4 and 5). Both studies found significant differences in yield relative to spacing. Lowest yields were obtained at the 4ft x 4ft spacing and highest yields at the 2ft x 2ft spacing. But the earlier work found no significant difference in yield between cultivars, whereas the current study does. The Manu'a cultivar out-yields the Niu'e.

Moreover, the cultivar/spacing interaction (CxS) source of variance is highly significant. Upon closer examination (Table 6) the interaction is found to be due almost entirely to the performance of the Manu'a cultivar at the 2ft x 2ft spacing. This

combination yields 70% more corm weight per hectare than the Niu'e cultivar at the same spacing (Table 4

### CONCLUSIONS

A summary of the findings of both taro experiments is given in Figure 3. Both studies show no significant difference in corm weight among spacings, but spacing does affect yield simply because of the greater density of plants as spacing decreases. The two studies differ in degree, but not in trend with regard to corm weights and yields between cultivars. The earlier experiment found the difference in average corm weight between cultivars significant, (1.2kg and 0.8kg for Manu'a and Niu'e, respectively). Though the current experiment did find the Manu'a cultivar to produce heavier corms, (340g versus 231g), this difference is not significant

In contrast the difference in yield between cultivars in the earlier experiment was not significant, (15.9 tons/ha and 12.1 tons/ha for Manu'a and Niu'e, respectively) In the current study the 5.0 ton/ha yield of the Manu'a cultivar is significantly greater than the 3.3 ton/ha yield of the Niu'e cultivar.

From the combined studies we recommend planting the Manu'a cultivar at a 2ft x 2ft spacing to optimize yield. Since average corm weight is unaffected at the spacings studied, further trials at even closer spacings seem warranted in order to attain ultimate yield

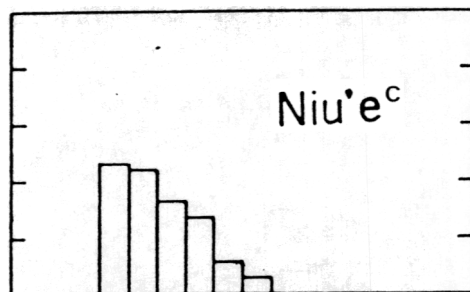
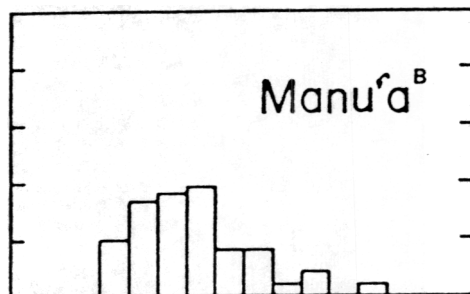
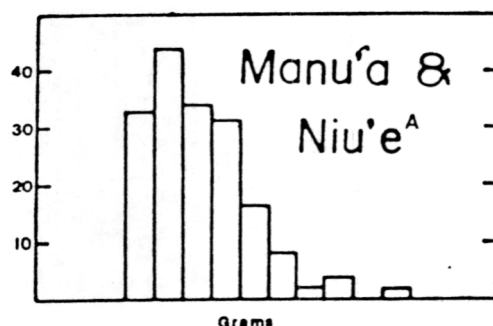
Figure 1: Field layout for taro cultivar and spacing trial No. 2.<sup>A</sup>

		M			N	
	2	4	3	4	3	2
II	4	N	3	2	M	3
III	3	M	2	3	N	4
IV	4	N	3	4	M	2

<sup>A</sup>Split-plot experimental design layout for the second taro experiment, 3JUN86 to 18DEC86. Each subplot, e.g. II-M-3 (for Block II, Manu'a cultivar, 3ft x 3ft spacing), contains three rows of taro. Only the center rows were harvested for the experiment.



Figure 2: Frequency distribution of individual corm weights of Manu'a and Niu'e taro cultivars, both combined and separate.



<sup>A</sup>Frequency distribution of individual corm weights of 173 taro plants of mixed variety and spacing. Weights range from 35g to 985g and are divided into 10 cells of 95g widths.

<sup>B</sup>Frequency distribution of individual corm weights of 88 taro plants of the Manu'a cultivar at mixed spacing.

<sup>C</sup>Frequency distribution of individual corm weights of 85 taro plants of the Niu'e cultivar at mixed spacing.

Figure 3: Summary of the two taro experiments.

	C	S
W	5:NS <sup>A</sup>	NS:NS
Y	NS:5	5:1

C is Cultivar

S is Spacing

W is average corm Weight

Y is average Yield

<sup>A</sup>The first character represents the level of significance of the first experiment, separated by a colon from the level of significance of the second (i.e. present) experiment. Numerals indicate percent level of significance; NS means "not significant".

Table 1: Average corn weights according to Block, Cultivar and Spacing.

<u>B-C-S<sup>A</sup></u>	<u>Ave. Weight(g)</u>	<u>C.V. %<sup>B</sup></u>	<u>n<sup>C</sup></u>
I-M-2	340	48	11
I-M-3	371	81	7
I-M-4	303	24	6
I-N-2	176	64	9
I-N-3	360	37	7
I-N-4	296	48	6
II-M-2	328	77	7
II-M-3	354	41	7
II-M-4	314	36	6
II-N-2	255	45	10
II-N-3	236	37	8
II-N-4	323	24	6
III-M-2	253	50	12*
III-M-3	133	53	4
III-M-4	321	85	5
III-N-2	158	78	8
III-N-3	183	64	5
III-N-4	137	47	6
IV-M-2	344	33	10
IV-M-3	468	49	8
IV-M-4	554	33	6
IV-N-2	154	55	7
IV-N-3	279	32	8
IV-N-4	210	84	4

<sup>A</sup>Block-Cultivar-Spacing

<sup>B</sup>Coefficient of Variation

<sup>C</sup>Number of corms in center row

\*Includes 3 taro mistakenly planted in a Niu'e subplot of the same spacing and block.

Table 2: Multiplication factors for converting average corm weight into yield (metric tons/ha).

<u>SPACING (ft x ft)</u>	<u>Plants/ha</u>
2 x 2	26 896
3 x 3	11 954
4 x 4	6 724

Since a hectare (ha) is 10 000 square meters, or 100m x 100m and there are 3.28 ft per meter, a yft x yft spacing would have  $(3.28 \text{ ft/m})(100\text{m})/(\text{yft/plant})$  plants per row with an identical number of rows for a total of  $(328/\text{y})^2$  plants/ha.

Table 3: ANOVA for average corm weight due to cultivar and to spacing.

<u>Source of Var.</u>	<u>Sum of Squares</u>	<u>d.f.</u>	<u>MS</u>	<u>F</u>	<u>F (5%)</u>
Subplots (SP)	246 577.83	23			
Main plots (MP)	172 485.83	7			
Blocks	65 582.83	3	21 860.94	1.89	9.28
Cultivar (C)	72 160.67	1	72 160.67	6.23	10.10
MP Error	34 742.33	3	11 580.78		
Spacing (S)	1	1	7 278.17		3.89
C x S	5 462.33	2	2 731.17		
SP Error	5 407.33	4	506.11		

Table 4: Corm yields (metric tons/ha) due to cultivar and to spacing.

Treatments		Blocks				Totals
Cultivar	Spacing	I	II	III	IV	
Niu'e	2 x 2	9.14	8.82	6.80	9.25	34.01
	3 x 3	4.43	4.23	1.59	5.59	15.84
	4 x 4	2.04	2.11	2.16	3.73	10.04
	2 x 2	4.73	6.86	4.25	4.14	19.98
	3 x 3	4.30	2.82	2.19	3.34	12.65
	4 x 4	1.99	2.17	0.92	1.41	6.49

Table 5: ANOVA for average corm yield due to cultivar and to spacing.

Source of Var.	Sum of Sq.	d.f.	MS	F	F(5%)	F(1%)
Subplots (SP)	141.70	23				
Mainplots (MP)	33.11	7				
Blocks	10.46	3	3.49	2.24	9.28	29.46
Cultivar (C)	17.97	1	17.97	11.53	10.13	34.12
MP Error	4.68	3	1.56			
Spacing (S)	91.52	2	45.76	72.42	3.89	6.93
C x S	9.48	2	4.74	7.50		
SP Error	7.58	12	0.63			

Table 6: ANOVA for cultivar x spacing interaction in yield data.

Source of Var.	Sum of Squares	d.f.	MS	F	F(5%)	F(1%)
C x S	9.48	2	4.74	7.50	3.89	6.93
C x (2 vs 3,4)	9.47	1	9.47	15.03	4.75	9.33
C x (3 vs 4)	0.01	1	0.01	0.01		
SP Error	7.58	12	0.63			