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Pesticide Science and Pest Control
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ISSN: 2833-0943

RESEARCH ARTICLE

Yield and Post-Harvest Pest Status of Some White Yam (*Dioscorea rotundata* Poir) Landraces in Uyo Southeastern Nigeria

Ikeh, A.O[1]*., Umelo, C.Q1. & Ndaeyo, N.U[2]

[1]*Department of Crop Science, Faculty of Agriculture, University of Agriculture and Environmental Sciences, Umuagwo, Imo State, Nigeria.*

[2]*Department of Crop Science, Faculty of Agriculture, University of Uyo,Uyo, Akwa Imo State, Nigeria*

Corresponding Author:* Ikeh, A.O Department of Crop Science, Faculty of Agriculture, University of Agriculture and Environmental Sciences, Umuagwo, Imo State, Nigeria

Received: 07 March 2023; **Accepted:** 15 May 2023; **Published:** 24 April 2023.

Citation: Ikeh, A.O., Umelo, C.Q. and Ndaeyo, N.U. (2023), Department of Crop Science, Faculty of Agriculture, University of Agriculture and Environmental Sciences, Umuagwo, Imo State, Nigeria. Pesticide Science and Pest Control.2[2]. DOI10.58489/2833-0943.018

Abstract

Field experiment was conducted at National Cereals Research Institute (NCRI),Uyo out- Station in 2012 and 2013 to evaluated yield and post-harvest pest status of some yam landraces in Nigeria. The experiment was laid out in a randomized complete block design (RCBD), replicated thrice. Treatments were eight white yam landraces; Nwopoko, Obiotorugo, Offala, Hambakwashe, Aloshi, Udeanyi, Pepa and Eteme and one improved yam cultivar TDr 89/02665. Data obtained from yield and pest severity were subjected to analysis of variance. Result showed that Hambakwase produced significant tuber yield of 31.10 and 33.01 t/ha in 2012 and 2013, respectively. Obioturugo produced 28.18 and 28.02 t/ha, respectively. Eteme produced the least tuber yield of 16.23 and 15.33 t/ha. Udanyi had significant higher number of rotten tubers per plot at harvest; 2.41 and 2.08 in both years. At 3 months in storage, Offala had significant dry rot of 1.73 and 2.01, followed by 1.61 and 0.91 dry rot tubers per plot, recorded in Aloshi. Number of wet rot tubers per plot as influenced by white yam landraces at 3 months storage varied significantly different ($p<0.05$). Udanyi had significant higher number of wet tuber rot; 4.30 and 3.22 in 2012 and 2013. Presence of mealy bug infestation were seen Offala, Aloshi,Udanyi and Eteme in 2012. In 2013, Offala, Udanyi, Eteme and TDr 89/02665 had mealy bug infestation. .Among the yam landraces, scale insects were observed in the following; Obioturugo, Hambakwase and Udanyi in 2012 while in 2013, Obioturugo, Udanyi and Eteme had presence of scale insect in tubers at 3 months storage. This study therefore recommended Hambakwase and Nwopok for high tuber yield, less susceptible to rot, beetle and termite attack. Also, these promising yam landraces showed be incorporated into yam breeding programme in Nigeria.

Keywords: *yam, landraces, yield and post-harvest, pest.*

Introduction

Yams (*Dioscorea* sp) belongs the family of *Dioscoreacea*. They are annual or perennial tuber-bearing and climbing plants. Yam is a versatile crop, it can be consumed as boiled yam, fried yam, baked yam or roasted yam as eat with palm oil, stew or sauces (Etokeren, 2016). Yam can equally be consumed as pounded yam and eat with vegetable sauce or soup. There is limited or little international trade in yam, although significant trade in yams occurs within the various producing areas in derived savannah, southern and northern guinea savannah of Nigeria. Cultivation of yam in southern Nigeria is associated with many traditional and religious ceremonies, which no other crop has such recognition. In Igbo land, southeastern part of Nigeria, yam is the only crop that has its god known as Ahajioku. They believe, Ahajioku control the growth, yield and storability of the crop. At each stage of the production process, rituals and traditional religious practices are performed for the success of the crop. As the crop maturity approaches, a date will be fixed for new yam festival. Normally, farmers may not harvest or consume new yams before the date (Onwueme and Sinah, 1991; Ikeh et al 2015). It is noteworthy that no other crop in African is associated with great amount of social, religious and cultural activities than yam. Yam features prominent in thanksgiving, marriage and ritual worship. Yam is being regarded as men crop while cocoyam is regarded as women crop. It occupies a place in many traditional ceremonies and in a special diet for mothers in confinement after child birth. In many communities in Nigeria especially in southeastern, yam is reorganized as a prestige crop, whosoever that produced the largest yam tuber is every community is crown as *Ezeji* (King of Yam).

Furthermore, yam production contributes to food security and income in West Africa. Almost 94% of the worlds' yam production is from this region, and 75–78% of it is from Nigeria (FAO (Food and Agriculture Organization of the United Nations), 2017). Yam ranks as the most important source of dietary calories in Nigeria and is the country's most important crop in terms of gross value of production (about $11.3 billion US dollar,FAO (Food and Agriculture Organization of the United Nations), 2017). The crop directly supports the food and income security of almost a third (31.8%) of the population in the country (Mignouna et al., 2014). Out of 11 cultivated species of *Dioscorea* in Nigeria, four are of major importance in southeastern Nigeria; *Dioscorea rotundata*, *Dioscorea alata*, *Dioscorea cayenensis* and *Dioscorea dumenterum,* that are economically, social and cultural important in Nigeria. Nigeria is the largest yam producer in the world, contributing to two-thirds of global yam production each year; and, according to the GHS-Panel, 46 percent of households in the post-planting season, and 53 percent of households in the post-harvest season, reported consuming yams in the week preceding the interview (NBS, 2022). Yams are the fifth most widely harvested crop in Nigeria (following cassava, maize, guinea corn/sorghum, and beans/cowpeas); and, after cassava, the most commonly harvested tuber crop. In 2010/2011, the National Bureau of Statistics in collaboration with the World Bank conducted the General Household Survey Panel (NBS, 2022).

Yam breeding initiatives in Nigeria have sought to improve the quality and availability of seed yam of improved varieties in Nigeria with little or no effort to improve or identify some desirable traits in most of existing yam landraces. Over the past two decades, 24 improved varieties of yam have been released in Nigeria (African Yam, 2018). However, the adoption rate and accessibility of new yam varieties is low in Nigeria and other parts of West African region (IITA, 2020). The reasons for low adoption of the improve yam cultivars could be that most of the yam farmers have little or no knowledge of yield potential and pest status of these yam varieties. Pest is a major challenge that hinders or reduced farmers interest in yam cultivation (Ikeh et al, 2017).

In Nigeria, the extent of affliction has over the time coupled with low tuber yield had been aggravated by the low access of improved (resistant/tolerant) yam cultivars and the inability of subsistence yam farmers to afford the cost of judicious control measures. In most yam producing communities in Nigeria, most of the post-harvest damage to the tubers occurs in storage. Insect pests can be the cause of serious yield losses in stored tubers. Surveys carried out in 1981, 1983 and 1984 in Coˆ te d'Ivoire showed increasing levels of infestation of stored yams over a period of 4 months of storage, with 63% of stored tubers being infested by moths and weight losses of 25% attributed to the insects (Sauphanor and Ratnadass 1985). Feeding damage by H. meles, P. caniculus and A. hartii allows fungal infections to develop in the tubers (Acholo et al. 1997). Results have been revealed that tubers with cut surfaces are more prone to attack by Lepidoptera than those with unbroken epidermis, possibly because first-instar larvae are better able to penetrate the skin of the former (Iheagwam and Wojtusiak 1989). Signs of infestation are visible externally as holes filled with larval faecal matter held together by silken thread produced by the larvae themselves (Iheagwam 1986; Iheagwam and Wojtusiak 1989). A. hartii (Asiedu et al. 2001), H. meles and H. appius (Tobih et al. 2007) continue to be important insect pests of yam tubers in storage because of favourable temperatures and humidity in storage rooms. H. meles was reported to be the single largest cause of yam tuber rots (Acholo et al. 1997). Storage facilities with poor ventilation favour heavy infestation by P. dioscoreae on newly emerged sprouts (Quin 1985). Stored yam tubers were found to be infested by Xyleborus ferrugineus (Fab.) (Coleoptera: Scolytidae) in Nigeria (Williams 1988). Infestation started in November when the tuber moisture content was about 62%. Eggs were laid on the tuber surface damaged during harvesting and the first-instar larva burrowed inside the yam. Research at the Central Tuber Crops Research Institute (CTCRI), Trivandrum, India, revealed that A. hartii and Araecerus laevigatus were the key pests of Lesser Yam (D. esculenta) in storage (Pillai and Rajamma 1997). In addition to these two insects, Coffee Bean Weevil, A. fasciculatus, damages tubers of Greater Yam D. alata (Lal and Pillai 1997; Pillai and Rajamma 1997). In D. alata, 16% of the samples and in D. rotundata 60% of the samples were infested by A. fasciculatus after 2 months of storage. A. fasciculatus completes its life-cycle in 30– 40 days in D. alata and D. rotundata (Rajamma et al. 2004).

Many workers have recorded variation in infestation of tubers of different species of yam, but it is not known what factor is responsible for such a differential attack; differences in the quantities of alkaloids and other secondary plant metabolites have been postulated. In India, between 1979 and 1982, several genotypes of D. alata, and D. esculenta were found to be susceptible to A. hartii; however, D. bulbifera and D. hispida were free of A. hartii (Abraham et al. 1979). The mealybug Ferrisia virgata was observed only on D. dumatorum (Nair et al. 1982). The Central Tuber Crops Research Institute (CTCRI) has released varieties of yam suitable for cultivation by farmers in different parts of India. Five genotypes of D. alata, Sree Keerthi, Sree Roopa, Sree Shilpa, Sree Karthika and Orissa Elite are resistant to A. hartii. In Nigeria, during 1998 to 1999, 24 D. rotundata varieties were evaluated for their resistance against YMV transmitted by several aphids. In a screen house evaluation involving mechanical and vector transmission, three varieties remained free from YMV infection, confirming resistance to YMV (Hughes et al. 1998). Natural seed set is rare in D. alata and D. esculenta. However, hybrid seeds and sexual progeny were successfully produced through germplasm exploration, judicious selection and timely planting of flowering accessions to achieve flowering synchrony of males and females, and through artificial pollination techniques. Sree Shilpa, the first intervarietal hybrid of D. alata was released for cultivation in 1998 in India (CTCRI 1998). Data obtained on development and longevity of Yam Moth, D. rugosella, on different yam species D. alata, D. rotundata, D. cayenensis and D. dumetorum showed that D. alata was the most susceptible of all yam species tested (53.3

Material and Methods

The study was carried out during the 2012 and 2013 cropping seasons at the National Cereals Research Institute, Uyo-out station. Uyo is located at (Latitude 5017' and 5027'N Longitude 7027' and 7058'E and altitude 38.1m above sea level). This rainforest zone receives about 2500mm rainfall annually. The rainfall pattern is bimodal, with long (March - July) and short (September - November) rainy seasons separated by a short dry spell of uncertain length, usually during the month of August. The mean relative humidity is 78%, atmospheric temperature is 300C and the mean sunshine hours is 12 (Peters *et al*., 1989). The site was under fallow for 2-years after being planted maize, okra and fluted pumpkin intercrop.

The nutrient composition of soils of the experimental site at 0-30 cm depth was: 1.76% Organic matter, 0.70 % Nitrogen, 101.33 mg/kg Phosphorus and 1.11 cmol/kg Potassium. The soil pH of the experimental plot was 5.50. The major dominant vegetation cover were mainly Elephant grass (*Cynodon* spp.) and Siam weed (*Euphatorium odorata*).

Land preparation was manually done with machetes, spade and native hoe. The site, after clearing was left to dry and the trashes of were raked and packed at the borders. The experimental layout was measured 40 by 22 m (880m2). Each plot size was 5 by 3 m. Each plot and replications were demarcated by 1 m pathway. Mounds were constructed at a distance of 1m x 1m. A randomised complete block design was used and replicated three times. Eight white yam landraces from different yam belt of Nigeria were evaluated (Nwokpoko, Obiotorugo, Offala, Hambakwashe, Aloshi, Udeanyi, Pepa and Eteme) and National white yam check (TDr 89/02665) constituted the treatments. The yam landraces were obtained from the National Root Crop Research Institute (NRCRI) Umudike. Before planting, yam setts were treated with a mixed solution of a pesticide cocktail prepared as follows: Macozeb (70g powder) + Chlorpyrifos (75 ml) + Tap water of 10 litres, to encourage wound healing and prevent entry of pathogenic organisms on cut surfaces that could spoil the setts. Yam setts of the same landrace was properly labelled in a net bag and dip it into the solution for 10 minutes, and then leave them in a shaded tree for 24 hours to allow the cut surface to dry.

Planting was done in March in both years at the crest of mounds and uniform pre germinated setts yam sett weighed of 200g was used in each treatment. Planting was done depth of 15 cm in the crest of mounds. Grasses were used as mulching material to reduced sett damage by heat before and after sprouting. The experimental plots and its surrounding of 3 m paths were weeds free. A combination of diuron (a systemic pre-emergent) and glyphosate (a contact) herbicide were applied in a mixture of diuron and glyphosate at 2.3 L and 1.8 L, respectively, per hectare rate. The application was done at 7 days after planting (DAP) of the yam. Subsequent manual weeding with aid of weeding hoes were done at 2 and 4 MAP.

Staking was done at I MAP. Bamboo sticks 3 meters height was used. Regular guiding and training of the yam vines to the stakes were was carried out twice a week for proper twining during the active growth of the plant. Harvesting of tubers was done at 9 MAP on treatment basis when all the yam landraces attain 100% senescence. Harvesting was done with carefully digging the tubers out of soil with aid of stout pegs, cutlass and spade. The harvestable net plot were carefully marked. All harvested tubers from the plot are packed on the harvested spot in each plot and prepared label tags for the corresponding plot assigned for collection of relevant harvest data and proper storage of tubers after data collection.

Data Collection and Analysis: Pest and diseases data generated were. Yam growth, yield and yield components recorded were number of tubers per plant, length of tuber, circumference of tuber and tuber yield, number of rotten tubers, presence of mealy bug, presence of galls in a tuber, yam tuber beetle feeding holes per tuber, termite feeding holes per tuber, percentage yam tuber beetle and termite attack per yam landrace. The harvested tubers were physically examined for termite and beetle feeding holes. The identified holes were counted with aid of black marking pen. Percentage tuber attacked by the termite and beetle were calculated by subtracting all tubers with termite and beetle feeding holes from the total number of tubers harvested in each plot. This was further divided by the total number of tubers harvested per treatment and multiple by 100. Data collected were subjected to analysis of variance, significant means were compared with least significant difference (LSD) at 5% probability leve.l

Results and Discussion

Table 1: Yield and Yield Components of White Yam as Influenced by Landraces

White Yam Landraces	***2012***			***2013***		
	Tuber Length (cm)	***Circumference of Tuber (cm)***	***Tuber Yield (t/ha)***	***Tuber Length (cm)***	***Circumference of Tuber (cm)***	***Tuber Yield (t/ha)***
Nwokpoko	*40.07*	*31.19*	*26.06*	*41.34*	*33.20*	*26.18*
Obioturugo	*28.33*	*43.01*	*28.18*	*29.01*	*41.77*	*28.02*
Offala	*39.11*	*25.12*	*20.99*	*40.33*	*26.59*	*19.76*
Hambakwase	*48.13*	*39.20*	*31.10*	*47.56*	*40.80*	*33.01*
Aloshi	*27.34*	*22.12*	*24.22*	*28.18*	*23.43*	*23.34*
Udanyi	*29.13*	*38.45*	*18.11*	*27.00*	*37.77*	*19.14*
Pepa	*31.19*	*25.90*	*23.18*	*33.11*	*27.52*	*25.33*
Eteme	*19.55*	*22.44*	*16.23*	*20.22*	*23.09*	*15.33*
TDr 89/02665	*30.23*	*33.20*	*21.12*	*33.81*	*35.00*	*20.40*
LSD(p<0.05)	***3.17***	***4.43***	***3.23***	***2.91***	***3.55***	***3.67***

Tuber length as influenced by white yam landrace is shown in Table 1. Hambakwase had significant longer tuber; 48.13 and 47.56 cm in 2012 and 2013, respectively. Tuber of 40.07 and 41.34 cm in 2012 and 2013, respectively was recoded in Nwopoko. The shortest tuber; 19.55 and 20.22 cm respectively was recorded in Eteme. Tuber circumference as influenced by white yam landraces is shown in Table 1. The Obioturugo had significant larger tuber circumference; 43.01 and 41.77 cm in both cropping seasons. Hambakwase had 39.20 and 40.80 cm tuber circumference in 2012 and 2013 cropping seasons, respectively. The least tuber circumference; 22.44 and 23, 09 cm, respectively was recorded in Eteme. Tuber yield as influenced by white yam landraces is presented in table 1. The results of tuber yields varied significantly different (p<0).

Table 2: Number of Tubers per Plot, Number of Rotten Tubers per plot and Presence of Galls on Tubers as Influenced by Landrace

White Yam Landraces	***2012***			***2013***		
	Number of Tubers per plot	***Number of Rotten Tubers per plot***	***Present of Galls on Tubers***	***Number of Tubers per plot***	***Number of Rotten Tubers per plot***	***Present of Galls on Tuber***
Nwokpoko	*16.45*	*0.00*	*1*	*17.40*	*0.00*	*1*
Obioturugo	*18.33*	*0.74*	*2*	*18.89*	*0.10*	*2*
Offala	*12.45*	*0.33*	*2*	*11.81*	*0.18*	*1*
Hambakwase	*20.34*	*0.00*	*1*	*21.05*	*0.00*	*2*
Aloshi	*11.45*	*0.00*	*1*	*12.11*	*0.00*	*1*
Udanyi	*9.77*	*2.41*	*2*	*10.55*	*2.08*	*2*
Pepa	*10.02*	*0.00*	*1*	*10.33*	*0.00*	*1*
Eteme	*8.65*	*1.31*	*2*	*9.01*	*0.94*	*2*
TDr 89/02665	*15.10*	*0.00*	*1*	*13.13*	*0.00*	*1*
LSD(p<0.05)	***2.83***	***0.77***	*-*	***3.14***	***0.21***	*-*

Table 2 shows number of tubers per plot as influenced by white yam landraces, the result showed significant difference in both cropping seasons. Hambakwase had significant higher number of tubers per plot; 20.34 and 21.05 in 2012 and 2013, respectively. This was followed by 18.33 and 18.89 tubers per plant, respectively, recorded in Obioturugo. The least number of tubers per plot; 8.65 and 9.01 was recorded in Eteme. Number of rotten tubers per plot as influenced by yam landraces is shown in Table 2, The result varied significantly different among the yam landraces, Udanyi had significant sever number of rotten tubers per plot at harvest; 2.41 and 2.08 in 2012 and 2013 cropping seasons, respectively. Eteme had 1.31 and 0.94 rotten tubers per plot in 2012 and 2013 cropping seasons, respectively. No rotten tubers at harvest were recorded in Nwopoko, Hambakwase, Aloshi, Pepa and improved variety (National check- TDr 89/02665, irrespective of cropping seasons (Table 2). Present of galls in yam tubers were checked at harvest. Based on physical observation, The re were present of galls in obioturugo, Offala,Udanyi and Eteme in both 2012 and 2013 while no present of galls in Nwopoko, Hambakwase, Aloshi, Pepa and TDr 89/02665 in both 2012 and 2013 cropping seasons (Table 2)

Table 3: Presence of Mealy bug, Scale Insect on Tuber at Harvest

White Yam Landraces	***2012***		***2013***	
	Mealy Bug	***Scale Insect on tubers***	***Mealy Bug***	***Scale Insect on tubers***
Nwokpoko	1	1	1	1
Obioturugo	1	2	1	2
Offala	1	1	2	1
Hambakwase	1	1	1	1
Aloshi	1	1	1	2
Udanyi	2	2	2	2
Pepa	2	1	1	1
Eteme	2	2	2	2
TDr 89/02665	**1**	**1**	**1**	**1**

1=Absent, 2= Present

Result showed present of mealy bug infestation on the following while yam landraces; Udanyi, Pepa and Eteme in 2012 while in 2013 cropping season, mealy bug infestation were recorded in Offala, Udanyi, and Eteme. No mealy bug infestation were recorded in Nwopoko, obioturugo,Hambakwase, Aloshi, and National Check (TDr 89/02665) in 2012 and 2013 cropping seasons. Presence of scale insect on tubers as influenced by white yam landraces is shown in Table 3. Scale insects were found in the following yam landraces; Obioturugo,Udanyi, and Eteme in 2012 while in 2013, presence of scale insects were observed in Obioturugo, Alosh.

Table 4: Number of Dry/ Wet Rot Tuber per Plot, Mealy bug and Presence of Scale Insects on Tubers under 3 Months Storage

White Yam Landraces	2012				2013			
	Number of dry Tuber Rot per plot	Number of Wet Tuber Rot per plot	Mealy Bug	Scale Insect on tubers	Number of dry Tuber Rot per plot	Number of Wet Tuber Rot per plot	Mealy Bug	Scale Insect on tubers
Nwokpoko	0.00	0.00	1	1	0.00	0.10	1	1
Obioturugo	0.00	1.89	1	2	0.00	1.33	1	2
Offala	1.73	0.00	2	1	2.01	0.70	2	1
Hambakwase	0.00	0.51	1	2	0.00	0.80	1	1
Aloshi	1.61	0.87	2	1	0.91	0.60	1	1
Udanyi	0.10	4.30	2	2	0.00	3.22	2	2
Pepa	0.00	0.00	1	1	0.00	0.00	1	1
Eteme	0.00	3.73	2	1	0.00	3.13	2	2
TDr 89/02665	0.00	0.11	1	1	0.00	0.25	2	1
LSD(p<0)	**0.**	**0.28**	**-**	**-**	**0.31**	**0.34**	**-**	**-**

Udanyi and Eteme. Number of dry rot tubers per plot at 3 months storage as influenced by white yam landraces is shown in Table 4. The result showed significant difference (p<0>

Number of wet rot tubers per plot as influenced by white yam landraces at 4 months storage is presented in Table 3. The result varied significantly different (p<0>

Table 5: Yam Beetle and Termite Attack at Harvest

White Yam Landraces	2012				2013			
	Number of Beetle feeding holes per tuber	Number of Termite feeding holes per plot	% Number of Tubers attacked by Beetle	% Number of Tubers attacked by Termite	Number of Beetle feeding holes per tuber	Number of Termite feeding holes per tuber	% Number of Tubers attacked by Beetle	% Number of Tubers attacked by Termite
Nwokpoko	0.00	0.00	9.33	0.00	0.00	0.00	0.00	0.00
Obioturugo	4.13	0.00	16.50	0.00	4.33	0.00	14.45	0.00
Offala	5.01	0.00	18.56	0.00	7.08	0.00	22.17	0.00
Hambakwase	0.00	0.00	0.00	0.00	0.00	0.00	1.78	0.00
Aloshi	0.00	1.55	0.00	1.45	0.00	1.08	0.00	2.77
Udanyi	8.77	3.12	45.11	13.12	10.53	2.40	49.51	10.63
Pepa	0.00	0.00	0.00	0.00	0.33	0.00	0.32	0.00
Eteme	4 .51	0.55	20.14	7.80	6.45	0.20	30.12	2.16
TDr 89/02665	0.10	0.00	0.99	0.00	0.17	0.00	1.45	0.00
LSD(p<0.05)	**2.11**	**0.75**	**4.17**	**2.04**	**2.25**	**0.18**	**3.19**	**2.11**

Number of beetles feeding holes per tuber as influenced by white yam landraces is shown in Table 5. The severity of yam tuber beetle attack was significantly higher in Udanyi; 8.77 and 10.53 per tuber in 2012 and 2013, respectively. This was seconded by 5.01 and 7.08 feeding holes per tuber recorded in Offala in both cropping seasons. Yam tuber beetle feeding holes recorded in Eteme was 4.51 and 6.45 in 2012 and 2013, respectively (Table 5). There were no yam beetle feeding holes in the following yam landraces; Hambakwase, Aloshi, Pepa and TDr 89/02665 in 2012 cropping season. In second year trial, the following yam landraces; had no beetle feeding holes; Nwopoko, Hambakwase, Aloshi and Pepa.

Number of termite feeding holes per tuber as influenced by white yam landrace is shown in Table 5. Udanyi had significant higher termite feeding holes per tuber; 3.12 and 2.40 in 2012 and 2013, respectively. Number of termite feeding holes recorded in Aloshi was 1.55 and 1.08, respectively. There were no termite feeding holes in Nwopoko,,Obioturugo, Offala, Hambakwase, Pepa and TDr 89/02665 in both cropping seasons. Comparing the percentage yam tuber attacked by yam beetle (Table 5), Udanyi had significant higher percentage of beetle attack, 45.11 and 49.51 % in 2012 and 2013, respectively. Eteme had 20.14 and 30.12 % yam tuber attack in 2012 and 2013, respectively. Percentage termite attack as influenced by yam landraces differed significantly different (p<0>

Discussion

The result of the study showed significant variation in yield and yield components of white yam landraces. There was no record of any genetic improvement of these yam landraces. The differences observed in yield may be attributed to varietal differences. Tuber yields were highest in Hambakwase and Obioturugo. Nwopoko, Aloshi and Pepa were among the yam landraces that out-yielded National check (TDr89/02665). The Nwopoko, Hambakwase, Aloshi, Pepa and TDr 89/02665 had no tuber rot at harvest, compared to the Udanyi and Eteme. Although, Offala and Obioturugo had less number of rotten tuber at harvest. The differences observed in terms of number of rotten tuber per plot could be that some yam landraces like Hambakwase and Nwokpoko were more tolerant to causal organism that are responsible to rot at harvest. From the result, presence of galls were recorded in Obioturugo, Offala, Udanyi and Eteme in both cropping seasons. Four of the yam landraces (Nwopoko,,Hambakwase, Aloshi,Pepa and improved cultivar TDr89/02665 had no visible galls at harvest indicating that those landraces may be tolerant or resistance to nematode infection on tubers.

Hambakwase, Obioturugo and Nwopoko were among the yam landraces that produced higher number of tuber per plot, longer and larger tuber circumference. The higher tuber yield obtain from these yam landraces were as a result of inherent characteristics of different yam cultivars. The actual number of roots which eventually from tubers depends on several factors including genotypes, assimilate supply, photoperiod and temperature (IITA, 1990; Ikeh eta al, 2012). Despite genetic make-up of the crop, resistance to biotic stress such as insect pest, pathogens, nematodes also would encourage good quality tubers (Ikeh, 2010 and Ikeh et al, 2012). Tuber yield also is a dependent on its photosynthetic efficiency and assimilation rate of such yam cultivar which usually correlate with leaf area, leaf area duration and crop management practices. The influence of biotic stress especially pest and disease resulted into leaf area reduction and destruction of leaf chloroplast and invariably reduced tuber formation and yield as well as damaging or deteriorating the yam tubers. Estimate of 50% reduction in tuber yield, reduction in tuber size and weight in infected yam (D. rotundata) had been reported (Russel, 1981 and Agbaje et al; 2003).

Result showed that Udanyi and Eteme were severely affected by yam tuber beetle and termite. The high level of infestation recorded could be due chemical constituent of the yam landraces were desirable to both insect pest. This agrees with the report of Degras (1993) that the disparities observed in the infestation level and the severity between yams cultivars could be partly attributed to their biochemical composition. The tolerance/resistance of some yam genotypes to termite and yam beetle observed in some genotypes could be attributed differences in biochemical constituent, differences in tuber initiation, formation and maturation. Tuberisation of most of the genotypes could coincide with the peak destructive periods of yam tuber beetle and termite population density. Pest attack recorded in most yam landraces such as Hambakwase and Nwokpoko could be that biochemical constituent of some of the yam landraces deters yam tuber beetle, termite and nematode infestation. This observation agrees with findings with earlier report of Gaidamashvili et al, (2004), that the roles of yam lectins and saponins are believed to play an important role in host plant defense against insects.

The result showed significant increase in number of rotten tuber. Udanyi and Eteme which had the significant higher number of tuber rot were among the landraces that were severly affected by yam tuber beetle. This could be that feeding holes created by yam tuber beetle and termite predisposed the tubers to rot. This agrees with the report of Asiedu et al. (2001), that yam tuber beetle Heteroligus meles (Billberger) (Coleoptera: Dynastidae), was considered to be the single largest cause of yam tuber rot in Africa. According to Tobih et al. 2007, yam setts are attacked by the adults of H. meles shortly after planting. H. meles also feeds on tubers, making holes of 1–2 cm diameter prior to harvest, resulting in a low market value and a predisposition to fungal and bacterial infections in the field and during storage.

Conclusion

Yam cultivation is faced with serious challenges of pest and diseases especially in rainforest ecology of Nigeria. The extent of identification of some promising yam cultivars that could natural resist or tolerate pest and disease at minimal level will go in long way in promoting yam cultivation in the area. This study therefore identified and recommended Hambakwase and Nwopok landraces for high tuber yield, less susceptible to rot, beetle and termite attack. Also, these promising yam landraces showed be incorporated into yam breeding programme in Nigeria.

Acknowledgements

The authors are grateful to Dr John Ikeorgu. of National Root Crop Research Institute (NRCRI) Umudike, Umuahia for supplying the yam landraces and Dr (Mrs) Etokeren, U.E., Head of Department Agricultural Technology, Akwa Ibom State College of Science and Technology for her technical assistance

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