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EFFECTS OF FOUR AGROBOTANICAL EXTRACTS AND THREE TYPES OF BAGS ON THE CONTROL OF INSECT PESTS AND MOULDS OF STORED YAM CHIPS.

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ABSTRACT

A study was conducted to evaluate the effects of four agrobotanical extracts and three types of storage bags as alternative options to the use of agrochemical insecticides for yam chip storage. Dried yam chips were obtained from Shaki area of Oyo State, Nigeria and treated with extracts from Azadiractha indica (neem) leaf, Xylopia aethiopica (uda) pod, Occimum graticimum (nche anwu) leaf and Zingiber officinale (ginger) stem tuber. The storage bags were 0.05mm gauge polythene bags, 0.05mm gauge polythene-lined-jute bags and jute bags. After 3 or 6 months of storage, chip weight loss was always low at 1-5% with Azadiractha indica, Occimum graticimum, Zingiber officinale compared with the weight loss of 13 to 24% obtained where no agrobotanical was applied. At either 3 or 6 months of storage, insect damage through boring of holes was evident but was significantly higher with no agrobotanical treatment or with X. aethiopica than with the other agrobotanical treatments especially at 6 months of storage. There was little or no mould growth at 3 months of storage while at 6 months, mould growth was rather enhanced by X. aethiopica, Z. officinale and O. gratissimum and by A. indica to a lesser extent. The type of storage bag did not significantly improve the various criteria measured at either 3 or 6 months of storage. However insect damage appeared lower and chip quality assessment showed lower blemishes in polythene-lined-jute or jute bag alone. A. indica followed by O. graticimum gave better chip quality than the other treatments irrespective of the type of storage bag. Correlation analysis revealed that chip weight loss was highly and positively related with insect damage (r = 0.92) and highly but negatively related with quality assessment (r = - 0.89). Insect damage was also negatively related with chip quality score at the end of storage (r = -0. 87).

Keywords: Agrobotanicals, Storage bags, Storage pests, yam chips

INTRODUCTION

Yam (*Dioscorea* spp) is a major staple food crop grown in the humid and sub-humid tropics. In Nigeria and other West African countries yam is sold either as fresh tuber or as dried chips. In both forms yam can be stored with varying successes and benefits. The farmer's primary objectives in processing yams into chips are: reduction of post-harvest losses, removal of inedible and unmarketable parts, reduction of transportation costs, earn higher income, convert the fresh tuber into more convenient form, to produce a form that can store longer than fresh tubers, and to provide raw materials for agro- industries. (Eze, 1998). In a survey of major yam chip production areas of Nigeria (Orkwor *et al*, 1997), it was found that the leaves of *Cussonia bartei* and *Pihostigma thonningii* were added during parboiling of sliced yam tubers before drying into chips. The farmers who practiced that claimed that such treatments enhanced the quality of dried yam chips and prolonged storability. The survey also showed that chips were spread to dry on rock surfaces, road sides and old yam vines spread on the ground. Under such conditions, the drying yam chips are exposed to insects and fungal attack that could be inadvertently carried into storage.

Kulu *et al* (1983) reported that the average percentage mouldiness of stored yam chips could be significant and varied from 11.8 to 84.16, with the wetter months of April to July having high levels of mouldiness. Strains of *Aspergilus flavus*, *A. tamarii, A. niger, A. chevalieri, and A. rubber* were isolated in their work and were shown to be toxin-producing. Ogundana *et al* (1970) reported a considerable loss in the soluble carbohydrate content of yam chips infected by moulds. Vernier (1998) reported that weevil infestation in storage increased losses in terms of dry matter and visual quality of dried yam chips.

Yam chips are commonly stored in jute sacks with the application of some insecticides such as Actellic, Phostoxin or a mixture of Gamalin 20 and/or kerosene with water (Orkwor *et al,* 1997). Such preservation treatments have met the farmer's goal of reducing post-harvest losses and earning higher income, but pose health and environmental pollution risks. There is need to find a safer and more cost-effective method of preserving dried yam chips. In this study therefore, three types of storage bag and four edible and medicinal plants were evaluated for controlling or reducing storage losses in stored yam chips.

MATERIALS AND METHODS

Clean dried yam chips were obtained from a commercial yam chip processor in Shaki area of Oyo State, Nigeria, in January 2002. Four agorobotanical extracts were prepared from *Azadiractha indica* (leaf), *Xylopia aethiopica* (pod), *Occimum gratissimum* (leaf) and *Zingiber officinale* (stem tuber), while the storage bags were 0.05mm gauge polythene bag, 0.05mm gauge-polythene-lined-jute bag and jute bag. There was a control of where no agrobotanical was applied. The agorobotanicals were prepared by

drying the materials and grinding in a hammer mill and sieving through a 0.2mm sieve. The dry powder obtained after sieving was used as the extract. The experiment was conducted at the Crop Science research laboratory, University of Nigeria Nsukka. Nsukka is located at latitude 06^{o} 52" N and longitude 07^{o} 24" E, and at 447m above sea level, and is characterized by lowland tropical humid conditions.

The experiment was a 5 x 3 factorial laid out in completely randomized design (CRD) with three replications. The factors were five agrobotanical extracts and three types of storage bags, which resulted to 15 treatment combinations. Before storage, samples of the chips were taken for dry matter content determination. This was done using the standard oven method, that is drying known weight of the sample at 60^{0}C for 72 hours. One kilogram of the chips numbering 39-44 chips were put into each storage bag, and 10g of each of the agrobotanical extracts was then mixed with the chips, and the bags tied with a twine. The bags were arranged on wooden shelves in the laboratory. The bags were opened after 3 months and then at 6 months for determination of dry matter loss, storage insect activities and mould incidence. Dry matter loss was determined by weighing, using an electronic mettler balance. Insect activities were determined by counting the number of holes per piece of chip. Each chip of dried yam was evaluated for mouldinesss. Mouldiness was established if a patch of discolouration was found on any chip. The mouldiness of each bag was expressed as a percentage of the total number of yam chips in each bag. Visual quality was assessed by scoring in a 5 point hedonic scale for presence of blemishes on the dried chip whereby 1= very high, 2 = high, 3 = moderate 4 = low and 5 = very low blemishes. Panelists for assessment of visual appearance consisted of twenty postgraduate students of the University of Nigeria who were familiar with the acceptable appearance of stored yam chips. All data collected were statistically analyzed with SAS version 8 at the International Institute of Tropical Agriculture, Ibadan, Nigeria.

RESULT

After 3 months of storage, chip dry weight loss was significantly lower with treatments of *Azadiractha indica, Occimum gratissimum, Zingiber officinale* than with *Xylopia aetiopica* and the control (Table 1). Insect activity (number of holes per chip) was least in *A. indica* treated chips, and the general order of insect activity was Control > *X. aethiopica* > *Z. officinale* > *O. gratissimum* > *A. indica.* After 6 months of storage, dry matter losses were significantly lower with *A. indica, O gratissimum, and X. aethiopoca* treated chips than with *Z. officinale* and control chips.

Table 1: Effects of agrobotanical treatments on dry weight (DWt) loss, number of holes per chip, mould incidence and visual quality of dried yam chips after 3 and 6 months of storage.

	After 3 months of storage				After 6 months of storage			
Agro botanicals	DWt. loss (%)	No. of holes/ Chip	% of mouldy chips	Visual quality score	DWt. loss (%)	No. of holes/ Chip	% of mouldy chips	Visual quality score
A. indica	1.0	8.0	2.5	4.7	3.0	10.5	13.7	3.9
O. gratissimum	2.0	9.3	0	4.0	3.0	11.3	17.2	3.4
Z. officinale	2.0	12.5	0	3.1	5.0	11.5	17.2	2.7
X. aethiopica	6.0	13.9	0	3.4	3.0	17.4	17.6	2.9
Control	13.0	18.0	0	2.6	17.0	24.1	10.1	2.2
s.e.d	0.10	3.70	Na	0.52	0.20	3.60	0.70	0.50

Visual quality was assessed by scoring on a 5 point hedonic scale for presence of blemishes on the dried chip where by 1= very high, 2 = high, 3 = moderate 4 = low and 5 = very low blemishes.
na = not analysed

Table 2: Effects of storage bags on the dry weight (DWt) loss, number of holes per chip, mouldiness and visual quality of dried yam chips after 3 months and 6 months of storage

	After 3 months storage				After 6 months of storage			
Storage bags	DWt. loss (%)	No. of holes/ chip	% of mouldy chips	Visual quality score	DWt. loss (%)	No. of holes/ Chip	% of mouldy chips	Visual quality score
Polythene	1.0	9.5	0	3.7	3.4	10.9	1.7	3.5
Polythene-lined jute	1.7	14.5	0	3.3	3.5	17.1	7.7	2.9
Jute alone	1.6	13.1	1.5	3.3	5.4	16.9	34.9	2.7
s.e.d	0.02	4.70	0.60	0.70	0.03	4.60	8.40	0.64

Visual quality was assessed by scoring on a 5 point hedonic scale for presence of blemishes on the dried chip where by 1= very high, 2 = high, 3 = moderate 4 = low and 5 = very low blemishes.

Insect damage was significantly higher in the control than when treated with any of the agro botanicals. The agrobotanicals did not differ among themselves on their effects except for *A indica* treatment where there was less insect damage compared with *X. aethiopica.* Three months after storage, mould occurred only in *A. indica* treated chips. Mould incidence after 6 months was least in the control chips, which gave significantly lower values than the agrobotanical treated chips. Among the agrobotanicals, *A. indica* had the least mould incidence of 13.7. Visual quality of chips was better in agrobotanical treated chips than in non-treated control chips after 3 months of storage. After 6 months of storage *A. indica*-treated chips had significantly the highest visual quality value which did not differ with the value for *O. gratissimum* treated chips. The Control, *Z. officinale and X. aethiopica* treated chips had the least visual quality.

Three months after storage, polythene bags produced the least dry matter loss (1.0%) which was significantly lower than the values for jute bag and polythene-lined-jute bag (Table 2). The number of insect holes per chip did not differ with the type of storage bag. Chips in polythene and polythene-lined jute bags had mould growth after three months in storage. Visual quality assessment score was however, highest with polythene bag treatment. At six months, the yam chips in jute bag were significantly (P< 0·05) mouldier than those in polythene or polythene-lined-jute bags.

The dry yam chips stored in polythene bag treated with *A. indica, O. graticimum and X. aethiopica* were significantly higher in visual quality than non-treated chips (Table 3). Yam chips treated with *A. indica* had significantly (P=0·05) low blemishes compared with the other agrobotanicals and control. Polythene bag appeared to have preserved the yam chips better than the other type of bags.

Table 3: Effects of agrobotanical treatments and the type of storage bags on the visual quality assessment of dried yam chips after six months of storage

	Storage bags			
	Polythene	**Polythene-lined jute**	**Jute**	**Mean**
A. indica	4.7	3.7	3.6	4.0
O. gratissimum	4.3	2.3	3.7	3.4
X. aethiopica	4.0	3.3	2.3	3.0
Z. officinale	2.3	3.0	2.7	2.8
Control	1.5	1.0	2.6	2.7
Mean	3.7	2.7	3.0	3.2

s.e.d for 2 bags means =0.64
s.e.d.for 2 agrobotanical means = 0.52
s.e.d for 2 agrobotanical x bag means = 0.95
Visual assessment was based on presence and degree or absence of blemishes on the dried chips.1 = very high, 2 = high, 3 = moderate, 4 = low, 5 = very low blemishes

Correlation analysis revealed that dry matter weight loss was highly and positively related with insect damage (r =0.92) but highly and negatively related with visual quality (r = -0.86) (Table 4). Insect damage was also highly and negatively related with chip quality score at the end of storage.

Table 4 Correlation analysis for insect activities, mouldiness, dry weight loss and visual quality of dried yam (D. rotundata) after 6 months of storage

	Insect holes	**Mould incidence**	**Visual quality**	**Dry Weight**
Dry weight loss	0 .9152*	0.1557ns	- 0.8919***	- 0.3600*
Insect holes		0.197ns	-0.8688**	- 0.4042*
Mould incidence			-0.2438ns	.0042ns
Visual Quality				.0337ns

*** Significant at P<0 .0001 **Significant at P <0.001

*Significant at P<0.05 Ns =Not significant

DISCUSSION

The lower dry matter loss in the stored yam chips following treatment with *Azadiractha indica, O. gratissimum* and *Z. officinale* was evidently, in part, due to the reduction of insect activities and damage. Highly positive correlation (r = 0.95) existed between insect pest holes (pest activities) and dry weight loss. Bostid (1992) reported that neem (*Azadiractha indca*) oil or neem extracts prevented pests especially the weevils (*Sitophilus spp*), from penetrating stored grains for several months. Low insect infestation of samples as evidenced by less number of holes on the chips was obtained with the leaf extract of *A. indica* followed by the other agrobotanicals. The importance of the present study is that neem leaf is always available together with the other agrobotanicals and they are easy to process. These could substitute for the neem oil produced from the seed that is only periodically available and requires more elaborate extraction process.

The yam chips absorbed moisture in storage especially with the jute bags. Kulu *et al* (1983) observed that the average percentage mouldiness on the yam chips varied from 11.8 to 84.2 with the wet months having high levels of mouldiness. In the present trial, only the jute bag samples with average mouldiness of 34.9% fell within this range whereas polythene and polythene-lined-jute bags had 1.67 and 7.69% moulds, respectively. The polythene evidently shielded the chips from the moisture of the atmosphere to a great extent. Polythene and polythene-lined-jute bags reduced moisture absorption in the stored yam chips and consequently reduced moulds and improved visual quality. It is evident from this study that the tested agrobotanicals have potentials as storage insecticides. However, more research is needed to improve on the extraction method and to determine the shelf life of the agrobotanicals.

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