Journal of
Plant Science & Research

Open Science Publications

Volume 3, Issue 1 - 2016

www.opensciencepublications.com

Post Harvest Studies on Yam Tubers *Dioscorea rotundata* Poir. Pre-Treated With Bio- Pesticides against Soil Pests and Pathogen

Research article

Aghale DN[1*], Umeh OJ[2] and Onyenobi FI[3]

[1]*Michael Okpara University of Agriculture, Umudike, Nigeria*

[2]*Michael Okpara University of Agriculture, Umudike, Nigeria*

[3]*Abia State University, Uturu, Nigeria*

***Corresponding author:** Aghale, Duke Nduka, Michael Okpara University of Agriculture, Umudike, Nigeria, Tel No: 08134005735; E-mail: aghalenduka@yahoo.com

Article Information: Submission: 07/04/2016; Accepted: 30/04/2016; Published: 07/05/2016

Abstract

Post-harvest loses has been the bane of yam farmers over the years negating effort, resources and time invested in crop production. Farmers need to be equipped with pesticide alternatives for yam minisett seed dressing that are affordable, available, non-toxic to man and environmentally friendly. Post-harvest investigation was conducted on yam tubers harvested from field planted with minisett yams Dioscorea rotundata cv abii pre-treated with fruit powder of Azadirachta indica and Piper guineense in comparism with Apon plus 50DS and Minisett dust (NRCRI) as seed dressing at 2.7kg/ha against soil pests and pathogens. The germination / sprouting of the yam tubers was not significantly (P>0.05) affected by the bio- pesticides. At 16 weeks in storage, all the treatments except Minisett dust significantly controlled or reduced weight loss of yam tubers. The treatments significantly controlled yam rot while Piper guineense performed best. Nematode infestation (root knot galled tuber and Scutellonem bradys cracks) on yam tubers was effectively controlled (by Piper guineense, Azadirachta indica followed by Apron plus 50DS and Minisett dust treatment. Storage insects Araecerus fasciculatus Degeer and (Coleoptera Anthribidae) attacked all pre-treated and untreated (control) tubers in storage. Analysis of the yam tuber nutrient composition showed no significant difference in carbohydrate, protein, fat ash, and fiber contents compared with the composition of the untreated tubers (control). Apron plus treatment however, appeared to lower protein content of yam tubers and the yam tissue of Dioscrea rotundata cv abii. The study concluded that the use of A. indica and P. guineense fruit dust as seed treatment will encourage shelve life and higher production of seed yams which will affect the market value of planting materials positively. Therefore it is recommended for wide spread farmers awareness and use through extension advocacy.

Keywords: Bio-pesticides; Yam mini-sett; Nematodes; Insects; Agricultural Extension

Introduction

Yam (*Dioscorea* spp.) is the major agriculture crop in Nigeria that represents about 75% of West Africa's production [1]. It is the preferred home - grown food of the 100 million Nigerians [2]. Ware Yam and Yam minisett technology are among the key packages disseminated by Agricultural Development Programme (ADP) field extension agents which have met with low adoption rate due to crop loss to pest and diseases among others [3]. Furthermore, the cost of yam production is prohibitive due to the cost of seed yams. The new minisett technology has reduced cost considerably [4]. Macro seed yam production by minisett technology has been estimated to give a commercial grower an annual profit of £7,000-13,500/ha [4]. Pests and pathogens flourish in tropical soils and without pesticide treatments, the minisetts, will completely decay in the soil [5].

Substantial losses due to infestations by plant parasitic nematodes and other soil pests and pathogens during cultivation and subsequent

ISSN: 2349-2805

rot in storage due to complex disease syndrome of nematodes/ fungi/ bacteria and viruses have been reported by several investigators [6-8,5,1] Several commercial pesticides have been evaluated for their efficacy as seed dressing materials for the control of soil pests and pathogens with subsequent effect on the quantity and quality of yam tubers at harvest and also in storage with promising results [9]. A study by World Health Organization (WHO) in1972 estimated 500,000 annual pesticide poisoning globally with about 5,000 deaths (Farah, 1994) thus highlighting dangers of some synthetic pesticides in Agriculture [10].

The most common pesticides readily available and fairly affordable by most farmers are the organ chlorines such as Aldrex T (a combination of 30% Aldrin, a cyclodiene and fungicide thiram) [11]. Due to toxicological reasons, the pesticide mainly organochlorines have been banned on food crops in developed countries [12,10].

There is a need therefore to search for pesticide alternatives for yam minisett seed dressing that are affordable available non - toxic to man and are environmentally friendly [13]. This study was designed to evaluate the effects of ethno-medicinal plants (natural products) treatment on yam minisetts pre-treated in field and on the harvested macro seed yams in storage.

Materials and Methods

Post-harvested studies were conducted on yam tubers *(Dioscorea rotundata* cv abii) pretreated at cultivation in the field with *Azadirachta indica* and *Piper guineense* (fruit powder). Minisett dust (NRCRI) (from National Root Crops Research Institute, Umudike and Apron plus 50DS (a standard insecticide/fungicides) to control soil pests and pathogen. The treatments were applied as seed dressing dust on Minisetts yam tuber at 2.7kg/ha. And were replicated four times with 20 minisetts per replicate. The field was arranged in four fully randomized blocks with one replicate of each treatment per block. Each block measured 6 x 5m (made up of 5 ridges 6m in length with 1m between blocks). Discard ridges surrounded the experimental net plots. After normal cultural practices (staking weeding and fertilizer application at the appropriate times) the yam tubers were harvested after 28 weeks.

The harvested tubers were stored in an improvised well-ventilated barn where the yams were placed on horizontal racks. The temperature in the barn was monitored with a maximum and minimum thermometer and relative humidity measurements taken using a whirling hygrometer. The minimum temperature during the period of study ranged from 22.7-28.7 ˚C, while the maximum temperature ranged from 30.7-36.6 ˚C the relative humidity at 9.00-1.000h ranged between 78 and 85% and at 15.00-16.00 between 50 and 75%.

The investigation was conducted after 16 weeks in storage on the effect of treatments on yam tubers in parameter:

i. Weight Loss of yam tubers.

ii. Sprouting/Germination of yam tubers.

iii. Pests and pathogens infestation and yam rot.

iv. Nutrient/Composition of yam tubers.

i. Total weight loss of yam tubers (Table 1): Yam tubers for the study were randomly selected from each treatment and untreated control. (Each replicate of 10 yam tubers) After 16 weeks in storage, the yam tubers from each treatment and untreated control were weighed and the percentage weight loss calculated.

Wt of yam tubers at harvest - Wt of yam tubers after 16 weeks X 100, Weight of yams at harvest

Table 1: Effect of bio - pesticide treatments at cultivation on weight loss of yam tubers after 16 (sixteen weeks) in storage.

Treatments	Replicates (kg)				*Means ± S. E.	*Mean ± S. E. %
	I	II	III	IV		
Azadirachta indica	2.5	1.26	4.6	3.46	1.95 ± 0.92 *	27.4 ± 0.3*
Apron plus 50DS	2.9	1.29	11.67	2.29	1.03 ±0.91 *	21.0 ± 1.4*
Piper guineense	2.6	1.37	1.20	2.50	1.91 ± 0.73 *	25.4 ± 4.4 *
Minisets dust	3.95	1.49	2.60	1.84	2.47 ± 0.52 *	35.4 ± 0.5
Untreated Control	2.7	2.20	2.50	2.7	2.52 ± 0.68 *	48.6 ± 0.7
ANOVA (one way)					P< 0.05	P < 0.05
LSD (0.05)					1.45	

Each replicate = 10 (ten) yam tubers *Significant difference p< 0.05 between treatment means and untreated control.

Table 2: Effect of bio and synthetic pesticide treatments on the sprouting/germination of *D. rotundata* cv abii after 14 (fourteen) weeks in storage.

Treatments	Sprouting/Replicates				*Mean ± S. E. %
	I	II	III	IV	
Azadirachta indica	14	16	18	16	84.96 ± 1.
Apron plus 50DS	19	18	18	19	95.0 ± 2.0
Piper guineense	14	12	14	16	75.0 ± 4.5
Miniset dust (NRCRI)	17	15	16	17	80.6 ± 2.4
Untreated Control	16	17	16	18	82.4 ± 1.6
ANOVA (one way)					p >0.05
LSD (0.05)					

% mean of 4 replicates (Each replicate is 20 yam tubers). ANOVA (one way): no significant difference (p>0.05) between treatments and untreated control.

Citation: Aghale DN, Umeh OJ, Onyenobi FI. Post Harvest Studies on Yam Tubers *Dioscorea rotundata* Poir. Pre-Treated With Bio- Pesticides against Soil Pests and Pathogen. J Plant Sci Res. 2016;3(1): 146.

Table 3: Effects of bio and synthetic pesticide treatments on: pests, pathogens and rot/bio deterioration of *D. rotundata CV abii in storage, after* 16 weeks.

Treatments	*Means ± S. E. Rot %	** Mean ± S. E. Insects (%)	***Mean ± S. E. Nematode Infestation%
Azadirachtaindica	15.0 ± 5.0	30.0 ± 5.8	0.0 ± 0.0
Apron plus 50DS	5.0 ± 5.0	25.0 ± 5.0	5.0 ± 0.0
Piper guineense	0.0 ± 0.00	35.0 ± 5.0	0.0 ± 0.0
Miniset dust (NRCRI)	25.0 ± 9.6	30.0 ± 5.8	5.0 ± 0.0
Untreated Control	35.0 ± 9.6	30.0 ± 5.8	45.0 ± 12.6
* ANOVA (one way)	P < 0.05	(p > 0.05)	P < 0.05
LSD (0.05)	22.85	24.68	18.86

*Mean of 4 replicates (each replicate = 20 yam tubers)
ANOVA (One way) there was significant different (p < 0.05) in rot percentage and in nematode (root-knot) infestation. No significant difference (p> 0.05) between treatments on insects.

Table 4: Effect of bio and synthetic bio pesticide treatments on yam *D. rotundata* cv abii composition after 16 (sixteen) weeks storage.

Treatments	*Mean ± S. E. (%)				
	Protein	Carbohydrate	Fat	Fiber	Ash
Azadirachta indica	4.0 ± 0.08	20.92 ± 0.029	0.40 ± 0.00	1.55 ± 0.05	3.10 ± 0.13
Apron plus 50DS	3.75 ±.05	20.74 ± 0.22	0.37 ± 0.0006	1.55 ± 0.05	3.05 ± 0.10
Piper guineense	40.05 ± 0.0.10	20.89 ± 0.043	0.38 ± 0.005	1.60 ± 0.08	3.35 ± 0.05
Miniset dust (NRCRI)	415 ± 0.05	20.95 ± 0.028	0.37 ± 0.006	1.55 ± 0.05	2.90 ± 0.06
Untreated Control	4.15 ± 0.05	20.82 ± 0.024	0.360.005	1.60 ± 0.08	3.300.06
ANOVA (one way)	P > 0.05	P > 0.05	P > 0.05	P > 0.05	P > 0.05
LSD at (0.05)	0.225	0.306	0.015	0.197	0.262

Mean of replicates (each replicate = samples from 4 yam tubers)
No significant differences (p>0.05) between treatments on Protein, Carbohydrate Fiber, Fat and Ash.

ii. Sprouting/Germination (Table 2)

Four replicates of five tubers (4x5 = 20) were randomly selected from each treatment and the untreated control. Sprouting of the yam tubers were taken after 14 weeks in storage when dormancy must have been broken.

iii. Pests infestation and rot diseases in storage (Table 3)

a. Nematode infestation at harvest was not apparent. After 16 weeks in storage, galls were apparent indicating rook-knot nematode infestation. The galled tubers were counted and recorded for each treatment and the untreated control.

b. Insect infestation

The total numbers of adult insects found on the yam tubers were counted after 16 weeks and recorded for each treatment and untreated control. The main insects found were identified as *Araecerus fasciculatus* Degeer (Coleoptera: Anthribidae). (A yam storage insect).

c. Yam rot (complex disease syndrome of micro-organisms). Total number of yam tubers affected by rot disease were counted for each treatment and the untreated control and recorded.

(iv). **Yam tuber composition (Table 4)**

Analysis of yam composition of treated and untreated yam tuber sample were conducted for protein, carbohydrate, fat, ash and fiber contents at the Food Science/Biochemistry Laboratory at National Root Crop Research Institute (NRCRI) Umudike.

Results and Discussion

Effects of Treatment on Weight loss of yam tubers (Table 1).

After sixteen weeks in storage, tubers treated with *Azadirachta indica*, *Piper guineense* and Apron plus significantly controlled weight loss ($p < 0.05$) when compared with the untreated control. There was no statistically significant difference ($p > 0.05$) between yam tuber weight losses of treatment with Minisett dust (NRCRI).

(ii) **Effect of Treatments on Sprouting (Germination) of yam tubers (Table 2).**

After 14 (fourteen) weeks in storage, the effect of all the treatments showed no significant difference ($p > 0.05$) on sprouting of yam tubers compared with the untreated control. *Piper guineense* treatment appeared to inhibit germination while Apron plus 50DS treatment appeared to stimulate sprouting.

(iii) **Post-harvest Pest and pathogen infestation and yam tuber rot (Table 3).**

Azadirachta indica, Piper guineense, and Apron plus 50 DS treatment significantly controlled the rate of insect attack on all

Citation: Aghale DN, Umeh OJ, Onyenobi FI. Post Harvest Studies on Yam Tubers *Dioscorea rotundata* Poir. Pre-Treated With Bio- Pesticides against Soil Pests and Pathogen. J Plant Sci Res. 2016;3(1): 146.

treatments compared with the untreated control. There was no significant difference (p> 0.05) on the rate of insect attack on all treatment compared with the untreated control. Apron plus 50DS was the best in insect control. *Azadirachta indica, Piper guineense,* Apron plus and Minisett dust significantly controlled nematode infestations as indicated by galls (root-knot nematodes) and cracks with (*Scutellonem abradys*).

(iv) Effect of Treatments on yam tuber composition (Table 4).

Treatments of *Azadirachta indica*, *Piper guineense,* Minisett dust had no significant different effect (p > 0.05) on the carbohydrate, protein fat, and ash fiber contents of yam tubers. Protein content of yam tubers treated with apron of 50DS was lower than that of other treatments and untreated control.

Discussion

The objective of this research is to evaluate the effectiveness of biologically-based and environmentally safe natural products as alternative control methods for soil borne pests and pathogens, to replace toxicologically dangerous organochlorines such as methyl bromide, Aldrex T and carbonate carbofuran in yam protection, during cultivation and storage.

Coursey reported that nearly 50% of yam tubers were often lost after six months in storage due to yam metabolic processes (respiration and transpiration) and/or pest and pathogen infestation [14]. In this study the natural products controlled weight loss by directly controlling pests and pathogen activities.

After dormancy (a physiological rest period? yam tuber during which sprouting is suppressed), sprouting or germination starts. Sprouting can be inhibited in storage to prolong dormancy with gibberellin or stimulated with naphthalene acetic acid (NAA), [15].

Yam tuber treatments at 4 week in storage had no statistically significant difference (P>0.05) on sprouting. However, Onyenobi, et al., (in press) observed that *Piper guineense* treatments appeared to inhibit yam set sprouting after four weeks in storage compared with other natural product treatments. In this study, *Piper guineense* appeared to inhibit sprouting. *P. guineense* treatment proved very effective in the control of nematode infestation and yam bio - deterioration followed by Apron plus 50DS and *Azadirachta indica.* Onyenobi *et al*.,(in press) reported that *A. indica* and *P. guineense* leaf extract reasonably controlled bio-deterioration of yam tubers induced by root knot nematodes during storage, which further confirms the efficacy of these natural products in the control of yam rot disease.

Insect groups responsible for bio- deterioration of yam tubers in storage are *Coleoptera* (beetle) and *Lepidoptera* (moths and butterflies), [16]. *Araecerus fasciculatus* Degeer (Coleoteran ; *Anthribidae*) attacked the yam tubers in storage despite the treatment application. Possibly the natural products degraded to non- toxic concentrations hence the lose of effectiveness. The synthetic pesticide Apron plus50DS appeared to control insect infestation in storage best.

Conclusion

The biologically based natural products had no deleterious effects on the yam tuber composition (protein carbohydrate fat ash, and fiber). Apron plus 50DS appeared to reduce the protein content of the yam tubers and also gave a pink coloration, Pesticides constitute environmental problems and the recent analysis by an Environmental protection Agency reported that mortality rates estimates that the use of pesticides carbofuranalone has resulted in 1-2 million deaths in birds in United States of America annually, including some endangered and threatened birds [17]. *A. indica* and *P. guineense* are used for ethno medicinal practices and as food spices in Nigeria. They are readily available affordable accessible and non-toxic to man and the environment. They are easily propagated and produced, also could be encouraged as seed dressing bio-pesticides in crop production and storage treatments.

Recommendations: The use of *A. indica* and *P. guineense* fruit dust as seed treatment will increase shelve life and production of seed yams which will affect the market value of planting materials positively. Therefore it is recommended for wide spread farmers awareness and use through extension advocacy.

References

1. FAO (1993) FAO yearbook, FAO Rome Italy: 95.
2. Adesiyan SO (1995) Studies on the infection of yams by *Scutellonema bradys* (steiner Lettew).
3. Umeh OJ (2016) Comparative Performance Evaluation of the State ADPs in Nigeria. (Effective Extension Delivery Services). Lambert Academic Publishing. USA. Pp 160-167.
4. IITA (1995) Annual Report for 1995 (International Institute of Tropical Agriculture, Ibadan, Nigeria.
5. Onyenobi F, Ieoma (1986) Chemical control of Meloidogyne species (Nematoda) in yam (*Dioscorea rotundata* Poir.) production. Ph. D thesis of Imperial College London. (University of London) 262p.
6. Okafor N (1966) Microbial rotting of stored yams (*Dioscorea spp)* in Nigeria. Exptl Agric 2: 178-182.
7. Bridge J (1972) Nematode problems with yams (*Dioscorea spp*.) in Nigeria. PANS 18: 89-91.
8. Bridge J (1973) Nematodes as pest of yam in Nigeria. *(*scutellonema bradys, Pratylenchus).
9. Onyenobi F, Ijeoma (1993) Evaluation of commercial pesticides for protection of *Dioscorea rotundata* from *Meloidogyne incognit*a at cultivation. Advances in Yam Research 2: 34-41.
10. IRPTC (1994) Progress in implementation of the FAO/UNEP joint Programme on prior informed consent. Journal of the International Register of potentionally Toxic Chemicals devoted to information of hazardous chemicals 12: 8.
11. Onyenobi F, Ijeoma (1996) Pesticide Use and Misuse in Nigeria Fasmen Communication Okigwe Nigeria. ISBN 961-2362-68-5.
12. Visweswariah K, Jayaram M, Majumder SK (1975) Environmental pollution with pesticides. Journal of Food Science and Technology 2: 53-60.
13. BOSTID (1992) National Research Council; NEEM, a tree for solving global problems. *Brachyuru sMeloidogynincognita, Rotylenchus reniformis*). Meded Fac. Landbouwet. Riika University Gent. 38: 841-852.
14. Coursey DG (1967) Post- harvest problems of yam. Paper presented to 1st International????.
15. IITA (1986) Annual Report for 1986 (IITA) Ibadan. Nigeria.
16. Okwor GC, Asiedu R, Ekanayaka IJ (1998) Food yams. Advances in Research.
17. Hoppin PR, Liroff A, Miller MM (1997) Reducing reliance on pesticides in Great Lakes Basin Agriculture. Washinton D.C; world Wildlife Fund.

Citation: Aghale DN, Umeh OJ, Onyenobi FI. Post Harvest Studies on Yam Tubers *Dioscorea rotundata* Poir. Pre-Treated With Bio- Pesticides against Soil Pests and Pathogen. J Plant Sci Res. 2016;3(1): 146.