THE USE OF NURSERY TRANSPLANTS IN TARO (*COLOCASIA ESCULENTA*) CULTURE*

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SUMMARY

In Hawaii and other Pacific Islands, taro (*Colocasia esculenta*) is propagated by setts consisting of the uppermost top of the corms plus 12-20 cm of the lower petioles. These setts, called *huli* in Hawaii, are obtained at harvest and are perishable. In an effort to preserve planting materials, *hulis* were grown in closely spaced nurseries for 0, 2, 4 and 6 weeks before transplanting them to the field. Time in nursery had no effect on total corm yields. Plants held longer in nursery (6 weeks or more) were taller, produced more suckers, and produced corms with higher specific gravity. It was concluded that nursery transplants of taro may be used with no loss in yield: and, if higher specific gravity is an indication of greater corm maturity, crop duration in the field may be shortened by using rooted transplants.

RESUME

En Hawaï et dans les autres îles du Pacifique, le tarot (*Colocasia esculenta*) est propagé par boutures constituées par la partie supérieure de la tige bulbeuse et des premiers 12-20 cm de la partie inférieure des pétioles. Ces boutures, appelées *huli* en Hawai, sont obtenues au moment de la récolte et sont périssables. Pour pouvoir préserver le matériel de semis, les *hulis* sont cultivés en pépinières proches 1' une de 1' autre pendant 0,2,4 et 6 semaines avant qu'ils ne soient repiqués au champ. La durée des plantules en pépinière n'a aucun effet sur le rendement total des tiges bulbeuses. Les plantules qui restent plus longtemps en pépinière (6 semaines ou plus) sont plus longues, produisent plus de surgeons et les tiges souterraines bulbeuses ont une gravité spécifique plus élevée. La conclusion présentée est que les plants de pépinière pour le repiquage peuvent être utilisés sans perte de rendement dans le cas du tarot: et, si le fait d'avoir une gravité spécifique plus élevée indique une maturité de tige bulbeuse plus grande, la durée de culture au champ peut être réduite en utilisant des plants de repiquage á racine.

RESUMEN

En Hawaii y otras Islas del Pacifíco la malanga (*Colocasia esculenta*) se propaga utilizando la parte superior de los cormos junto con 12-20 cm de la parte baja de los peciolos. Estas "estacas" llamadas *huli* en Hawaii, se obtienen en la cosecha y son de carácter perecedero. Tratando de preservar estos materiales para siembra, se hicieron crecer *hulis* en viveros con los materiales dispuestos estrechamente, por 0,2,4 y 6 semanas antes de transplantarlas al campo. El tiempo en el vivero no tuvo efecto en el rendimiento total de cormos. Las plantas que permanecieron más tiempo en el vivero (6 semanas o más) fueron más altas, produjeron más hijos y dieron cormos con gravedad específica más elevada. Se concluyó que los transplantes de vivero se pueden usar en malanga sin detrimento del rendimiento y que si bien la gravedad específica es un indicador de una mayor madurez del cormo, la duración del cultivo, en el campo, puede acortarse utilizando transplantes ya enraizados.

INTRODUCTION

To propagate taro (*Colocasia esculenta*(L.)Schott) several 'seed' types may be used. Among materials used are corm pieces or small sucker corms which are called cormels, oha, daughter corms, setts or cormlets in various taro producing areas. In Hawaii and a few other islands of the Pacific, taro is propagated by vegetative setts called *huli* (about 0.5 cm of the tip portion of corms plus 20 to 25 cm of lower petiole). These make mechanical planting possible[12]. One problem is that the *hulis* do not store for long and therefore a farmer must carry out many operations – harvesting, plot preparation and planting within a week in order to be assured of availability of planting materials.

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Human nutrition studies[8,13,15] have caused taro to be recognised as a speciality food, and it is envisaged that higher demands for the crop may necessitate more extensive production.

Farmers have several alternatives in order to secure enough planting materials; these include:

1. The use of corm pieces, as practised in many parts of the world, e.g. Caribbean Islands, Africa and most of Asia. However, reductions in yield have been associated with the use of corm pieces[10,11] in comparison with setts from apical portions, and more weed problems and a higher incidence of sett rot occur when corm pieces are used for propagation[10].
2. The *huli* may be stored under controlled environment and used as necessary. The problem here is the large expenditure necessary to maintain equipment, and this approach will probably not be practical.
3. Alternatively, a small nursery may be maintained solely for preservation of the materials which can then be transplanted as needed.[7] The advantage here will be the low cost of maintaining such nurseries, plus preservation of all planting material.

This study was conducted to determine the practicability of growing taro *huli* in small nurseries before transplanting them to the field. Factors investigated were general performance of *huli* in nurseries, optimum time in nursery before transplanting, and influence of the practice on corm quality.

METHODS AND MATERIALS

Huli of two commercial cultivars of taro, lehua and maui lehua, were grown in the nursery for 2,4, and 6 weeks and then transplanted into the field. The experiment was laid out in randomized complete block design with three replications. The experiment was conducted on the island of Kauai, Hawaii, in an area having an average annual rainfall of over 100 cm. Plot size was 10 m x 4 m and plant spacing was 75 cm x 75 cm. Details of the experimental procedure have been reported elsewhere.[8] The performance of freshly cut *hulis* was compared with that of nursery grown transplants. Data recorded were sucker number, plant height, total corm yield, sucker corm yield, main corm yield, individual main and sucker corm yields, and specific gravity of sucker and main corms at harvest.

RESULTS

Corm yield

Table 1 shows the corm yield at 12 months from time of planting. There were no within-cultivar differences in total corm yield due to length of time in nursery. Differences in total corm yield between cultivars were also not significant. Significant yield differences (P = 0.05) between types of planting material were observed for main corm yields and also sucker corm yields. While cultivar maui lehua gave higher main corm yields, it produced lower sucker corm yields than lehua. When the yields from these two components were combined, comparable total corm yields were obtained, resulting in no significant yield differences between the two cultivars.

Plant height and suckering capacity

The extent to which top growth and root or tuber development are interdependent has been discussed by several workers 5,6,9,14. In taro, a flush of vegetative growth is produced in the first 3 to 5 months of the crop. Later, top growth declines and plant height shortens as photosynthate is accumulated in corms. Table 2 shows heights and suckering of the two taro cultivars at 3,5 and 10 months of age. Maui lehua was taller but suckering was greater in lehua at all ages. The effect of length of time in nursery on sucker number was inconsistent. However, there was an inverse relationship between sucker number and sucker weight. (Table 3)

Specific gravity

Specific gravity has been used successfully as an index of corm maturity of taro. Bowers *et al.*[2] found that the best range of specific gravity for the lehua cultivar was 1.05 to 1.15. Generally poi and flour yields increased with increasing specific gravity. Table 4 shows the ranges of specific gravity obtained from corms harvested at different dates and with planting materials of different ages. A specific gravity in the range of 1.11 to 1.16 was obtained within 6 months in the field when 6 weeks-old transplants were used. The specific gravity of sucker corms also tended to increase with increasing age of the transplants used and with increasing crop age.

The specific gravity of corms and corm dry weights were not correlated (Table 5). This supports previous observations of Ching[3] and de la Pena[4] for taro and Austin *et al*1 for sweet potatoes.

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TABLE I

The effect of time in nursery of rooted plants or huli on corm yield of lehua and maui lehua cultivars of taro grown for twelve months under paddy conditions

Time in nursery before transplanting.	TOTAL YIELD			MAIN CORM YIELD			SUCKER CORM YIELD		
	Cultivar			Cultivar			Cultivar		
Weeks	lehua	maui lehua	2 cvs. average	lehua	maui lehua	2 cvs. average	lehua	maui lehua	2 cvs. average
		t/ha*			t/ha*			t/ha*	
0	63.95a	68.12a	66.05	26.70b	28.58b	27.64	37.27c	39.52c	38.41
2	64.86a	73.43a	69.16	19.46b	32.33b	25.91	46.78c	41.00c	43.94
4	66.94a	72.69a	69.80	22.50b	34.06b	28.28	44.44c	33.59c	41.55
6	71.73a	71.41a	71.58	21.71b	34.23b	27.99	50.02c	37.05c	43.60
Average	66.23a	71.41a		22.60a	32.31b		44.63a	39.03b	

*Means on the same column followed by the same letter are not significantly different (P = 0.05) by the Duncan's Multiple Range Test.

TABLE 2

Effects of time in nursery on suckering capacity and height of rooted plants and hulis of two cultivars of taro at different periods during crop growth.

A. NUMBER OF SUCKERS PER PLANT

Time in nursery before transplanting.	Crop ages, months							
	3		5		10		Averages	
Weeks	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua
0	2.8	2.8	7.0	5.7	7.4	6.8	5.7	5.1
2	2.8	1.5	8.5	6.0	9.1	6.7	6.8	4.7
4	4.0	1.9	10.3	6.7	12.6	7.1	9.0	5.2
6	4.6	4.3	7.8	8.0	8.3	12.2	6.9	8.2
Average	3.6	2.4	8.4	6.6	9.4	8.2	7.1	5.8

B. PLANT HEIGHT* (cm)

Time in nursery before transplanting.	Crop ages, months						Averages	
	3		5		10			
Weeks	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua
0	93.7	115.5	120.6	185.9	74.6	94.7	96.2	132.0
2	99.5	114.3	125.2	151.6	77.2	96.0	100.5	120.6
4	104.1	140.9	117.0	158.5	90.9	123.9	104.1	141.2
6	107.7	153.9	122.9	169.9	98.8	140.2	109.7	154.6
Average	101.3	131.3	121.4	166.6	85.3	113.7	102.6	154.6

*Plant height is equivalent to length of longest petiole at the time of measurement.

TABLE 3

Effects of time in nursery of rooted plants and hulis on main and sucker corm yields of lehua and maui lehua cultivars of taro harvested at twelve months.

Time in nursery	Total corm weight(kg) per hill*		Number of suckers/hill*		Weight per sucker corm* (gms)		Weight per main corm* (gms)	
Weeks	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua
0	2.38	2.53	10.4	10.1	133	145	998	1064
2	2.46	2.73	12.9	7.7	135	199	725	1204
4	2.49	2.70	11.5	8.4	143	172	838	1268
6	2.67	2.66	12.4	8.3	150	166	808	1275
Average	2.50	2.66	11.8	8.6	140	171	842	1203

*Averages of 6 observations.

TABLE 4

The range of specific gravity of two cultivars of taro transplanted from nursery in which they were maintained for various periods. (Subscripts represent ages of transplant in nursery.)

Crop age (months)	Ranges of specific gravity				
	1.00-1.05	1.05-1.11	1.11-1.16	1.16-1.21	1.21
6	L_0, L_2, L_4 M_0, M_2	M_4, M_6	L_6, L_{14}**		
9		L_2 M_4, M_0	L_0 M_2, M_6	L_4, L_6, L_{14}**	
12			L_0	L_2, L_4, L_6 M_0, M_2 $L_0, L_2, L_4 L_6$* $M_0, M_2, M_4 M_6$*	L_{14}**

L = Lehua, M = Maui lehua.

* Specific gravity of main corms determined at 12 months.
** Lehua cultivar grown for 14 weeks in the nursery before transplanting. Since there was no maui lehua cultivar of corresponding age, this was not included in statistical analysis. All other notations are of sucker corms.

TABLE 5

Effect of time in nursery on the (a) specific gravity and (b) percent dry matter of two cultivars of taro at different ages.

(a) Specific gravity

Age of transplants	SUCKER CORMS Crop ages, months						MAIN CORM*	
	6		9		12			
Weeks	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua	lehua	maui lehua
0	1.008	1.003	1.112	1.103	1.134	1.160	1.124	1.111
2	1.013	1.016	1.098	1.122	1.190	1.136	1.155	1.153
4	1.011	1.101	1.175	1.164	1.182	1.211	1.136	1.155
6	1.121	1.098	1.163	1.147	1.164	1.163	1.135	1.133
Average	1.038	1.055	1.137	1.134	1.167	1.168	1.137	1.138

(b) Percentage dry matter

Weeks								
0	36.05	35.22	42.62	39.90	41.57	40.97	43.43	39.33
2	35.59	35.18	40.17	40.83	41.27	40.33	40.05	40.63
4	39.93	38.35	41.53	41.71	44.94	40.97	42.54	38.71
6	38.14	37.41	42.86	43.26	42.31	41.66	43.69	39.89
Average	37.43	36.54	41.94	41.43	42.53	40.98	42.43	39.64

*Main corm was sampled at 12 months only. For the 14 week old transplants, specific gravities were 1.134, 1.177 and 1.211 for sucker corms at 6,9 and 12 months age, respectively, and 1.153 for 12 months old main corms.

Corresponding percentage dry matter contents were as follows: 36.54, 41.43, and 40.98 for suckers and 39.64 for main corms.