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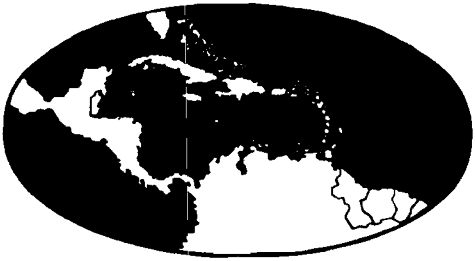

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WOUND PERIDERM FORMATION IN DASHEENS AND ITS EFFECTS ON STORAGE

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SUMMARY

Dasheen (*Colocasia esculenta* L) corms responded to wounding by tuberization of superficial cell layers followed by wound periderm formation. The rates of both processes were influenced by temperature and humidity. Under favourable conditions i.e. 32°C to 35°C and 95 - 100% relative humidity - wound healing proceeded rapidly, but the rate decreased with decreasing temperature and humidity. The rate of wound healing decreased from the top to the base of the corm.

Curing under favourable conditions, treatment with fungicides and storage in moist coir dust and at 13°C extended the storage life of corms.

INTRODUCTION

Dasheens (*Colocasia esculenta* L) are widely grown in Jamaica and are of some importance as an export crop.

The crop is characterized by high wastage on the local and foreign market (Burton 1970) due to rotting. A variety of microorganisms have been regarded as responsible for storage rots in dasheens and related corms in several countries (Harter 1916, Posnette 1945, Burton 1970 and Gollifer and Booth 1972). In Jamaica rotting during storage is usually caused by *Botryodiplodia* sp.

Locally, few attempts have been made at longterm storage of dasheens, but farmers recognise that corms free from mechanical damage store better than those with wounds.

It has long been known that exposure of certain tubers and corms to high temperature brings about rapid wound healing by encouraging tuberization and periderm formation (Appel 1906, Priestley and Woffenden 1923, Artswager 1927 and Artswager and Starret 1931). Curing of potato, sweet potato, gladiolus, yam and cassava prior to storage is known to reduce weight loss and rotting, but very little information exists on its effects on the storage of dasheen.

Gollifer and Booth (1972) have reported on storage losses of taro in the Cameroons and Solomon Islands.

The work discussed here investigates wound healing of dasheen and various methods which could possibly be used to prolong storage.

MATERIALS AND METHODS

All corms used in these experiments were obtained from commercial harvests in St. Andrew, Portland and St. Thomas. Corms were transported to Kingston where they were washed, air-dried, numbered and individually weighed at the beginning of the experiments. Table 1 shows conditions of curing and storage. Experiments A, B, and C were undertaken to determine what effects curing and trimming had on storage of corms under ambient conditions. Trimming involved cutting off tops and bases of corms after the farmers had prepared them for market. Experiments C and D investigated the possibility of eliminating or reducing the amount of rotting by dipping corms in 200 ppm and 225 ppm solutions of Benlate and TBZ prior to curing and storage. Experiment E was conducted to investigate the effects of wrapping on storage of corms at ambient and 13 - 14°C. Corms were wrapped individually or in groups of ten in perforated, 100 guage polyethylene. Moist coir consisted of sundried coir and water in a ratio of 1:1.5 parts by weight.

At regular intervals during storage corms were weighed, and sprouting, rotting and surface mould growth noted.

Anatomical studies were done on fresh and preserved material.

RESULTS

The results obtained from experiments A to E were typical of those obtained from a number of small scale experiments done intermittently over the past three years. Marketable corms were those free from rotting and softening without sprouts or with sprouts less than 1 cm., without surface mould or with a very light growth of saprophytic mycelia.

Wound Healing

When a corm was cut and held under ideal wound healing conditions, the peripheral layers of cells (excluding the outermost) started losing their starch grains. Tuberization of these peripheral cells soon started and progressed centripetally, but generally did not involve more than a few cell layers. Within the starch free zone, inside the tuberization layers, a cambium developed and cut off cells to the outside only, these became tuberized and formed the wound periderm.

The rapidity with which wound healing took place depended on the region of the corm, environmental conditions and the type of wounds.

Wound healing occurred more readily at the top of the corm than at the base, and sometimes failed to occur at the latter site.

At low humidity the cut surface dried out and cracked, tuberization and wound periderm formation were delayed and deep-seated. When humidity was high wound healing proceeded at a rate largely determined by the temperature. If the temperature was low wound healing was delayed, but if high it was hastened. We found that the best conditions for wound healing were 34°C to 36°C and 95 - 100% r.h. Under these conditions tuberization was noticeable at the top of the corm after two days and cambial activity after three to five days.

When bruising was severe periderm sometimes failed to develop. Less severe bruising resulted in irregular development of periderm below the margin of the injury or tiers of periderm developed with intervening necrotic cells. Peeling or cutting corms with a sharp knife resulted in periderm development near the cut surface; but a deep-seated periderm developed when the cut surface was abraised.

Effects of curing

Curing of untrimmed corms for three days at 35°C and high humidity increased the amount of material marketable during storage, reduced the rate of weight loss, the level of surface mould growth and rotting, but encouraged sprouting, Table 2 experiment A, Table 3. Curing at the same temperature but at a lower humidity, Table 2 experiment B, was not beneficial. The longer curing period was not advantageous.

Trimming of corms apart from reducing sprouting did not appear to be advantageous, Table 2.

In this and all other experiments rotting invariably started at the base of the corm and at wounds on the side.

Fungicides

Benlate and TBZ reduced the level of rotting and extended the marketability of dasheens, Tables 3 and 4. Both fungicides appeared to be equally effective during the first three weeks of storage, but thereafter Benlate gave better results. Treatment of corms with Benlate was more effective than curing in reducing storage losses, Table 3. Corms treated with Benlate before curing stored quite well.

Temperature and Wrapping

Corms in cold storage lost less weight than those stored at ambient, Table 5. Cool temperature also delayed sprouting.

Corms in polyethylene wrapping lost little weight during storage, but heavy surface mould growth occurred and sprouting was early and prolific at ambient, Table 5.

Dasheens in moist coir dust gained weight and were relatively free from surface mould growth and rotting, but sprouted profusely at ambient.

DISCUSSION

Cuts, scrapes and bruises are inevitable when dasheens are being harvested and prepared for market. These wounds provide entry sites for decay causing organisms. A temporary yet seemingly effective blocking off of the exposed surface is achieved by tuberization of the peripheral cell layers; but wound periderm is more permanent and offers more effective protection (Weimer and Harter 1921, Lauritzen and Harter, 1926 and Priestley and Swingle, 1929).

The reduced weight losses and rotting of corms cured at high temperature and humidity were undoubtedly a consequence of the wound healing which took place. These curing conditions, however, are ideal for the growth of many micro-organisms and this together with the delay in, and sometimes absence of, wound healing in the basal region of the corm explain why Benlate was more effective than curing, and the ineffectiveness of a prolonged curing period. The delay in wound healing in the basal region also helps to explain why corms invariably started rotting at the base; but the possibility of direct penetration occuring more easily in this older part of the corm cannot be eliminated entirely.

Sprouting, except in certain wrapping treatments, was not as important a factor in marketability as was rotting. However, it seems that if storage rots were controlled sprouting might then be an important factor in reducing storage life and quality of corms.

The low levels of surface mould and rotting when corms were stored in moist coir dust was in keeping with our findings on yams, potatoes, plantains and cassava.

The increase in mould growth on tubers stored in polyethylene was not associated with increases in rotting. With an effective fungicidal treatment storage in polyethylene wrappings appears feasible in cold storage.

From these preliminary small scale experiments, it seems that dipping in Benlate followed by curing will reduce storage losses at ambient and 13.5°C. Moist coir dust could be used as a packing when transporting dasheens by sea.

The condition and health of corms at the time they are placed in storage is of utmost importance. We also found that the beneficial effects of curing, fungicides and wrapping treatments were reduced or eliminated altogether if there was a long delay between harvest and storage.

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TABLE 1. Curing and storage conditions and number of corms used in experiments.

	Curing			Storage			
Experiment	^{o}C	% R.H.	Days	^{o}C	% R.H.	Weeks	No. of corms
A	35	95 - 100	3.6	23 - 31	61 - 86	6	60
B	35	70 - 75	3.6	26 - 29	58 - 86	4	48
C	35	90 - 100	3	23 - 31	54 - 68	6	80
D	-	-	-	26 - 29	58 - 86	10	30
E	-	-	-	13 - 14	84	5	40
				24 - 35	52 - 88	5	40

TABLE 2. Effects of curing and trimming on percentage of original weight marketable, rotting and sprouting. Uncured corms were held at ambient during the curing period.

		1 week			3 weeks			6 weeks			
	Treatment	% marketable	% rotting	% sprouting	% marketable	% rotting	% sprouting	% marketable	% rotting	% sprouting	% surface mould
Experiment A	No. curing Untrimmed	96.0	0	0	92.1	0	0	16.9	80	20	30
	Cured 3 days Trimmed	94.6	0	0	48.0	50	0	37.5	50	20	40
	Cured 3 days Untrimmed	96.2	0	40	92.5	0	60	75.6	20	80	10
	Cured 6 days Trimmed	83.1	10	0	0	100	0	0	100	0	80
	Cured 6 days Untrimmed	95.3	0	0	52.7	40	0	0	100	10	40
									4 weeks		
Experiment B	No. curing Untrimmed	93.9	0	0	90.2	12.5	0	80.3	12.5	0	0
	No. curing Trimmed	94.0	0	0	42.5	62.5	0	19.1	75.0	0	0
	Cured 3 days Untrimmed	92.7	0	0	61.8	25.0	0	37.2	50.0	0	0
	Cured 3 days Trimmed	91.9	0	0	37.9	50.0	0	17.7	75.0	0	50.0
	Cured 6 days Untrimmed	93.7	0	0	52.1	37.5	0	51.7	37.5	0	0
	Cured 6 days Trimmed	91.4	0	0	32.3	50.0	0	11.2	87.5	0	62.5

TABLE 3. Effects of curing and Benlate on the percentage of original weight marketable, rotting and rate of weight loss (g/kg/day).

	Treatment	1 week			3 weeks			4 weeks			7 weeks		
		% marketable	% rotting	Rate of wt. loss	% marketable	% rotting	Rate of wt.loss	% marketable	% rotting	Rate of wt. loss	% marketable	% rotting	Rate of wt. loss
Experiment C	Benlate Cured	79.4	10	14.5	67.2	10	7.1	62.5	30	6.2	45.1	30	4.0
	Benlate Not Cured	77.8	10	24.2	54.0	30	9.6	52.0	40	8.3	22.1	40	5.2
	No. Benlate Cured	92.3	10	13.6	20.7	70	5.4	0	100	-	0	100	-
	No. Benlate Not Cured	72.3	10	25.5	6.4	80	9.8	0	100	-	0	100	-

TABLE 4. Effects of TBZ and Benlate on percentage of original weight marketable, rotting and sprouting.

	24 days			66 days		
Treatment	% marketable	% rotting	% sprouting	% marketable	% rotting	% sprouting
Control	60.2	30	0	9.7	90	30
Benlate	85.6	0	0	35.6	30	60
TBZ	85.3	0	0	21.9	70	70

TABLE 5. Effects of temperature and wrapping treatment on (A) % marketability by number (B) % weight loss (C) % rotting (D) with surface mould and (E) % sprouting.

Time	Temperature	Wrapping			
		Unwrapped	Moist Coir	Individually wrapped	Group wrapped
			(A)		
1 week	Cold	40	100	50	0
	Ambient	80	100	0	0
2 weeks	Cold	10	100	30	0
	Ambient	70	90	0	0
4 weeks	Cold	0	100	0	0
	Ambient	0	0	0	0
			(B)		
4 weeks	Cold	12.1	0	0.6	3.1
	Ambient	18.7	0	0.9	9.0
			(C)		
4 weeks	Cold	10	0	10	10
	Ambient	10	0	10	20
			(D)		
4 weeks	Cold	100	0	100	100
	Ambient	10	10	100	100
			(E)		
4 weeks	Cold	0	90	80	70
	Ambient	30	100	90	100