INFLUENCE OF SETT SIZE ON GROWTH AND YIELD OF TARO (COLOCASIA ESCULENTA)

R. Michael Bourke* and C. H. Perry*

ABSTRACT

Three sizes of taro (Colocasia esculenta) *setts were compared as planting material. They were large (diameter of base > 65 mm), intermediate (51 to 60 mm) and small (< 45 mm). Number of surviving plants at five weeks and at harvest, corm and cormel yield and average corm weight were significantly greater in the large and intermediate sett size treatments. Leaf area index, average leaf area, plant height, number of suckers per plant and number of leaves per plant were significantly greater for large (or large and intermediate) setts early in the crop although differences tended to disappear or become smaller as the crop aged.*

Leaf area index (6, 38 weeks), plant height (6, 28, 38 weeks), average leaf and (6, 28, 38 weeks) number of leaves (6, 38 weeks) and sucker number (28 weeks) were significantly correlated with yield.

It is concluded that large setts are the best sized planting material for taro because they grow more vigorously initially and give better weed control and greater yield. The practical limitations of the application of these findings by subsistence taro farmers are noted.

INTRODUCTION

In Papua New Guinea, taro (*Colocasia esculenta* (L.) Schott) is normally propagated by setts. These consist of the lower 30 to 50 cm of the petiole with the leaf blade removed, together with the top centimetre or so of the corm. To determine whether sett size influences growth and yield of taro, a trial comparing three sett sizes was conducted and is reported here.

The size of planting material has been shown to influence growth and yield of a number of vegetatively propagated crops, with larger planting material generally resulting in greater yield. Examples are cassava (Jeyaseelan 1951), pineapples (e.g. Wang and Kwong 1967; Tan and Wee 1973), potato (e.g., Bates 1935; Singh 1952), strawberry (Hughes 1967), sweet potato (de Kraker and Bolhuis 1967) and yam (Green 1941; Enyi 1972). Several studies have been conducted on other aroids. In India Chaugule and Khot (1963) found that growth and yield of amorphophallus taro (*Amorphophallus campanulatus*) was greater with larger corm seed. Enyi (1967a) in Sierra Leone compared three sett sizes of Chinese taro (*Xanthosoma sagittifolium* (L.) Schott) and found that increased sett size significantly increased the yield.

The influence of sett size on taro has also been studied. In India it was found that large setts produced higher yield but the smaller setts were more economical (Mathur *et al.* 1966 cited by Plucknett *et al.* 1970). Ken (1971) in American Samoa compared three sett sizes. He report that higher yields were obtained as sett size increased. Sett size did not significantly affect plant height or leaf number at harvest. The number of cormels per plant at harvest was significantly greater at the largest sett size under furrow planting, but not under stick planting. In Fiji, Robinson *et al.* (1971) found that large setts from either parent corms or cormels outyielded smaller setts, although there was no significant difference between parent corms and cormels. In Brazil, da Silva *et al.* (1971) compared three sizes of seed tuber (not setts) and found that size did not influence total yield or its components.

The effect of sett size has been previously investigated in two small trials at Keravat (Bourke, unpublished data). Results were inconclusive although it was observed that larger setts resulted in more vigorous early growth. Differences between sett size treatments disappeared as the crops aged but there was a suggestion in both trials that plants from the smallest

*Agronomist and Entomologist respectively, Lowlands Agricultural Experiment Station, Keravat, East New Britain Province.

Table 1.—**Replicate effects. Taro Variety Trial 1**

	Replicate 1	Replicate 2	Replicate 3
Sett size planted	Large	Intermediate	Small
Number of plants ha that died	557 a	557 a	1 822 b
Average plant height (cm) at 15 weeks	102 a	95 b	91 c
Corm yield (kg/ha)	9 347 a	8 537 b	7 549 c
Average corm weight (kg)	0.79 a	0.72 b	0.66 b
Cormel yield (kg/ha)	4 983 a	4 820 a	4 653 a
Cormel number/ha	66 294 a	70 988 ab	73 067 b

Values in rows followed by the same letter are not significantly different at $p = 0.05$.

Table 2.—**Sett size treatment**

Treatment	Diameter of base of sett
1. Large setts	> 65 mm
2. Intermediate setts	51 to 60 mm
3. Small setts	< 45 mm

setts yielded less than intermediate and large size setts.

In Keravat Taro Variety Trial 1 which evaluated 36 varieties, setts of all varieties were split into three sizes before planting, viz., large, intermediate and small. There were three replicates in the trial and in each replicate only one class of sett size was used. Thus replicate effects also measured sett size effects. Replicate totals for a number of parameters are given in *Table* 1.

Definite conclusions cannot be drawn because sett size and location (replicate) effects cannot be separated. However there is a strong suggestion that sett size has influenced plant mortality, plant height, corm yield and average corm weight.

MATERIALS AND METHODS

An insecticide trial which evaluated the effectiveness of three insecticides for control of taro beetle *Papuana* spp. was also used to study the effect of sett size. The insecticidal aspects of the trial are reported by Perry and Bourke (in preparation). Trial design was a randomized block with split plots. There were seven insecticidal treatments (main plots), three sett size treatments (subplots) and two replicates giving 42 sett size plot in all.* Plot size was 10 m x 7 m.

* The subplots for sett size treatments will be referred to as plots in this paper.

The trial was located on the Lowlands Agricultural Experiment Station at Keravat on New Britain on a fertile volcanic soil. The site was cleared of mature secondary forest in 1970 and planted to *Pueraria phaseoloides*. This was slashed and incorporated into the soil prior to planting. Taro variety Kl, known locally as Ainabin, was used. Before planting, setts were grouped into three sizes corresponding to the three treatments (*Table* 2).

No distinction was made between setts derived from corms or cormels although it can be assumed that a greater proportion of the largest setts came from corms and a greater proportion of smallest setts came from cormels. Plant spacing was 1 m square giving a planting density of 10 000 setts/hectare. The trial was planted on 17th to 18th April, 1973, using the traditional sharpened planting stick. Weeding was performed as necessary.

Recordings.—Five weeks after planting, plant number per plot was recorded. At six weeks the following were recorded from ten plants in each plot: leaf length, taken as the distance from the leaf sinus to tip (AA'); leaf number; and plant height measured from ground level to the sinus of the tallest leaf. At 28 and 38 weeks, leaf length, leaf number, plant height and number of suckers per ten plants were recorded. All measurements were made on mother plants and not suckers. Only entire undamaged leaves were counted. Thus results for number of leaves per plant underestimate the actual number, particularly for the recordings at 28 and 38 weeks. At harvest, corm and cormel yield and the weight of rotten corms per plot were recorded. Various parameters related to taro beetle damage were also recorded, but these data are not presented here.

The three sizes of taro setts compared, large (diameter of base > 65 mm), intermediate (51 to 60 mm) and small (< 45 mm). Note the taro beetle (*Papuana* spp.) damage to the corms of the intermediate size setts. (Photo by senior author)

A regression between leaf length (AA') and area was established. To establish the regression, leaf length and leaf area were measured from 510 leaves of Kl taro from another area (Bourke, Morris and Bongbong 1976). Three regressions were considered and the following was used—

$$Y = 8.6 + 1.42165\ x^2\ (r = 0.983^{***})$$

where Y = leaf area (cm^2) and X = AA' distance (cm)

Substitution of measured values of AA' into the equation gave leaf area values. Leaf area index (LAI) of mother plants was derived by dividing leaf area per plot by plot area. Leaf area per plot was calculated from the product of average leaf area, number of leaves per plant and number of plants per plot. Because the recording for number of leaves per plant is an underestimation, so also is the LAI.

RESULTS

The overall corm yield was 5 200 kg/ha. It was observed that weed growth was greatest in plots of Treatment 3 and least in Treatment 1, but no measurement was made of weed growth. Recording on crop growth and yield are given in *Table* 3. Number of surviving plants at five weeks and at harvest, corm and cormel yield and average corm weight were significantly greater from the large and intermediate setts.

The weight of rotten corms was positively related to sett size. Growth parameters of leaf area index, average leaf area, average plant height, number of suckers per plant and number of leaves per plant were all significantly greater from large setts early in the crop, although the differences tended to disappear or become smaller as the crop progressed.

Correlation coeffecients between yield and growth measurements based on per plot recordings are given in *Table* 4. Leaf area index at 6 and 38 weeks, average plant height at 6, 28 and 38 weeks, average leaf area at 6, 28 and 38 weeks, number of leaves per plant at 6 and 38 weeks, and average number of suckers at 28 weeks were all significantly correlated with yield.

Table 3.—Crop growth and yield recordings

	Sett size			Level of significance
	1. Large	2. Inermediate	3. Small	
Number of plants/ha at 5 weeks	9 827 a	9 704 a	8 776 b	1%
Number of plants/ha at harvest (equals number of corms)	8 122 a	7 551 a	6 531 b	1%
Average plant height (cm)				
6 weeks	65 a	56 b	44 c	0.1%
28 weeks	122 a	119 a	110 b	5%
38 weeks	98 a	104 a	96 a	NS
Number of leaves/plant				
6 weeks	4.4 a	4.1 ab	3.9 b	5%
28 weeks	2.1 a	2.3 b	2.4 b	5%
38 weeks	2.4 a	2.5 a	2.4 a	NS
Average leaf area/plant (cm^2)				
6 weeks	959 a	722 b	494 c	0.1%
28 weeks	1 486 a	1 340 a	1 379 a	NS
38 weeks	1 003 a	1 143 a	1 059 a	NS
Leaf area (mother plants)				
6 weeks	0.42 a	0.29 b	0.17 a	0.1%
38 weeks	0.21 a	0.23 a	0.17 a	NS
Average no. of suckers/plant				
28 weeks	7.3 a	6.1 b	6.0 b	1%
38 weeks	8.1 a	7.4 a	7.9 a	NS
Corm yield (kg/ha)	6 077 a	5 654 a	3 864 b	0.1%
Average corm weight (kg)	0.73 a	0.75 a	0.60 b	1%
Weight of rotten corms (kg/ha)	1 482 a	1 141 b	505 c	0.1%
Cormel yield (kg/ha)	5 049 a	4 555 a	3 495 b	1%

Values in rows followed by the same letter are not significantly different at $p = 0.05$.

Table 4.—Correlation coefficients between corm yield and growth measurements

Growth measurement		Correlation coefficient	Level of significance
Average plant height (cm)	6 weeks	0.382	5%
	28 weeks	0.738	0.1%
	38 weeks	0.712	0.1%
Number of leaves/plant	6 weeks	0.592	0.1%
	28 weeks	0.085	NS
	38 weeks	0.359	5%
Average leaf area/plant (cm^2)	6 weeks	0.629	0.1%
	28 weeks	0.479	1%
	38 weeks	0.602	0.1%
Leaf area index	6 weeks	0.670	0.1%
	38 weeks	0.724	0.1%
Average number of suckers/plant	28 weeks	0.313	5%
	38 weeks	0.081	NS

DISCUSSION

It has been suggested that setts from parent corms outyield those from cormels (Hodnett 1958). However Robinson *et al.* (1971) reported that yield differences between the two are not significant when the size of material is also considered. The failure to distinguish between setts from parent plants and suckers in this trial is probably not important. Values for number of leaves per plant and leaf area index of mother plants underestimate these parameters but the error is likely to be evenly distributed between treatments so treatment differences are most likely real.

The large and intermediate setts have outyielded the small setts by a considerable amount and are to be preferred as planting material. The yield difference between large and intermediate setts was not significant. However the early growth advantage of the large setts, particularly as measured by leaf area index, suggests that they are to be preferred because of superior weed control. This is an important consideration to the subsistence farmer, perhaps more so than the overall crop yield. It should be noted that the total LAI, and hence ground cover, of both mother plants and suckers was of the order of twice that of mother plants only.

Weight of rotten corms increased with sett size which suggests that plants from the large setts matured earlier than those from the small setts. It may be that plants from the small setts would have eventually yielded as well as those from large and intermediate setts if they had been harvested later. However the yield difference is so large that it is unlikely the small setts would have caught up, especially as plant number per hectare was significantly less at harvest.

The low yield from the small setts is a product of both a higher plant mortality and a lower yield per plant. It is likely that the disadvantages of small setts might be offset to some degree by using a higher planting density. This would counteract the effect of the lower corm size per plant. However the overall yield would most likely be lower than from larger setts because of the effect of plant mortality.

The results clearly indicate that large setts are superior planting material. Nevertheless the application of the results by subsistence farmers, as are most taro farmers in Papua New Guinea, is not so clear-cut. The farmer must plant whatever material is available when the land is ready for planting. Small setts from suckers from an earlier planted garden or a neighbour's garden may be all that is available, rather than large setts from a recently harvested crop. The additional burden of carrying larger setts to some extent offsets the advantage of less weed growth and a higher yield.

The correlations established between yield and leaf area index, average plant height, average leaf area, and average number of leaves and suckers per plant is in agreement with other published work on taro and Chinese taro, Purewal and Dargan (1957a, b) reported highly significant and positive correlations between plant yield and plant height; plant yield and leaf area; and between height and leaf area. Reddy *et al.* (1968) found leaf area and corm weight of taro to be highly correlated. Solomon Islands Ministry of Agriculture and Rural Development (1975) reported that effective leaf area of taro and LAI are correlated with corm weight at various stages of taro growth. With Chinese taro a positive linear relation between leaf blade area at harvest and corm yield (Enyi 1967b) and leaf area index and corm yield (Enyi 1967a) has been shown.

CONCLUSIONS

Large or intermediate setts are the best sized planting material for taro. This is because more plants survive and they significantly outyield small setts. If available, large setts should be used in preference to intermediate setts because their better growth gives better weed control.

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