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FUNGI ASSOCIATED WITH PEELS OF POST HARVEST YAMS (*DIOSCOREA SPP.*) IN STORAGE

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ABSTRACT

Fungi on surface of three cultivars of white yam (*Dioscorea rotundata* Poir) and a cultivar of water yam (*D. alata* L.) were investigated. The objective of the study is to show vertical distribution (Head, middle and tail regions) of mycoflora of yam surface. The mycoflora consisted principally of *Aspergillus niger* Van Tiegh. *Botryodiplodia theobromae* Pat, *Trichoderma* sp., *Rhizopus* sp., *Fusarium solani* (Mart) Sacc, *Choanephora cucurbitarum* (Berk and Fav.) Thaxt, *Mucor* sp. and *Penicillium oxalicum* Currie and Thom in that order of their frequency of occurrence. The head region showed significant difference in occurrence of fungi ($p < 05$) more than the middle and tail regions. The frequency of occurrence of *A. niger* and *B. theobromae* was considerable in all the cultivars except in water yam where the occurrence of *A. niger* was relatively sparse. The implication of tuber surface mycoflora on the post harvest storage of yams is discussed.

Key words: yam, Peel, tuber surface, mycoflora

INTRODUCTION

The edible varieties of yam are monocotyledonous plants belonging to genus *Dioscorea* in the family Dioscoreaceae. Yam is an important food crop in West Africa, the Caribbeans, the Northern and Central parts of South-East Asia including parts of China, Japan, Malaysia and Oceania (Coursey, 1967; Okigbo, 1986). On the basis of some statistics provided by the F.A.O, Coursey (1967) estimated the world production of the crop to be twenty million tons per annum with Nigeria accounting for almost half the global output. The six most widely cultivated yam species in Nigeria are *Dioscorea rotundata* Poir (white yam), *D. cayenensis Lam.* (yellow yam), *D. alata L.* (water yam) *D. dumetorum* (Cluster or bitter yam), *D. esculenta* (Lour) Burk (Chinese yam) and *D. bulbifera L.* (aerial yam) (Otusanya and Jeger, 1996).

The mycoflora on the surfaces of harvested commodities can be manipulated to enhance resistance of the commodities to rot. (Okigbo and Ikediugwu, 2000 b, 2001; Okigbo, 2002). Antagonists have been artificially introduced onto plant surfaces to impart resistance against pathogen. Wilson (1989) manipulated the epiphytic microorganisms to impart resistance to the fruits and vegetables. Tronsmo and Dennis (1977) were able to control rot of strawberries in storage by treatment with an antagonistic *Trichoderma* species. Manipulation of the surface microflora of yam tuber in storage by the introduction of antagonists onto the tuber surface has been reported for yams (Okigbo and Ikediugwu 2000 b, 2001; Okigbo, 2002). The vertical distribution of mycoflora of yam tuber surface has not been studied. There is need to understand the role and or the dynamics of surface mycoflora of different region of yam in the post harvest pathology of rot. The present work deals with the study of vertical distribution of mycoflora on the tuber surface of different regions of post harvest yams.

MATERIALS AND METHODS

Isolation of Surface Mycoflora of Yam Tuber

Yam tubers employed in this investigation were three cultivars of white yam (*D. dioscorea*) 'omi', 'iyawo' and 'ikale' and a cultivar of water yam (*D. alata*). They were harvested from the College of Education Agricultural Farm in Agbor, Delta State and stored in the barn for seven months from December, 1990 to June, 1991. Isolation of mycoflora from the tuber surfaces were made from head, middle and tail regions of the tubers soon after harvest and subsequently at monthly intervals. Frequency of occurrence was calculated. The frequency of occurrence was taken as the number of fungi found on surface of all yams sampled expressed as percentage of total number of yam in the storage barn. The method used for isolation was that of Ikediugwu and Ejale (1980). Yam tubers were first washed under running tap water to loosen the attached soil and then tuber peels, which consisted of the outer brown layer the removal of which exposes the inner phelloderm, were carefully removed and cut into small pieces of 3mm by 5mm in dimension. Five tubers of each cultivar were used at each sampling date. For each yam a peel was obtained from each of the head, middle and tail regions and pieces washed together 30

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Table 1. Fungi and their percentage frequency of occurrence on the different parts of the tuber of omi cultivar of white yam from December 1990 to June 1991.

Fungi	DEC			JAN			FEB			MAR			APR			MAY			JUNE		
	H	M	T	H	M	T	H	M	T	H	M	T	H	M	T	H	M	T	H	M	T
A. niger	22.2		12.0	16.7	0	0	22.2	0	0	33.3	33.3	22.2	66.6	22.2	0	55.5	44.4	33.3	44.4	55.5	22.2
B. theobromae	44.4	11.1	9	66.6	33.4	15	66.6	22.2	0	66.6	44.4	33.3	66.6	66.6	33.3	55.5	55.5	66.6	55.5	55.5	33.3
Choanephora	55.5	55.5	11.1	0	0	0	0	0	11.1	0	0	0	33.3	11.1	11.	33.3	55.5	55.5	33.3	22.2	22.2
F. solani	33.1	22.2	11.1	50.1	50.1	11.1	66.6	55.5	24	33.3	22.2	22.2	0	0	0	0	0	0	0	0	0
F. oxysporium	9.9	0	0	0	0	0	0	0	0	33.3	0	0	0	0	0	0	0	0	0	0	0
Mucor sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.2	0	0	0	0
Neurospora sp.	1.1	0	0	50.1	0	0	0	0	0	33.3	0	0	0	0	0	0	0	0	0	0	0
P. oxalicum	22.2	11.1	33.3	0	50.1	16.7	0	11.1	11.1	0	0	0	0	0	0	0	0	0	0	0	0
Rhizopus	15.1	11.1	11.1	83.5	83.5	66.6	0	0	0	0	0	0	66.6	55.5	11.1	0	0	0	11.1	0	0
Trichoderma sp	33.3	22.2	11.1	83.5	50.1	33.4	33.3	11.1	0	33.3	33.3	11.1	11.1	0	0	22.2	22.2	11.1	0	11.1	0
P. fagurcagnon	0	0	0	0	0	0	11.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key: H = head, M = middle, T = tail

times in 10ml sterile distilled water contained in a McCartney tube by agitating vigorously for two minutes at each of the washing. Both water and tube were changed at each wash up to the tenth wash but only water was changed following the rest of the washing. There were thus 15 replicate peels for each cultivar of yam on each sampling date. The tuber peels were then dried on sterilize tissue paper and plated out on PDA to which an antibiotic mixture of penicillin and streptomycin was added to discourage bacteria growth. There were three replicate tuber peels on each agar plate. Plates of tuber peels were incubated for up to 7 days during which isolation and identification of tuber-surface mycoflora were made. Monthly record of frequency of occurrence of tuber surface mycoflora was done on all cultivars but only omi cultivar was recorded, as other cultivars show similar trend while the mean percentage for the whole period (7 months) were obtained for the other cultivars.

RESULTS

The fungi commonly isolated from the tuber surface of all the cultivars of yam included. *Aspergillus niger, Botryodiploidia theobromae, Choanephora, Fusarium solani, Penicillum oxalicum, Rhizopus sp., Trichoderma sp.* (Table 1). Of these, the most frequently isolated were *B. theobromae, A. niger, F. solani* and *Trichoderma sp. B. theobroma* and *F. solani,* to a lesser degree, maintained high level of occurrence throughout the six months of storage in all cultivars (Table 1). The frequency of occurrence of *A. niger* was considerable throughout the year in all cultivars except in water yam where the occurrence was relatively sparse (Tables 1, 2 and 3). The occurrence of *P. oxalicum* was sporadic and sparse in all the cultivars where it was recorded only at the earlier months of storage (Table 1). The surface mycoflora of the water yam (*Dioscorea alata*) was particularly rich in *Rhizopus* sp. (Table 2). *Trichoderma* sp. was consistently isolated from all the cultivars throughout the storage period and like most of the fungi, with the notable exception of *A. niger* and *B. theobromae* its frequency of occurrence decreased with time (Table 1). The frequencies of occurrence of individual fungi on the head, middle and tail regions of tubers of an individual cultivar of yam were generally different. The fungi showed preference for the head region of a yam tuber throughout the period of storage (Table 2). *B. theobromae, A. niger, Trichoderma* sp. *Rhizopus* sp. and *F. solani,* in that order, had the highest frequency of occurrence (Tables 2 and 3). *P. oxalicum* was one of the least frequently occurring isolate.

There was a significant (P<05) difference in occurrence of *A. niger* and *Rhizopus* on the head, middle and tail regions of all the cultivar (Table 2). However, there were no significant (P>05) difference in the occurrence of *A. niger* between omi and water yam, omi and iyawo, and water yam and iyawo (Table 2). Also, in comparing the occurrence of *Rhizopus* sp. between water yam and omi showed that there was no significant difference. There were no significant (P>05) difference in mean occurrence of *B. theobromae, Trichoderma* sp., *P. oxalicum* and *F. solani* in head, middle and tail regions of all the cultivars (Table 2). However, comparing the mean occurrence of *F. solani* using Duncan's multiple range showed that there were significant differences between the ocurrence in ikale on the one hand, and the other cultivars of yam, omi, iyawo and water yam, on the other.

DISCUSSION

Post harvest handling and storage of yam is an essential aspect of economic development in Nigeria. The results obtained in this study show that small number of fungi are consistently associated with the tuber surface of yams (Tables 1 and 2). The fungi which were regularly isolated from the tuber surface in the present study included *B. theobromae, A. niger F. solani, Choanephora* sp., *Rhizopus* sp. *and Trichoderma* sp. Most of these (*A. niger, B. theobromae, F. solani* and *Rhizopus* sp.) have been strongly implicated in pre-and postharvest rot of yams Ogundana *et al.,* 1970; Ekundayo and Naqvi, 1972; Otusanya and Jeger, 1996; Okigbo and Ikediugwu, 2000a, Okigbo, 2002). As with cassava tubers (Ikediugwu and Ejale, 1980) the tuber surface mycoflora of yam were restricted to few fungi which also included the most important pre and post harvest pathogens of the tubers. Some of the fungi are restricted to certain regions while a few are found in all the regions of yam tuber. The fungi showed preference for the head region of a yam tuber due to the contribution of Saprophytic mycoflora found on decaying materials at that levels of soils in which head region exist. The pattern of occurrence of tuber surface mycoflora has been attributed to the possible selective effects imposed on microorganisms by the modification of its immediate soil environment by the tuber in several ways including the excretion of organic substances (Burges, 1958). The implicated organisms of rot were usually opportunistic pathogens on the surface of tubers that might have gained entry to cause rot through wounds and natural opening as observed by Ogundana *et al* (1970). It is significant to note that rotting of

Table 2. Mean Percentage frequency of occurrence of tuber-surface fungi on the different parts of cultivars of white yam and water yam from December, 1990 to June, 1991.

Fungi	Omi			Iyawo			Ikale			Water yam		
	H	M	T	H	M	T	H	M	T	H	M	T
	%	%	%	%	%	%	%	%	%	%	%	%
A. niger	37.3	22.2	12.8	26.0	25.0	7.0	49.1	43	41.7	19.5	11.1	9.3
B. theobromae	60.3	41.2	27.2	54.0	31.2	17.1	46.3	44.4	35.2	46.3	38.9	38.9
Choanephora sp.	22.2	20.6	15.9	28.9	21.0	15.4	18.5	12.0	13.0	18.5	18.5	9.3
F.solani	26.2	21.4	6.6	24	18	9	14.0	9.3	1.9	31.5	16.0	10.5
F. oxysporium	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mucor sp.	0.0	3.2	0.0	14.0	11.0	7.0	1.9	1.9	1.9	16.7	7.4	1.9
Neurospora sp.	12.1	0.0	0.0	16.0	18.0	9	1.9	3.7	0.0	8.4	5.6	5.6
P. oxalicum	41.2	17.8	7.8	28	18	13	0.0	0.0	1.9	14.6	7.4	1.9
P. purpuregenum	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rhizopus sp.	25.2	21.4	12.7	17.0	4	2	14.1	11.1	11.1	38.5	36.1	23.2
Trichoderma sp.	31	21.4	11.1	25	11	5.0	40.4	29.3	19.5	24.1	12.0	9.0

Key: H = Head; M = Middle; T = Tail.

Table 3. Mean percentage frequency of occurrence of tuber-surface fungi on different cultivars of yam.

Fungi	Onni	Iyawo	Ikale	Water yam
	%	%	%	%
A.niger	24.1	18.3	44.4	13.3
B. theobromae	42.9	34.1	44.6	41.4
Choanephora sp.	19.6	22.0	14.5	15.5
F. solani	12.3	17.0	8.4	19.2
F. oxysporium	1.9	0	0	0
Mucor sp.	1.2	10.7	1.9	8.6
Neurospora sp.	4.0	14.3	.9	6.5
P. oxalicum	45.7	19.7	0 6	8.0
P. purpuregenum	0.6	0	0	0
Rhizopus sp.	19.8	7.7	12.1	32.6
Trichoderma sp.	21.2	13.7	29.7	15.5
Average	17.57	14.32	14.37	14.60

yams in storage probably started in soil and progressed in storage. This happens when infected tubers do not show perceptible external symptoms. The occurrence of mycoflora in the surface of all the tubers vary with the site of planting, therefore, the distribution of causal organisms may vary from place to place (Ogundana *et al.* 1970). As observed by Ekundayo and Naqvi (1972), rot caused by fungal pathogens vary due to variations in the distribution of the microorganisms.

The fungi that have been reported as causal agents of yam rot in storage are actually present as natural flora of the yam tuber surface right from harvest. Also, any part of the tubers can be nitch for the fungi even though a few species are concentrated on the head region than others. However, these fungi as natural residents of the tubers, are favourably placed to invade the tubers at the least opportunity. They are, therefore, expected to play an important role in postharvest pathology of the produce.

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