

A CULTIVAR TRIAL WITH YAMS IN THE BRITISH SOLOMON ISLANDS

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SUMMARY

Fresh weight yields of eight cultivars of *Dioscorea alata* ranged from 15-37 t/ha and are thus comparable with those in the West Indies despite a growing period of about 200 days which is one month shorter. During 116 days of storage red pigmented tubers lost very much more weight (23%) than white fleshed (8.7%) in *D. alata*. *D. esculenta* tubers lost 24.6% in the same period. At mid-storage the moisture content had increased above that at harvest suggesting that under the conditions of the storage trial respiratory loss of weight was of major importance. The pigmented cultivar Lawanihara was significantly higher yielding than all other cultivars in the trial.

RESUME

Le poids frais des rendements de huit cultivars de *Dioscorea alata* a donné de 15 à 37 t/ha et sont ainsi comparables à ceux des Antilles, bien que la période de croissance n'a été que de 200 jours environ, ce qui représente une réduction d'un mois. Pendant 116 jours de stockage, les tubercules de pigmentation rouge ont perdu beaucoup plus de poids (23%) par rapport aux tubercules blanches, 8.7% en ce qui concerne *D. alata*. Les tubercules de *D. esculenta* ont perdu 24.6% dans la même période. A la mi-stockage la teneur en humidité s'est accrue par rapport à celle enregistrée à la récolte, ce qui laisse supposer que dans les conditions où le stockage a été expérimenté, la perte de poids due à la respiration avait une incidence non négligeable. Le cultivar Lawanihara pigmenté avait un rendement nettement supérieur à celui des autres cultivars soumis à l'essai.

RESUMEN

El rendimiento en peso fresco de ocho cultivares de *Dioscorea alata* varío de 15-37 t/ha, comparable por tanto al de las Indias Occidentales a pesar de que el período de crecimiento, de cerca de 200 días, es un mes más corto. Durante 116 días de almacenamiento los tubérculos con pigmento rojo perdieron mucho más peso (23%) que los de pulpa blanca (8.7%) en *D. alata*. Los tubérculos de *D. esculenta* perdieron 24.6% en el mismo período. A la mitad del período de almacenamiento el contenido de humedad se había incrementado por arriba del que se tenía a la cosecha, lo que sugiere que bajo las condiciones de almacenaje de la prueba, las pérdidas de peso por actividad respiratoria fueron de las más importantes. El cultivar pigmentado Lawanihara fué significativamente más alto en rendimiento que todos los otros cultivares empleados en la prueba.

INTRODUCTION

Yams (*Dioscorea* spp.), sweet potatoes (*Ipomoea batatas* (L.) Lam) and taro (*Colocasia esculenta* (L.) Schott) are major food crops in the Solomon Islands. Barrau³ has discussed the differing ecological requirements and preferences among the crops. Sweet potatoes are grown both by the taro and yam-planting communities. Taro production tends to be on the decline, while yam production is being maintained in the traditional yam growing areas.

The two most important yam species are *D. alata* L. and *D. esculenta* (Lour.) Burk. *D. bulbifera* L., *D. nummularia* Lam. and *D. pentaphylla* L. are sometimes planted, but more often collected from wild plants².

Mean annual rainfall exceeds 3.0 m for most coastal areas and is well distributed and a possible 8.0 m or more falls in the mountain ranges near the centre of the main islands. Mean maximum temperatures seldom exceed 31°C or mean minimum fall below 21°C, and relative humidity is about 80 percent throughout the year.

Many of the coastal soils are over raised coral reefs and generally deficient in available nutrients¹.

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MATERIALS AND METHODS

Cultivar trial

Eight cultivars of *D. alata* from Malaita were planted on 11 September 1970. In a three-replicate, randomized block experiment (excluding guard rows), plot size was 0.0018 ha with 49 plants spaced at 0.6 x 0.6 m (26,888 setts per hectare). Land was newly cleared from 4.5 m high bush. The ground was dug and loosened to a depth of about 35 cm and the diameter of the cultivated planting area for each sett was approximately 35 cm. The tubers were cut into setts nine days before planting (each sett being marked as in local practice to indicate the end taken from nearest the tuber head.) The mean weight of each sett was 88 g. and planting rates are shown in Table 1.

One sett was planted at each stand so that its top was three to four cm. below the surface. No hilling was done, the cultivated areas being only slightly higher than undisturbed ground. This is the standard planting procedure for the 'Kwara'ae' district of Malaita.

One stake of about 2.4 m height was provided 18 days after planting for each plant. No fertilizer was used. Harvesting was on 29 March 1971, 199 days after planting. Tubers were dug with digging sticks, which is the normal practice.

Storage trial 1

Harvested tubers were used in a storage trial, together with tubers from two other *D. alata* cultivars. The tubers were weighed four days after harvest and then placed on wooden shelves in a well ventilated rat proof store room. Only sound undamaged tubers were selected. The design was four randomized blocks, and each experimental unit comprising 5.0 kg of tubers.

Tubers were weighed at monthly intervals and the percentage weight losses calculated. Sprouting was assessed at monthly intervals, by scoring for the amount and length of sprouts on the following scale: 0 = no sprouting; 1 = slight sprouting; 2 = moderate; 3 = excessive sprouting.

The storage trials started on 2 April 1972, and were terminated after 172 days' storage.

Storage trials 2 and 3

These trials used a non-pigmented cultivar of *D. alata*, 'Inemaui', and of *D. esculenta*, 'Fananiu'. The trials were to determine the rate of weight loss during storage, and to determine the extent that this was due to moisture changes or other losses.

Storage commenced at seven and two days respectively after harvest for the *D. alata* and *D. esculenta* cultivars. *D. alata* tubers were stored for 213 days and those of *D. esculenta* for 123 days.

Tuber moisture was determined at monthly intervals in tubers selected at random by oven drying slices for 24 hours at 100°C. Sprouting was assessed as before. Randomized blocks had five replicates for *D. alata* and four for *D. esculenta*.

RESULTS

Cultivar trial

From Table 1 it can be seen that cultivar 'Lewanihara' had a significantly higher yield than the seven other cultivars, and there were significant differences between the tuber mean weights of cultivars. Tuber yield was not correlated with the weight of planting material used per hectare. The mean multiplication ratio of weight harvested to weight planted was 9.4. The two highest yielding cultivars had pigmented tubers. About 1 percent of tubers were damaged in a way similar to that described for *Heteroligus* sp. in West Africa, but here *Papuana* sp. is the pest involved.

Cultivar 'Asikare' suffered tuber rot of unidentified causation of about 0.55 t/ha.

At about 100 days after planting, virus-like symptoms were observed on all cultivars except for the two with pigmented tubers, cultivars 'Lewanihara' and 'Nutohuto'. Young leaves towards the tips of the shoots became curled, cupped and leathery, with brown margins and tips.

Leaf spots, from which various fungi were obtained (but not tested for pathogenicity) were observed on foliage of all cultivars at about four months after planting, but damage was very slight.

Storage trial 1

Weight losses and sprouting indices are given in Table 2. Values refer to the means of the non-pigmented cultivars¹, and of the pigmented cultivars². The red fleshed tubers had much poorer storage characterization than the white fleshed tubers, and they also sprouted more.

After 172 days' storage the non-pigmented tubers had a mean percentage loss in weight of 11.6, whilst that for the pigmented tubers was 24.5. The mean values for the sprouting indices were 42.7 and 100.0 for the non-pigmented and pigmented tubers respectively after 154 days' storage. The sprouts were removed after the weighing at 154 days' storage, but sprouts which developed after this were included in the final 'tuber' weights.

Storage trials 2 and 3

The moisture contents and percentage losses attributable to evaporation and respiration are shown in Tables 3 and 4 for the *D. alata* and *D. esculenta* tubers respectively.

After 213 days' storage the moisture content of the *D. alata* tubers had fallen from 75.4 to 69.1 percent. The total percentage loss in fresh weight for the period was 42.5 percent, the respiration loss is considered to account for 36.2 percent loss on the basis of the initial moisture content.* The sprouts were removed after weighing at 182 and 215 days of storage, and before oven drying for moisture determinations. The sprouting index at 182 days was assessed as 66.7 percent.

D. esculenta tubers lost 4.1 percent of weight due to moisture losses after a storage period of 125 days, the other weight losses, assumed to be due to respiration, were 18.6 percent** making a total weight loss of 22.7 percent. Sprouting commenced after 32 days' storage, and the sprouting index was 100 percent by 100 days.

Mealy bugs *Planococcus dioscorea* Williams¹⁴ were found on both the *D. alata* and *D. esculenta* tubers in all three storage trials and tended to be concentrated towards the head end of the tubers from which most sprouts emerged. They became apparent on the *D. alata* tubers after about 150 days of storage, and in the case of *D. esculenta* after 100 days.

No roots developed on any of the tubers in the three trials over the entire storage period.

DISCUSSION

In the 'Kware'ae' district of Malaita, the method of planting yams *D. alata* is different from that used for *D. esculenta*. In the latter, small seed tubers of approximately 0.26 kg weight are placed at the bottom of the planting hole, with the head end facing downwards. Lea¹² describes how in New Guinea, *D. alata* seed tubers are planted near the top of the planting mound. In Trinidad the normal planting procedure is for approximately 113 g. setts to be planted in ridges at a spacing of 1.2 x 0.3 m. Spacing of setts is normally wider than that used at Dala¹³

Staking is important in its effect on yield¹³, and was considered by Chapman⁶ to increase tuber yields through greater leaf area duration, and a more efficient canopy structure.

The yields of fresh tubers ranging from 15.89 to 36.85 with a mean of 22.21 t/ha for the eight cultivars are comparable with those quoted for the West Indies, whilst the mean weight of tubers 0.58 kg, is smaller than normal⁸. This was possibly because of the close spacing used. The growing period in the trial of approximately 200 days is about a month less than that for Trinidad^{6,10}. The mean number of tubers per plant was similar to the norm for *D. alata* cultivars, and there was no correlation between the yield of tubers, and the mean number of tubers per plant.

Pests and diseases appeared to be of little importance in the trial. The leaf spots probably had little effect if any on yields, as they were not significant until towards the end of the crop cycle.

Gooding⁹ found that *D. alata* cultivars had a mean percentage weight loss after a storage period of 116 days of 14.1 percent. However, this was only accounted for by 8.7 percent for the white fleshed cultivars and 23.1 percent of the pigmented ones. The one *D. esculenta* cultivar had a weight loss of 24.6 percent. At Dala the weight losses for the non-pigmented tubers and for *D. esculenta* after 123 days' storage were similar to the values given by Gooding.⁹

Campbell *et al*⁴ reported weight losses of 10-14 percent in *D. alata* tubers after four months' storage, and 20-24 percent at six months. By seven months weight losses had risen to approximately 47 percent. Final weight losses were similar at Dala (Table 5) to those determined by Campbell *et al*.⁴ for their untreated tubers. Sprouting was not apparent until 150 days (Table 3), whereas sprouting in Campbell *et al*'s trial commenced after about 100 days' storage. The removal of sprouts at 182 days probably slowed down the losses due to respiration from 17.18 to 5.44 percent (Table 3).

The slight increases of moisture (Tables 3 and 4) at 59 and 91 days for *D. alata* and at 61 days for *D. esculenta* tubers suggests uptake of water from the atmosphere. Coursey⁷, working with *D. rotundata* considered that respiration accounts for considerable losses in weight of stored yams as only slight changes in

* But calculated on a dry weight basis the data given appear to indicate a respiratory loss of 27.5 percent

**Also on a wet weight basis.

the moisture content usually take place during storage. Weight losses other than those due to moisture were therefore assumed to be due to respiration in this study as no rots developed in the stored tuber.

The pigmented cultivars in the trial were the highest yielding but also the poorest; they also sprouted earlier than non-pigmented cultivars.

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*List not included since leaf spot damage reported was very slight and no pathogenicity tests were undertaken.

TABLE 1

Yield and planting data of yams in cultivar trial

Cultivar	Yield of tubers (t/ha)	Mean weight of tubers (kg)	Mean number of tubers/plant	Planting (g/sett)	Material (t/ha)
Lawanihara	36.85a	0.95a	1.7	104.3	2.81
Hutohuto	25.15	0.82b	1.2	78.5	2.11
Inemaauri	21.49	0.59bc	1.4	78.5	2.11
Tomaa	20.96	0.45cd	1.8	112.8	3.04
Talabuli	20.61	0.59bc	1.4	83.1	2.23
Asikare	19.50	0.50cd	1.4	95.3	2.56
Rokee	17.19	0.50cd	1.3	71.7	1.95
Kai	15.89	0.27d	2.3	80.2	2.16
Mean	22.21	0.58	1.6	88.1	2.37
S.E.	±3.31	±0.08	±0.26	±5.11	±0.14
Coefficient of variation	25.9%	24.3%	27.9%	16.6%	16.6%

Mean separation by Duncan's Multiple Range Test.

Means followed by letter 'a' are significantly different from those means not having 'a' etc. (P = 0.05)

TABLE 2

Mean percentage weight losses and sprouting indices of yam tubers in storage trial

Percentage weight losses	Storage period (days)					
	31	62	94	123	154	172
Non-pigmented tubers (8 cultivars)	3.1	4.9	6.0	8.7	10.7	11.6
Pigmented tubers (2 cultivars)	6.2	7.8	9.6	14.6	21.0	24.5
<u>Sprouting indices</u>						
Non-pigmented tubers	0	0	0	14.6	42.7	-
Pigmented tubers	0	8.3	83.3	100.0	100.0	-
Sprouting index = $\frac{\text{Score}}{\text{Total possible score}} \times \frac{100}{1}$						

TABLE 3

Percentage weight losses of *D. alata* tubers after storage, showing moisture contents and changes due to moisture and respiration

Days of storage	0	28	59	91	120	151	182	213	Total
Moisture contents(%)	75.42	73.92	73.96	75.14	74.22	71.66	71.28	69.14	
S.E. ±	0.63	0.24	0.84	2.10	1.38	0.80	0.92	0.84	
Moisture weight changes (%)	-	-1.40	+0.04	+1.18	-0.92	-2.56	-0.38	-2.14	-6.28
Other weight losses (%)	-	1.04	0.78	4.04	0.66	7.08	17.18	5.44	36.22
Total weight losses %	-	2.54	3.28	6.14	7.72	17.36	34.92	42.50	
Sprouting indices %	0	0	0	0	0	0	16.6	66.7	

TABLE 4

Percentage weight losses of *D. esculenta* tubers after storage, showing moisture contents and changes due to moisture and respiration

Days of storage	0	32	61	92	123	Total
Moisture contents(%)	72.58	70.75	74.08	71.03	68.53	
S.E. ±	1.02	1.59	1.27	1.56	1.73	
Moisture weight changes (%)	-	-1.85	+3.35	-3.05	-2.50	-4.05
Other weight losses (%)	-	5.25	7.00	3.93	2.40	18.58
Total weight losses %	-	7.10	10.75	17.73	22.63	
Sprouting indices %	0	8.3	50.0	100.00	100.00	