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A STUDY OF INSECT PEST INFESTATIONS ON STORED FRUITS AND VEGETABLES IN THE NORTH EASTERN NIGERIA

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ABSTRACT
A Survey of insect pest infestations on dried fruits and Vegetables in the north eastern region of Nigeria was obtained from market men and women in Monday and Gambaro markets (Borno State), Potikum and Gashua markets (Yobe State), Muda Lawal and Central Markets (Bauchi State), Yola and Jimeta Markets (Adamawa State) Jalingo and Wukari Markets (Taraba State) and Central and Kasuwan Mata (Gombe State). The experiment was set up in the Department of Crop protection Entomology Laboratory, University of Maiduguri for the period of three months. Twenty of each sample of dried fruits and vegetables were initially assessed of their level of infestation and each sample was assessed monthly to know the number of infested and uninfected. The experimental containers were set up in complete randomize block design with three replications. The result showed that among the dried fruits, Chinese date *Ziziphus spinachrisk* (*Z. mauritania*), balanites (*Balanites aegyptiaca)*, Tamarind (*Tamarindus india)* were seriously attacked while date palm (*Phoenix dactylifera*) were less infested. Among the dried vegetables, chill pepper (*Capsicum frutescens L.)* Tomato (*Lycopersicon esculentus Mills*) and Bell-shaped pepper (*Capsicum annum L.*) were severely infested while dried okra (*Abelmoschus esculentus L. Moench*) was less infested during the three month storage period. The result showed that *Tribolium castaneneum* (Herbst,*Plodia interpunctella* (Hubn), *Ephestia coutella* and *Trogoderma granarium* were found to infest all the dried fruits and vegetables during the study period. There were other insect species identified which were associated with dried fruits and vegetables such as *Stegobium penicium* (L.) (=*Sitodrepa panicea)* and *Teneboides mauritanicus* (L.). The infestation of these stored dried fruits and vegetables led to loss of quantity, quality and market value. Adoption of modern drying technologies, occasional re-drying, good packaging and storage facilities coupled with good market structures will reduce the losses of these valuable crops.

KEYWORDS: dried, fruit, Vegetable, insect, infestation.

INTRODUCTION

Vegetables and fruits are cultivated on small and large pieces of land annually during rainy and dry seasons in Northern Nigeria to ensure adequate and all year round provision of fresh and dried fruits and vegetables are highly perishable, so they need to be preserved to enhance their life span (Williams *et al.*, 2002). Most fruits and vegetables are dried and stored after harvest to preserve them from post – harvest pest deterioration and loss (Tindall, 1983, Walter, 2002). Some of the vegetables are dried after minimal processing like slicing (okra, eggplant and pumpkin), cutting (vegetable leaves), drying (onions, tamarinds, Roselle, fig fruits, thyme, clove, peppers, date palm, Chinese date, desert date) (Okunade *et al.*, 2001).

Most vegetables and fruits are dried in sun or shade for sometimes to reduce moisture content which usually encourages insects, diseases and micro –organisms infestations (Mound, 1989). Fruits and vegetables if not properly dried and stored in good storage facilities get infested and are damaged beyond use.Dried fruits and vegetable are the major economics of the people living in the dry Savanna region of Northeastern Nigeria. The drying of the vegetables and fruits help in prolonging their lifespan, hence making the commodities available at the time the fresh produce are not available in the farmers fields and also minimizes their deterioration by insect pests and micro-organisms (Lale, 2002).Drying fruits and vegetables help farmers sell the products during offseason at higher price (Degri, 2007).The drying of the fruits and vegetables help in reducing the moisture content to about 9-12% in the drier areas of Nigeria therefore minimizing the activities of storage insect pests and pathogens (Okunade *et al.,*2001*,* Lale, 2002). The major dried fruits and vegetables commonly used marketed in North eastern Nigeria include tomatoes, peppers, okra, sorrel, kenaf, amaranths, balanites leaves and fruits, onions, date palm, tamarinds, Chinese date, moringa leaves, bitter leaves, and others (Okunade *et al*., 2001).

Major insect pests that were associated with stored dried fruits and vegetables in the dry savanna zone of Nigeria include confused flour beetle (*Tribolium casteneum),* rust red grain beetle (*Cryptolestes ferugineus*) Steph.), cadelle (*Tenebroides mauritanicus)* khapra beetle (*Trogoderma granarium* EV.), drugstore beetle (*Stegobium paniceum* L.), coffee bean weevil (*Araecerus fasciculatus* (Deg.), Australian spider beetle (*Ptinus tectus* Boield) cigarette beetle (*Lasioderma serricorne* F.), *Ephestia elutella* Hubn), Indian meal moth (*Plodia interpunctella* Hubn),

flour mite (*Tyroglyphus farinae* L.) and *Sitophilus spp*. (Lale, 2002,Walter, 2002,Williams *et al.*, 2002).

MATERIALS & METHODS

A study was conducted on the insect pests infestation of stored dried fruits and vegetables in the dry North eastern region of Nigeria between January 2011 – March 2011. The specific objectives of the study was to investigate the major insect pests that attack stored dried fruits and vegetables in the five states located in the North eastern region of Nigeria namely Borno,Yobe, Bauchi, Gombe, Taraba, and Adamawa States. The experiment used dried fruits like Balanites (*Balanites aegyptiaca*), Tamarind (*Tamaridus indica*), date palm (*Phoenix dactylifera*), Chinese date (*Ziziphus Muritannia*) and dried vegetables like tomatoes (*Lycppersicon lycopersicon*), okra (*Abelmoschus esculentus*), hot pepper (*Capsicum frustenscens*) and sweet Bell – shaped pepper (*Capsicum annum*). Twenty each of the dried fruits and vegetables were used for the study which was conducted in the Department of Crop Protection Entomology Laboratory, University of Maiduguri for three months. Twenty of the samples were inspected after every one month to investigate the numbers that were infested and non-infested and the percentage of infestation of the products calculated. Each dried fruit and dried vegetable was opened using a sharp table knife tip and the inside of the dried fruit and vegetable observed under a hand lens for the presence of insect pest. Those dried fruits and vegetables that have the presence of frass or cocoon or the live or dead insect larva or adult were recorded as being infested, while those without those signs were recorded as uninfested.

The live insect observed and collected on those dried fruits and vegetables were killed using 70 $^{0}/_{0}$ alcohol and labeled property according to the product that was collected using masking tape and a permanent market. The collected insect pests from the dried fruits and vegetables were taking to Entomological Museum, Department of Crop Protection, Ahmadu Bello University, Institute of Agricultural Research ABU/IAR, Zaria for identification. The insects were identified accordingly.

The data collected on infested and non-infested dried fruits and vegetables were subjected to analysis of variance (ANOVA) and their means were separated using least significant different (LSD) at 5%level of probability according to Gomez and Gomez (1984).Percentage was used to determine the level of infestations within the product while LSD was used to know the level of damage among the products.

RESULTS & DISCUSSION

Result on infested and uninfected dried fruit and vegetables is presented in (Table 1).The result showed that dried okra (0.0) was not infested when collected from the marketers but the other three dried vegetables were infested. There was significant difference ($p<0.05$) among the infested dried vegetables dried tomato was infested more than the others. The result also showed that dried tamarind (0.0) was not infested when it was collected from the markets. Dried balanites fruits were more infested (7.0) followed by Chinese date (5.0) and date palm (4.0). There was significant difference among the means from one another. The highest infestations recorded under dried tomato and dried balanites indicate that they were more susceptible to storage insect pests than the other dried vegetables and fruits (Okunade *et al.*, 2001), during the study period. The lower infestations recorded under dried okra and tamarind indicate that these two dried vegetables and fruits were less susceptible to storage insect pests than the other products (Linda and Timothy, 2008) who reported that storage insect pests causes more serious damage to material they preferred and are susceptible to them. Also the amount of moisture content in the storage products (fruits and vegetables) and storage facilities and structures could encourage the high level of insect pest infestations.

TABLE 1. Effect of insect pests on dried fruits and vegetable in the North eastern Nigeria in January

Crop	infested	non-infected N=20
vegetable**s**		
Chilli (hot) pepper	5.0	15.0
Tattase (sweet) pepper)	2.0	18.0
Tomato	6.0	14.0
Okra	0.0	20.0
SE ±	1.08	3.29
LSD (0.05)	1.53	4.65
FRUITS		
Date palm	4.0	16.0
Chinese Date	5.0	15.0
Tamarind	0.0	20.0
Balanites	7.0	13.0
SE ±	0.87	2.66
LSD (0.05)	1.22	3.76

Values are means of three replicates

Table 2 show the result on the effect of insect pests on dried fruits and vegetables taken in February from some markets in Northeastern Nigeria. The result showed that dried okra (0.0) had no infestation while hot pepper (8.0), tomato (7.0) and sweet pepper (6.0) were significantly infested during the study period. All the four dried products means were significantly different ($P<0.05$) from one another.

Result showed that date palm (6.0) was less infested than Chinese date (8.0) and tamarind (8.0). Balanites was more significantly infested than the three dried fruits during the same period.

The highest infestation recorded under hot pepper and dried balanites indicate that they were more susceptible to storage insect pests them the other dried fruits and vegetables (Okunade *et al.*, 2001, Krischik, 1995, Lewis, 1995). The Low insect infestation recorded under dried okra and date palm implies that these products were not susceptible to storage insect pests. This finding agrees with findings of Okunade *et al.* (2001) Linda and Timothy, (2008).

TABLE 2: Effect of insect pests on dried fruits and Vegetables in the northern eastern Nigeria in February

Crop	infested	non-infected	N=20
Dried Vegetables			
Hot pepper	8.0	12.0	
Sweet pepper	6.0	14.0	
Tomato	7.0	13.0	
Okra	0.0	20.0	
SE ±	1.20	2.36	
LSD (0.05)	2.80	3.34	
Dried fruits			
Date palm	6.0	14.0	
Chinese date	8.0	12.0	
Tamarind	8.0	12.0	
Balanites	10.0	10.0	
SE ±	3.00	2.40	
LSD (0.05)	4.24	3.40	

Values are means of three replicates.

Result presented in (Table 3) showed that dried okra stored for three months had mean infestation (5.0) followed by sweet pepper (8.0) and tomato (10.0). Hot pepper (12.0) had the highest pest infestation during the three months storage period. Date palm had significantly the lowest pest infestation (11.0) among the dried fruits. Chinese date (13.0) and balanites (13.0) were not significantly different from one another, but significantly different from tamarind (18.0) which had the highest insect pest attack in store. The highest insect infestation recorded on dried hot pepper and dried tamarind (18.0) indicate that these two dried commodities were the most susceptible to storage insect pests during the three months storage during period. This implies that dried fruits and vegetable stored after harvest must be properly preserved against post- harvest pest infestations and lost (Tindall, 1983, Lale, 2002, and Okunade *et al.*, 2001). The drying of the fruits and vegetables is to reduce moisture content which usually encourages insects and disease infestations (Degri, 2007). Also, poor storage facilities and structures which could also cause infestations in storage should be properly kept dried and fumigated or disinfested some of these infestations could be as a result of movement of insect pests from one commodity to another and to other parts of the storage and structures when they are transported or kept together (Cranshaw, 2003). This is common with polyphagous insect pests like *Lasioderma serricorne*, cosmopolitan insects like *Ephestia cautella, Trilolium casteneum* and *Trogoderma* sp. which are serious pests on most storage dried fruits and vegetables due to their flying adults (Walter, 2008).

TABLE 3. Effect of insect pests on dried fruits and vegetables in North eastern Nigeria in March

Crop	infested	non-infested N=20
Dried vegetables		
Hot pepper	12.0	8.0
Sweet pepper	8.0	12.0
Tomato	10.0	10.0
Okra	5.0	15.0
SE ±	2.02	2.24
LSD (0.05)	2.86	3.16
Dried fruits		
Date palm	11.0	9.0
Chinese date	13.0	7.0
Tamarind	18.0	2.0
Balanites	13.0	7.0
SE ±	3.30	1.15
LSD (0.05)	4.65	1.63

Values are means of three replicate

TABLE 4 showed the mean infestation of dried vegetables and fruits after three months of storage in North eastern Nigeria. Okra (1.67) and date palm (7.00) had significantly the lowest infestation during the storage period. Dried hot pepper (8.33) and dried balanites had significantly the highest infestations. This indicate that okra and date palm were less susceptible to storage insect pests than the other dried vegetables and fruits. The highest infestation figures recorded in dried chili (hot) peppers and dried balanites indicate that they are more susceptible to storage pests during the three months storage duration than other commodities used in the study (Hodges *et al.*, 1985, Okunade *et al.*, 2001 and Lale, 2001).

TABLE 4. Mean effect of stored insect pests on dried fruits and vegetables during three months storage in north eastern Nigeria

Crop	infested	non-infested N=20
Dried Vegetables		
Hot pepper	8.33	11.67
Sweet pepper	5.33	14.67
Tomato	7.67	12.33
Okra	1.67	18.33
SE ±	1.22	1.58
LSD (0.05)	1.72	2.24
Dried fruits		
Date palm	7.00	13.00
Chinese date	8.67	11.00
Tamarind	8.67	11.00
Balanites	10.00	10.00
SE ±	2.00	1.90
LSD (0.05)	2.90	2.69

Result on Insect pest species associated with dried vegetables and fruits in North eastern Nigeria taken at different markets is presented in Table 5. The four dried vegetables and dried fruits had different insect species infestations. Okra and tamarind had the insect species attacking them during the three months storage and fruits had more other than two insect species attacking them. Okra (*Abelmosclus esculentus* L. Moench) was attacked by *Tribolium* Sp. and *Plodia interpunctella*, Tamarind (*Tamarindus indica* L.) was attacked by *Caryedon serratus* and *Lasioderma Serricorne*. Chili (hot) pepper (*Capsicum frustenscens* L.) was attacked by *Tribolium* sp., *Stegobium* sp., *Plodia interpunctella* and *Ephestia cautella*, sweet pepper *Capsicum annum* was attacked by *Stegobium penicium*, *Plodia interpunctella*, *Ephestia cautella*, and Tomato (*Lycopersicon lycopersicon* by *Trogoderma granarium*, *Tribolium casteneum, Stegobium penicium*.

Dried date palm fruits were attacked by *Trogoderma granarium, Plodia interpunctella, Sitophilus sp and Corpophilus* sp; dried Chinese date by *Tribolium casteneum, Ephestia cautella and Plodia interpunctella* and dried balanites fruits were attacked by *Tribolium casteneum, Ephestia cautella and Plodia interpunctella*.

TABLE 5. Insect species Associated with dried fruits and vegetables in North Eastern Nigeria.

Crop	Insect Species Identified
Dried Vegetables	
Chilli (hot) pepper	*Tribolium casteneum, Stegobium penicium, Plodia interpunctella, Ephestia cautella.*
Sweet (Tattase) Pepper	*Plodia intepunctella, Ephestia cautella Stegobium penicium*.
Tomato	*Trogoderma granarium, Tribolium casteneum, Stegobium penicium*, *Plodia interpunctella, Stegobium cereallela*
Okra	*Tribollium casteneum and Plodia interpunctella*
Dried fruits	
Date palm	*Trogoderma granarium*, *Plodia interpunctella Sitophilus sp and Corpophilus sp*
Chinese date	*Tribolium casteneum, Ephestia cautella*, *Plodia interpunctella*
Tamarind	*Caryedon serratus and Lasioderma serricorne*
Balanites	*Tribolium casteneum, Ephestia Cautella and Plodia interpunctella.*

CONCLUSION

Result from this study indicates that proper drying of fruits and vegetables to the required moisture content and proper storage in good storage facilities and structures will significantly reduce the losses usually caused by insect pest infestations and make them available at the time the fresh produce are not available in the farmers field. It also showed that adopting modern drying, packaging, occasional re-drying and good storage facilities and market structures will reduce the colossal losses usually encountered by the producers, marketers and users of the dried fruits and vegetables.

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