REDUCTION OF WASTAGE IN STORED YAMS

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SUMMARY

A combination of treatment with thiabendazole and storage of treated tubers in polythene bags in cool storage appears to be a practical possibility for yam storage in Jamaica.

RESUME

Une combinaison de traitement au thiabendazole et de stockage des tubercules traités dans des sacs de polythène en stockage frais semble être une possibilité pratique de stockage de l'igname en Jamaïque.

RESUMEN

Un tratamiento combinado de thiabendazole y el almacenamiento de los tubérculos así tratados en bolsas de polietileno bajo almacenaje refrigerado, parece ser una posibilidad práctica para el almacenamiento de ñame en Jamaica.

INTRODUCTION

Yams (*Dioscorea* spp.) are a major staple in many tropical countries[7] and are also gaining importance as an export crop[3]. Storage, to extend periods of availability, is necessary but usually gives rise to high wastage. Weight losses arise from desiccation, respiration, necrosis caused by microorganisms[1,2,6,10,13], and parasitic nematodes[17]. Storage of yams below 12.5°C causes chilling injury[9] but high levels of decay can occur at 15°C.[4]. It was concluded[7] that cold storage alone cannot be used as a method of reducing losses in yams although treatment of tubers with benomyl or thiabendazole fungicides can reduce wastage in cool storage[14,15,18]. Curing undamaged yams before storage reduced weight losses and microbial infections[11,16]. Waxing, which has been used commercially to improve the market appearance of sweet potatoes, has not apparently been used for yams. Premature sprouting (lack of dormancy) is a major cause of wastage, particularly in *D. cayenensis* Lam. However, attempts at chemical control of sprouting in ambient storage of yams has not been successful[5,12] (an A.K. Thompson, unpublished data).

MATERIALS AND METHODS

Tubers were obtained from commercial harvests in the area of northern Manchester and southern Trelawny in Jamaica and were used for experiments one day after harvesting.

Experiment A used *D. cayenensis* and Experiments B and C used *D. rotundata* Poir. Tubers were cured for 25 hours in experiments A and B and 65 hours in experiment C at 36–40°C and 96–100% rh. or alternatively kept in ambient storage. Half the cured and uncured tubers were then stored at 12–13°C and 92–98% rh while the remainder were stored under ambient conditions (24–31°C and 56–92% rh).

Experiments D, E, G, H, I and J were on *D. rotundata* and experiment F was on *D. trifida* L. In each of these experiments half the tubers were wrapped individually in 150 gauge polyethylene bags secured with a rubber band while the remainder were left unwrapped. All storage was in 520 x 360 x 190 mm cardboard cartons under ambient conditions except in experiment H in which storage was at 12–13°C and 92–98% rh for 89 days, followed by ambient storage. All tubers in experiment H were cured for 24 h and then dipped for 3 minutes in 1000 ppm thiabendazole (2–(4–thiazolyl) benzimidazole) before storage. Tubers in experiment J were removed from storage at 11.7°C and 84% rh to ambient storage at weekly intervals. Tubers in experiments I, D and E were 'waxed' with the commerically available emulsion (Epolene E10 vegetable wax) diluted with water and air dried. In D and E waxing was combined factorially with polyethylene wrapping but no significant interaction was observed.

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Each tuber was weighed before storage and marked with an identifying number. At intervals (7–14 days) during storage each tuber was weighed, inspected for sprouting and scored for incidence of surface fungi according to the following scale:

0 = none
1 = negligible
2 = obvious
3 = severe
4 = very severe
5 = surface almost entirely covered

At the end of the storage period each tuber was cut open longitudinally and the percentage of internal necrotic tissue estimated.

Rates of loss in fresh weight were calculated for each tuber between each observation on the following basis:

$$S = \frac{(I_1 - W_2)\ 1000}{(t_2 - t_1)\ \ W_{1,1}}$$

where S = storage loss range (g of fresh weight lost/kg of tuber present at day t_1.) W_1 and W_2 = tuber fresh weight in g at t_1 and t_2 respectively. t_1 and t_2 = days in storage.

This approach to weight loss is derived from the formulae proposed to measure Crop Growth Rate and Relative Growth Rate.[19]

A.N.O.V., where appropriate, was on data transformed to logarithms but the results presented here refer to unstransformed parameters. Significant 'fits' (P = 0.05) could be made to quadratic functions and these functions were plotted rather than the actual data to illustrate the effects.

RESULTS

Curing

Results are summarized in Table 1 with data from Experiment C presented graphically in Fig. 1 (curves derived from Experiments A and B were similar). Curing before storage reduced weight losses but the favourable effects of curing was less pronounced as storage progressed. Curing reduced the levels of fungal infections during cold storage and internal necrosis but hastened sprouting. Longer curing than 24 hours did not appear to produce a greater effect.

Temperature

Tubers in cold storage had a low and constant rate of weight loss throughout storage whereas under ambient conditions a rapid initial rate was followed by a lower rate which increased again at a time approximately coinciding with the appearance of sprouting (Fig. 1). Tubers in cold storage did not sprout at all during storage but high levels of fungal infection and internal necrosis were evident (Table 1). Storage at 11.7°C caused chilling injury symptoms of extensive necroses, high levels of fungal infection and high weight losses following removal to ambient conditions (Fig. 2).

Wrapping in polyethylene bags

Tubers in polyethylene bags lost little weight during storage (Table 2 and Fig. 3) but considerable levels of fungal growth occurred on tuber surfaces and also there appeared to be a proliferation of parenchyma around lenticels. This occurred within a few days of placing tubers in the bags, but quickly disappeared when they were removed. This phenomenon was entirely absent if tubers in bags were stored at 12.5°C. Tubers treated with thiabendazole prior to storage in polyethylene bags developed negligible incidences of surface fungi during storage.

Waxing

Waxed tubers had a very attractive appearance and this treatment could probably be used as an aid to marketing in those countries where the use of such treatment is permissible. Waxing however, had no effects on levels of fungal infections and the effect on weight loss was inconsistent.

DISCUSSION

The three *Dioscorea* spp used in these experiments all began to sprout early in the storage period and as no effective chemical suppressant has been found yet, reduced temperatures appear essential for prolonged storage*. Cold storage also prevents the build up of lesion-causing nematodes[17] but increases mould

growth[18] both of which can cause internal necrosis. The former is hard and dark brown in colour while that caused by fungi is generally soft and brownish purple[1]. Levels of fungal infection were reduced by both curing and thiabendazole treatment; the latter being considerably more effective. The effect of curing was to hasten and enhance the formation of periderm tissues especially in areas of mechanical damage (B.O. Been, unpublished report).

The increase in mould growth on tubers stored in polyethylene bags was not associated with increases in necrosis, which in fact tended to be decreased. The high humidity inside the bags thus appears to be associated only with superficial mould growth. In isolated instances, bacterial rots were observed in tubers stored in polyethylene bags but this was rare and is considered of little importance. Although little weight loss occurred on tubers stored in polyethylene bags at ambient temperature, the high level of mould growth and the lenticel cracking would detract too much from appearance for this method to be suitable for practical storage for subsequent marketing. Combining an effective fungicidal treatment with storage in polyethylene bags in cool storage may well be practicable.

Figure 1. Effects of curing and storage temperature on weight losses of yam tubers in Experiment C.

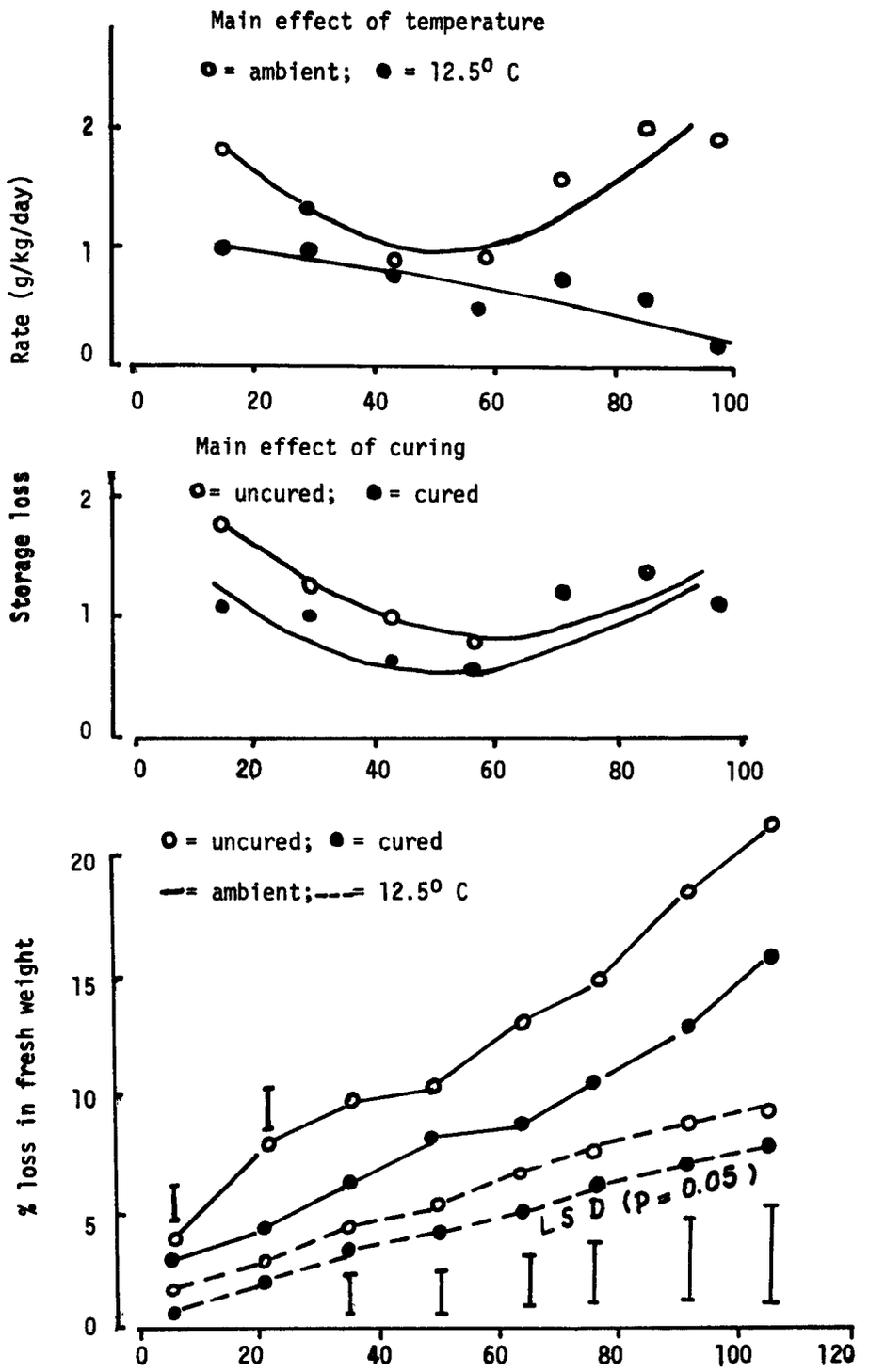
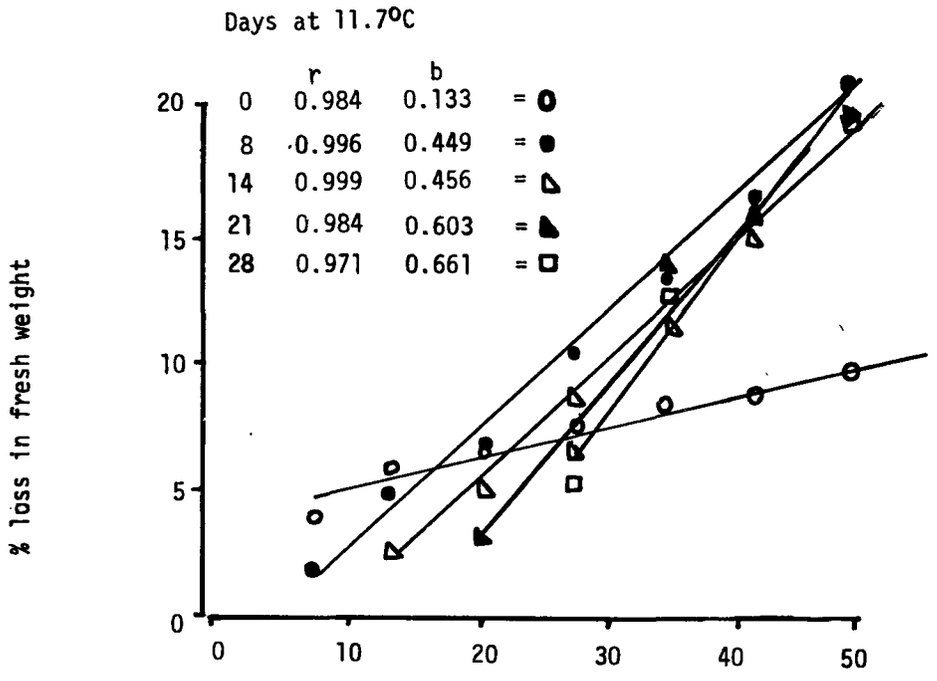


Figure 2. Effects of days at 11.7°C on loss in weight during ambient storage



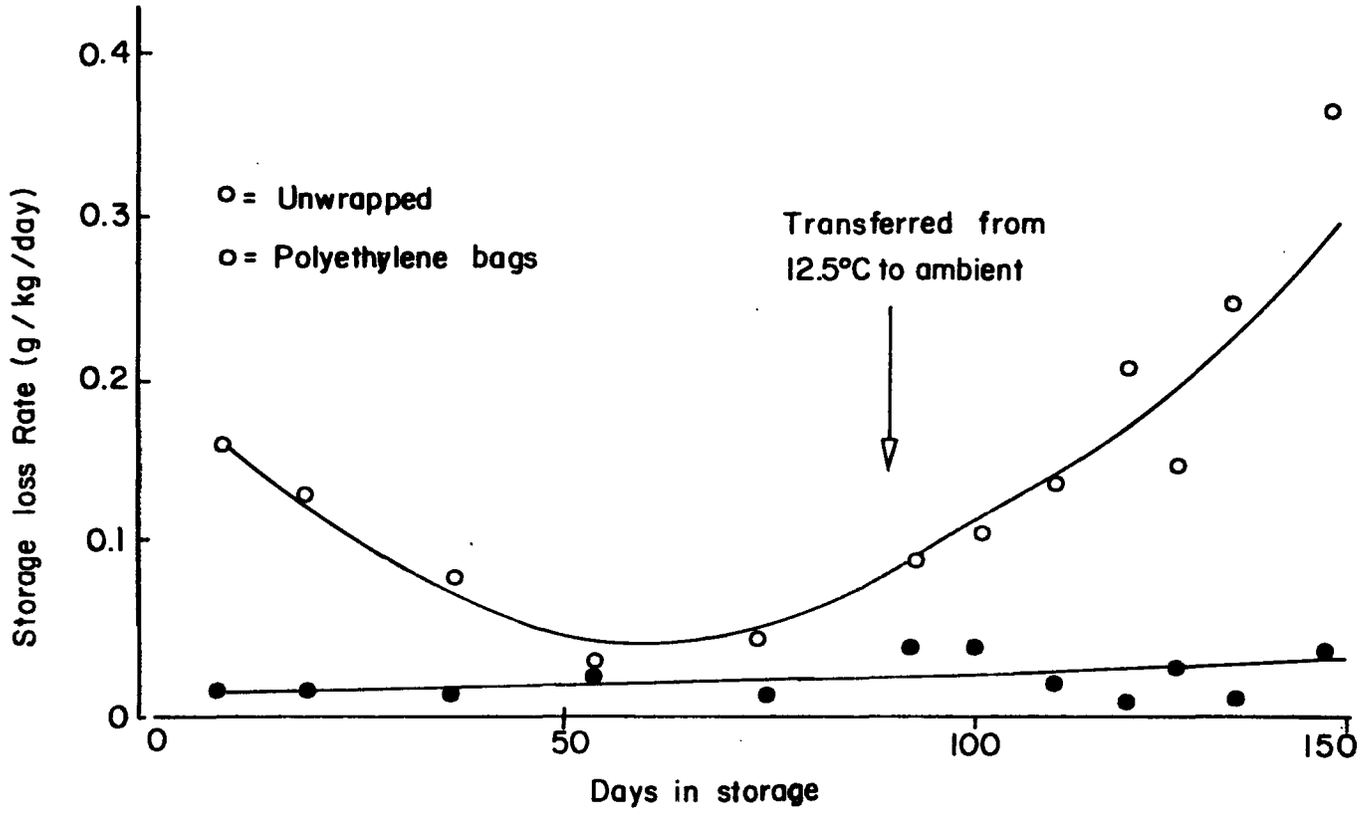


Figure 3. Effect of storage in polyethylene bags on loss in weight of yam tubers

Waxing of tubers appears to be of doubtful economic value since weight loss was inconsistent and the costs of application high.

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TABLE 1

Effects of curing on fungal growth, mean days to sprouting and % internal necrotic tissue in cold and ambient storage

Experiment	A		B		C	
Storage conditions	amb.	cold	amb.	cold	amb.	cold
Mean fungal score						
uncured	0.2	2.9A	0.0	3.0A	0.0	1.4A
cured	0.3	2.3B	0.0	2.6B	0.0	1.2B
Mean % internal necrosis						
uncured	62AB	96A	17B	64A	4A	9A
cured	58AB	46C	2B	7B	3A	10A
Mean number of days to sprouting						
uncured	64A	-	72A	-	93A	-
cured	68A	-	57B	-	78B	-

Figures followed by the same letter were not significantly different (P = 0.05)

TABLE 2

Effects of storing tubers either unwrapped or individually wrapped in 150 gauge polyethylene bags on surface fungal score, internal necrosis and loss in weight

Experiment	Days in storage	Fungal score		% internal necrotic tissue		% loss in fresh weight	
		0	Poly.	0	Poly.	0	Poly
D	80	1.4B	3.0A	2	1	48.6	1.4
E	91	0.8B	4.1A	26A	8B	52.1	4.0
F	64	0.3D	1.2A	43A	23B	35.7	6.9
G	72	0.0	1.9	22	12	30.0	3.1
H	148	0.3*	0.3	0	2	18.3	2.8

* Dipped in 1000 ppm TBZ prior to storage

TABLE 3

Effects of waxing tubers on loss in fresh weight and fungal development

Experiment	Days in storage	% solids in wax 0	5	10	15	20
				Fungal score		
I	140	1.2	1.1	1.3	-	1.3
D	80	2.4	-	-	2.3	-
E	91	2.5	-	2.4	-	-
I	140	53.8	42.8*	42.6*	-	49.6
D	49	16.4	-	-	16.4	-
E)	62	22.4	-	19.3*	-	-
)	91	29.7	-	26.3	-	-

* Significantly different from 0 (P = 0.05)