Market Survey of Insect Pest Infestation of Dried Root and Tuber Products across Nigeria-Benin Land Border

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Abstract

A detection survey was conducted to assess infestation of dried cassava chips, yam chips and yam flour transported across Nigeria-Benin land border. Twelve stored products insect pest species and one mite were found in the samples collected across the two countries. Insect pest population found on the consignments from Benin Republic was significantly ($\alpha \leq 0.05$) higher than those found on consignments from Nigeria. Trogoderma granarium (Everts), Sitophilus granaries (L), Sitophilus zeamais (Motschulsky), Cryptolestes ferruginensis (Stephens), Ploidia interpunctella (Hubner), Lasioderma serricome (Fabricius) and Acarus siro were found to be insect pests and mite of quarantine significance to dried cassava chips in Nigeria. Relevance of enforcement of Standard quarantine laws amidst trade liberalization are discussed.

Key words: Land border, stored products, insects, quarantine, and trade liberalization

Introduction

In West Africa, especially Nigeria, Benin Republic, Togo and Ghana, yam flour, dried cassava chips and yam chips constitute important source of carbohydrates in the diet of the citizens of these regions (Okereke and Nwosu, 1987). Chips from cassava and yam are processed mainly for the purpose of self-sufficiency as well as for obtaining income and foreign earnings, (Cock, 1985 and Stabrawa, 1991). In yam and cassava growing areas of tropical African countries especially Nigeria, cassava and yam are converted to flour and utilized in different forms. Although, yam is regarded as the traditionally most acceptable source of flour over other crops like cassava, cocoyam and plantain Ekundayo, (1986) reported that the conversion of yam tuber to flour is recommended as a suitable and convenient method of storing the crop to prevent post harvest losses encountered during storage.

As reported by Okigbo and Nwakammah (2005) yam storage losses are usually attributed to post harvest pathogens and insect pests. Insects often infest the chips during the process of drying and also in storage. Stored product insect pests cause high losses in the storage of yam flour, yam and cassava chips (Hodges et al., 1985). According to the same authors these pests infest not only flour and chips but also other foods which are stored under tropical conditions. However, most of these insect pests are alien to the tropics but were inadvertently transferred across different land borders through natural means or human activities (Mcfarlane, 1988; Dick, 1998; Pike et al, 1992; FAO, 2005 and Steward-Jones, 2007). Accordign to ICPM (2005), human activities constitute the major route through which new or unknown insect pests are introduced into a previously uninfected area resulting in serious pest outbreak. International trade of plants and plant products without the involvement of plant quarantine services has described as one of the major human activities by which dangerous insect pests are introduced into another country (Anon, 2005).

The land borders across Nigeria and Benin Republic has been reported to be more porous and prone to illegal importation of plant and plant products without conforming to the plant quarantine rules and regulations for importing such items (Anon, 2005). This unwholesome practice where sanitary and phytosanitary laws are evaded under several guises such as trade liberalization has resulted in huge amount of crop damage and high loss due to serious outbreak of insect pest infestation of most economic crops in Nigeria. (Compton et al., 1993).

Root and tuber crops are important part of tropical African diets. However, increase in their production is constrained by infestation of stored product insects in the storage. Information on the incidence of insect pest infestation of dried root and tuber products (cassava chips, yam chips and yam flour) transported across West Africa sub-region is scarce. This detection survey was carried out to assess the incidence of insect pest infestation of dried root and tuber products imported and exported across Nigeria and Benin land borders and recommends means of preventing the spread of the detected insect species to non-existing regions or zones.

Materials and methods

Sampling technique

The samples were collected across Nigeria-Benin land border. Purposive sampling technique was used to select seven land border on the report of high rate of trans border trading activities and that these land borders were also found to be the most busy in the south western zones of Nigeria (Opeke, 1994, Anon., 2005).Two markets were randomly selected through balloting from each of the seven border points to give fourteen markets. Samples of cassava chips, yam chips and yam flour were purchased at random from ten sellers of such produce in each market place. One hundred and forty samples of 500g of each of dried cassava chips, dried yam chips and yam flour were collected at 30 days interval for four (4) months (August – November) in 2005.

All samples were placed in sealed cellophane bags and labeled appropriately to avoid contamination. These samples were subjected to import and export regulations on plant and plant products for relevant approval from Nigerian Quarantine Service of Federal Ministry of Agriculture before taken to laboratory for analysis at Plant Quarantine Unit's Laboratory at the Moor Plantation, Ibadan, Nigeria.

Laboratory analysis and data collection

250g of each of the sample were incubated in a bottle jar in the laboratory for 30 days. At the end of incubation period, the samples were sieved with 5, 10 and 20mm mesh to remove dead and living insects and separated into Petri dishes. Data were collected on detection and identification of insect species and mites. Type, growth stages of insect pests and mite species encountered whether dead or alive in each sample were identified using binocular or hand lens as the case may be and counted. This procedure was repeated every 30 days for each of the samples in each of the four sampling periods. The jars containing the produce were arranged on workbench in a complete randomized design with four replications.

Data analysis

Data were analyzed using analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) at $\alpha \leq 0.05$ level of significance (Gomez and Gomez, 1984).

Results and discussion

Insect pests of stored products were found on all the samples of dried root and tuber products collected across Nigeria and Benin Republic land borders. Twelve insect pest species made up of the order coleoptra, Lepidoptera and one mite (Arachnida) dominated the insect pest population found on the sample from both countries. Significant difference was observed in the population and types of insect pest infestation of the different produce and across the two countries (Tables 1-4). Dried cassava and yam chips was significantly ($\alpha \leq 0.05$) infested by *Prostephanus truncates (Horn)* (Coleoptera; Bostrichidae) in both countries though much more abundant in Nigeria than Republic of Benin.

This insect species according to Hodges (1995) could cause losses of up to 70% of cassava and yam chips after storage for four (4) months. Stewart-Jones et al. (200&0 described the insect as a serious exotic beetle of pest of stored maize and cassava in Africa. Series of studies have revealed that tropical roots and tubers being an important carrier of carbohydrates, contribute greatly to securing the basic nutrition.

This particularly applies to the countries of the humid tropics in Africa where these food commodities often secure over 50% of the nutrients for local populations (Oyenuga, 1968; FAO, 1990; Okereke and Nwosu, 1997; Okigbo; and Ikediugwu, 2000; Hillocks, 2002). This suggests that there is a need for intervention by all stakeholders especially governmental agencies; to evolve strategic plan to check the spread of the *P. truncates* across the sub-region. This is important as its further spread to the species free regions, could initiate hunger and famine in root and tuber dependent community especially in the tropics.

Table 1 shows that across the two countries, twelve insect pest species were found on the cassava chips samples before and after incubation. Of the twelve insect pest species, only six were found infesting cassava chips samples obtained from Nigeria land borders. The results in Table I show that the population of insect pest species found on dried cassava chips consignment from Benin Republic land border was more than those found on sample from Nigeria land border except for *P. truncatus*. This suggests that importation of dried cassava chips from Benin Republic to neighbouring countries within the West Africa coast could spell doom for the importing country considering the high insect pest infestation rate of dried cassava chips from Benin Republic.

It is highly imperative for countries sharing border with Benin Republic to enforce and ensure strict compliance with quarantine laws by produce importers as well as travelers. This would help to prevent accidental introduction and spread of these insect pests associated with dried cassava chips, other plant and plant products to the species free zones either by natural means or human activities.The result revealed that, *Trogoderma granarium* (Evers), *Sitophilus granaries* (L), Sitophilus zeamais (Motshculsky), *Cryptolestes ferruginensis* (Stephens), *Ploidia interpunctella* (Hubner), *Laisoderma serricome* (Fabrucius) and *Acarus siro* are insect pests and mite of quarantine significance to dried cassava chips in Nigeria.

The implication of this is that the above listed insect pest species are of potential economic importance to the Nigeria cassava chips industry since they are not yet present but not widely distributed (Table 1). It therefore becomes necessary for the Federal Ministry of Agriculture to ensure adequate quarantine measures that will nib the spread and eventual outbreak of these insect pest species in the bud.Similarly, samples of yam chips from Benin Republic were shown to possess higher insect pest species and population that those samples from Nigeria (Table 2). The reason for the high insect infestation population might not be unconnected with inadequate or lack of effective and standard quarantine regulations which, permits illegal inflow of plants and products with impunity into Benin Republic.

Adequate sanitary and phytosanitary measures through adherence to the standard quarantine laws (Youdeowei *et al* 1999 and FAO, 2005) has become an urgent and important issue for all the countries sharing border with Benin Republic.In contrast, sample of yam flour from Nigeria land border had significantly higher insect pest species and population than those from Benin Republic (Table 3). Yam flour is an important part of the Nigerian diet, unlike in the other parts of West Afirca sub-region (Ekundayo, 1986) hence; the high insect species and population. The methods of processing the yam flour according to Okigbo and Nwakammah (2005) predisposes the flour to insect pest infestation.

In order to preserve the commodity from insect pest infestation better processing methods that prevent insect pest infestation needs to be developed to make the commodity acceptable at international markets.*Acarus siro* a storage mite was found on both cassava and yam chips in Benin Republic, while it was not detected on sample of produce obtained from Nigeria land borders (Table 1 and 2). The mite is known to attack cereal grains, animal feed, cassava chips and is widespread across the globe but not yet found in Nigeria (Lewis, *et al*, 1995). Their detection from samples from Benin Republic portends serious danger for Nigerian dried root and tuber produce as produce from Benin Republci may find their ways into Nigeria markets through illegal means whereby produce traders and travelers circumvent the laid down quarantine procedures and import plant and plant products habouring the mite.

There is need for urgent pest risk assessment exercise to be conducted across the major markets in south western Nigeria in order to ascertain *Acarus siro* introduction and prevent its further spread. In addition, strict compliance with quarantine rules should be enforced on all produces especially root and tuber produce from Benin Republic so as to prevent introduction and eventual spread of this dangerous mite in Nigeria.

Conclusion

This study revealed that root and tuber produce samples from the Republic of Benin had more insect pest population and species that those obtained from Nigeria. This suggest that there is the need for the government of Benin Republic to strengthen the sanitary and phtosanitary regulations guiding movement of plant and plant products in and out of the country to prevent introduction of insect pest across the border. This becomes necessary as studies have shown that most of the insect pests found in samples from Benin Republic were alien to Africa but were inadvertently introduced into the continent perhaps due to trade liberalization or poor sanitary and phytosanitary practices (Wright, Akou-edi and Stabrawa 1983; Dick, 1988; Haines, 1991; Golob, et al 1996; FAO, 2006 and Stewart-Jones, 2007) by the importing nation.

It is essential to engage official control concept toward the containment of insect pest species associated with root and tuber products in Nigeria where P. truncatus was abundant and in Benin Republic where Acarus siro was detected. In addition, empowerment of quarantine officials in the form of manpower development become expedient in order for them to be able to cope with the emerging challenges associated with trade liberalization versus movement of plant and plant products across different geographical zones.

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Table 1: Mean population of adult insect pests associated with cassava (Manihot esculentus (L. Cranz) chips across Benin-Nigeria land border before and after incubation.

Insect Pest Infestation before Incubation

s/no.	Insect species	Common name	Order	*Mean insect Population	
				Benin	Nigeria
1.	*Tribolium cofusum*	Confused flour beetle	Coleoptera	22.25c	ND
2.	*Sitophilus granaries*	Rice beetle	Coleoptera	52.25bc	ND
3.	Cryptolestes ferruginenesis	Rust-red grain beetle	Coleoptera	3.00	ND
4.	*Trogoderma granarium*	Khapra beetle	Coleoptera	98.75b	5.75bc
5.	*Lasioderma serricorne*	Cigarette beetle	Coleoptera	86.00b	ND
6.	*Protesphanus truncatus*	Larger grain borer	Coleoptera	178.25a	246.25a
7.	*Sitophilus zeamais*	Maize weevil	Coleoptera	40.25bc	3.00c
8.	*Araecerus fasciculatus*	Cofee weevil	Coleoptera	2.05c	8.50b
9.	*Ephestia cautella*	Tropical warehouse moth	Lepidoptera	3.00c	ND
10.	*Sitotroga cerealella*	Angoumois grain moth	Lepidoptera	2.5c	ND
11.	*Plodia intepounctella*	India meal moth	Lepidoptera	45.75bc	ND
12.	*Acarus siro*	Spider mite	Arachnida	62.75b	ND

Insect Pest Infestation after Incubation

s/no.	Insect species	Common name	Order	*Mean insect Population	
				Benin	Nigeria
1.	*Tribolium cofusum*	Confused flour beetle	Coleoptera	26.50e	ND
2.	Sitophilus granaries	Rice beetle	Coleoptera	143.00bc	ND
3.	*Cryptolestes ferruginenesis*	Rust-red grain beetle	Coleoptera	62.50cd	ND
4.	*Trogoderma granarium*	Khapra beetle	Coleoptera	246.50b	17.25bc
5.	*Lasioderma serricorne*	Cigarette beetle	Coleoptera	228.25b	6.25d
6.	*Protesphanus truncatus*	Larger grain borer	Coleoptera	516.00a	554.25a
7.	*Sitophilus zeamais*	Maize weevil	Coleoptera	136.00c	12.25c
8.	*Araecerus fasciculatus*	Cofee weevil	Coleoptera	7.25e	36.5b
9.	*Rhizophertha dominica*	Lesser grain borer	Coleoptera	2.75e	ND
10.	*Ephestia cautella*	Tropical warehouse moth	Lepidoptera	10.50e	3.25d
11.	*Sitotroga cerealella*	Angoumois grain moth	Lepidoptera	10.50e	ND
12.	*Plodia intepounctella*	India meal moth	Lepidoptera	89.75d	ND
13.	*Acarus siro*	Spider mite	Arachnida	170.00b	ND

*Means followed by the same letters for each produce are not significantly different at $\alpha < 0.05$ND = Not detected.

Table 2: Mean population of adult insect pests associated with dried yam (Dioscorea rotundata Poir) chips across Benin-Nigeria land border before and after incubation.

Insect Pest Infestation before Incubation

s/no.	Insect species	Common name	Order	*Mean insect Population	
				Benin	Nigeria
1.	Sitophilus granaries	Rice beetle	Coleoptera	28.75b	ND
2.	Protesphanus truncates	Larger grain borer	Coleoptera	32.75b	71.25a
3.	Sitophilus zeamais	Maize weevil	Coleoptera	ND	3.75
4.	Araecerus fasciculatus	Cofee weevil	Coleoptera	ND	22.75b
5.	Rhizopertha dominca	Lesser grain borer	Coleoptera	0.25c	5.75c
6.	Plodia intepounctella	India meal moth	Lepidoptera	92.75a	ND
7.	Ephestia cautella	Tropical warehouse moth	Lepidoptera	ND	0.25c
8.	Acarus siro	Spider mite	Arachnida	27.57b	ND

Insect Pest Infestation after Incubation

s/no.	Insect species	Common name	Order	*Mean insect Population	
				Benin	Nigeria
1.	Sitophilus granaries	Rice beetle	Coleoptera	104.50b	ND
2.	Protesphanus truncates	Larger grain borer	Coleoptera	319.75a	269.00a
3.	Sitophilus zeamais	Maize weevil	Coleoptera	82.75b	9.0c
4.	Araecerus fasciculatus	Cofee weevil	Coleoptera	5.00c	102.25b
5.	Rhizopertha dominca	Lesser grain borer	Coleoptera	1.50c	7.50c
6.	Ephestia cautella	Tropical warehouse moth	Lepidoptera	ND	4.25c
7.	Acarus siro	Spider mite	Arachnida	94.00b	ND

*Means followed by the same letters for each produce are not significantly different at $\alpha < 0.05$ND = Not detected.

Table 3: Mean population of adult insect pests associated with yam flour across Benin-Nigeria land border before and after incubation

Insect Pest Infestation before Incubation

s/no.	Insect species	Common name	Order	*Mean insect Population	
				Benin	Nigeria
1.	Protesphanus truncatus	Larger grain borer	Coleoptera	2.5a*	3.75ab
2.	Ephestia cautella	Tropical warehouse moth	Lepidoptera	ND	8.00a

Insect Pest Infestation after Incubation

s/no.	Insect species	Common name	Order	*Mean insect Population	
				Benin	Nigeria
1.	Protesphanus truncatus	Larger grain borer	Coleoptera	4.5A	23.00ab
2.	Ephestia cautella	Tropical warehouse moth	Lepidoptera	ND	32.00a
3.	Araecerus fasciculatus	Coffee weevil	Coleoptera	ND	2.50b

*Means followed by the same letters for each produce are not significantly different at $\alpha < 0.05$ND = Not detected.