Comparative Toxicity Of *Zingiber officinale* and Deltamethrin On *Prostephanus Truncatus* (HORN)

Ejiofor, M. E[*] *and Okonkwo, N. J.*

Department of Crop Science and Horticulture, Nnamdi Azikiwe University Awka, Nigeria

KEYWORDS

Cassava chips,
Deltamethrin,
Insect Mortality
Prostephanus truncatus,
Zingiber officinale,

ABSTRACT

In Africa, Prostephanus truncatus is a destructive pest of economic importance which has deteriorative effects on dry cassava chips in storage. The present study investigates the effects of Zingiber officinale on P. truncatus on dried cassava chips . Deltamethrin was used as the reference insecticide. The plant extract was used at different concentrations (500 µg/ml ul/ml, 250ul/ml, 125ul/ml, 62.5ul/ml, 0ul/ml(control) and 0.05ul/ml(reference)) 100g of cassava chips were put in a plastic plate and treated differently with Z. officinale and Deltamethrin, the control contains only acetone, each treatment was replicated 3times .10 unsexed P. truncatus adults were put into each plate and the plates were covered with muslin cloth held with a rubber band. Results were taken after 24hrs, 48hrs, 72hrs and 7days after treatment. All the data generated was subjected to one-way analysis of variance (ANOVA) No reference in abstract. The result of the experiment showed that Z. officinale recorded one hundred percent mortality at higher concentrations of 250ul/ml and 500ul/ml,and for which time duration? its effects were similar to the reference insecticide.

*CORRESPONDING AUTHOR

me.ejiofor@unizik.edu.ng

INTRODUCTION

Cassava (*Manihot esculentus*) is a staple food crop in Africa, produced in large quantity by peasant and commercial farmers with Nigeria being the highest producer in the world .(FAO, 2013). In order to prevent its deterioration and wastage, fresh roots of cassava are converted into dried chips. The process of conversion into chips, is achieved by drying and subsequent storage for long periods until needed. However during this storage period, dried cassava chips are exposed to attack by insect pests, thus threatening food security in sub-Saharan Africa. Parker and Booth. (1979) reported that cassava chips are heavily infested during sun drying and when in store by a number of stored product pests including the larger grain borer P. truncatus (GASGA ,1993).

The Larger Grain Borer (LGB) ,*Prostephanus truncatus* (Horn) (Coleoptera : Bostrichidae), is a stored product pest beetle indigenous to Central America , where it has spread to many countries (Eppo, 2013) . In Africa, it was accidentally introduced through Tabora region of Tanzania in the late 1970s the capacity to exploit a new environment (Dick, Ress, Lay and Ofusu 1989). This pest has become a serious pest of stored maize and dried cassava in part of east, South and West Africa (Eppo, 2013). In, Southwestern part of Nigeria, the earliest reports of *P. truncatus* indicated its presence in areas of Oyo, Ogun and Lagos States, mostly in areas near the border with the Republic of Benin (Pike, Akinnibagbe and Bosque-Peres 1992) . However, Echendu and Ojo (1997) reported that *P. truncatus* has moved out of the border areas of the south-west from where it probably entered into the country but extent of spread is yet unknown. According to Espinal , Markham and Wright *(*1996), adult and larval stages of *P. truncatus* has ability to damage wide range of commodities including some roots and tubers, cereals, pulses, cocoa, coffee, groundnut and wooden structures.Objectives of the study.

MATERIALS AND METHODS

Study Area

The study was carried out in the Department of Parasitology and Entomology, at the Science Village of the Faculty of Bioscience Nnamdi Azikiwe University Awka (6°14'N ,6°14.5'N to 7°8, 6°E, 7°9'E) Anambra State (6°25'N, 7°12'E) The annual rainfall of the area ranges from 1,000mm - 1,500mm with 2 seasons – dry and rainy.

Experimental Design

The 4 experiments were laid out in 5x2x2(concentration, insecticides, varieties and processing methods) Factorial experiment in Completely Randomized Design (CRD) with each treatment repeated 3 times.

Experimental Insect Collection and Culture

The adult larger grain borer, *P.truncatus* that was used for the study was obtained from commercial produce stores in Eke Awka market. One kilogram (1kg) of the dried cassava chips containing both lavae and adult was weighed into a transparent 2kg bucket. Prior to the culturing. One kg of the dried cassava in a sealed polythene bag was refrigerated for 3 days at 4^{o}C to kill any hidden infestation. Thereafter, it was infested with the pest. The Culturing lasted for a period of 40 days under ambient laboratory temperature and humidity conditions. The newly emerged F1 adults were used for the experiment.

Source and Extraction of *Z.Officinale*

Z.officinale rhizome was sourced from Eke Awka market. Two kg each of these plant products were peeled, sliced, and dried under shade for 12days at 65^{o}C, it was thereafter pulverized. The crude extracts were extracted using n-hexane in Soxhlet apparatus. The n-hexane was removed with rotary evaporator.The extraction was carried out in Botany laboratory in the Department of Botany, Nnamdi Azikiwe University, Awka

Source of Deltamethrin

Deltamethrin 12.5 EC equivalent of 15.5g/l of active ingredient was sourced from Comfort Agro Chemical Nigeria Limited Onitsha, Anambra State,

Serial Dilution of *Z. Officinale*

The serial dilution of the crude extract was prepared in acetone using 20ml syringe to obtain 50%, 25%, 12.5% and 6.25% thus obtaining 500 ul/ml, 250 ul/ml, 125 ul/ml and 62.5 ul/ml of oil per 1 ml respectively.

Residual Effect of the Oil Extract of Zingiber Officinale and Deltamethrin

Sterilized different processed forms of cassava chips weighing100 g were put into plastic plates and treated with 2 mls of the oil extracts (500 ul/ml, 250 ul/ml, 125 ul/ml and 62.5 ul/ml), deltamethrin was applied at 0.005ul/ml. The applications were done with the aid of a syringe and mixed thoroughly. Deltamethrin was used as a reference insecticide while acetone was used as the control. The chips were air dried for one hr to enable the acetone to vapourize and a cohort of 10 *P.truncatus* of 15days old were introduced into the treated cassava chips. The plates were covered with a muslin cloth and held with a rubber-band to aid ventilation and prevent the escape of the insects. Each treatment was replicated 3 times and the set up were kept under the laboratory conditions of 25-34^{o}C and 61-92% RH. Mortalities were recorded at 24hrs, 48hrs, 72hrs and 7th day

Data Analysis

The data collected on insect mortality, damage and loss was subjected to one-way analysis of variance (ANOVA) in Genstat package 9.2 (9th edition). Difference between mean values were separated using least significant difference (LSD) at P<0.05 (Finney 1971).

RESULTS AND DISCUSSION

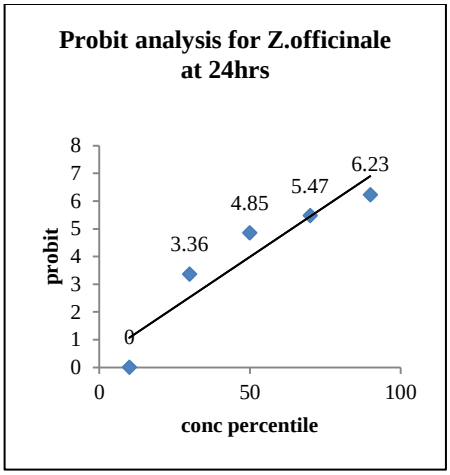
Evaluation of *Z. officinale* on mortality (24, 48, 72hours and 7 days after treatment)

The effect of concentration, on percentage mortality of *P. truncatus* at 24, 48, 72 hours and 7 days after treatment (DAT) with *Z. officinale* is presented in Table 4.1.1a. The result obtained showed that the concentration levels were significant (P < 0.05) at 24, 48, 72 hours and 7 DAT.

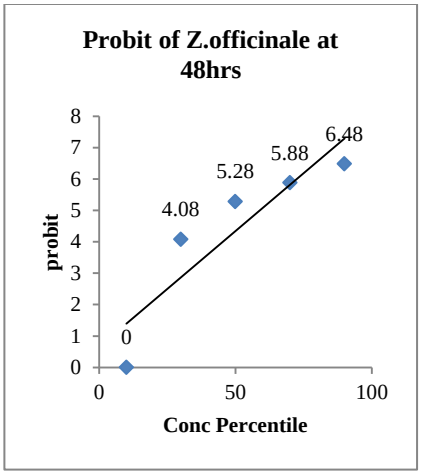
Table 1: Main effect of Concentration, on percentage mortality at 24, 48, 72 hours and 7 Days After Treatment (DAT) with *Z. officinale*

	Mortality			
Concentration (ul/ml)	24hrs	48hrs	72hrs	7DAT
Z. officinale (500)	89.17	93.33	99.17	100.00
Z. officinale (250)	67.50	80.80	92.50	100.00
Z. officinale (125)	44.17	60.83	75.83	99.22
Z. officinale (62.5)	5.00	17.50	23.33	65.00
Z. officinale (0)	0.00	0.00	0.00	0.00
Deltamethrin (0.005)	99.17	100.00	100.00	100.00
LSD (0.05)	6.048	5.200	4.675	4.303

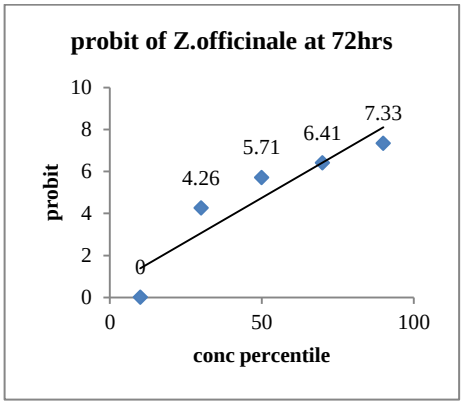
Probit analysis of *Z.officinale* at 24hrs, 28hrs, 72hrs and 7 days after treatment



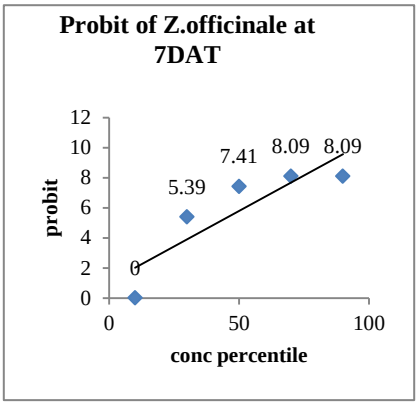
Y = ax + b
Y = 2.30x + (-0.15)
5 = 2.30x – 0.15
X = 2.239
LD50 = antilog x
LD50 = 173.4ul/ml



Y=ax+b
Y= 2.43x + (-0.032)
5 = 2.43x - 0.032
X = 2.07
LD50 = antilog x
LD50 =117.5ul/ml



y=ax+b
y = 2.70x + (-0.12)
5 = 2.70x - 0.12
x=1.896
LD50 = antilog x
LD50 = 78.7ul/ml



y=ax+b
y = 3.19x + 0.06
5 = 3.19x + 0.06
x =1.55
LD50 = antilog x
LD50 = 35.5ul/ml

DISCUSSION

In mortality assessment for *Zingiber officinale*, at 24 to 72 hours there was a significant difference ($P < 0.05$) in the concentrations. At 500ul/ml, there was 89% mortality recorded at 24hrs, which was significantly lesser than the mortality recorded in the reference which was 99%. An increased mortality was recorded in the subsequent days, which implies some of the insects responded quicker to the pesticide than others At 250ul/ml, the mortality recorded at 24hrs was 67.50% which was significantly lesser than the mortality at 500ul/ml. An increased mortality was recorded in the subsequent days. At 125ul/ml, 44% mortality was recorded after 24hrs, which is highly significantly lesser than the mortality recorded at 250ul/ml. At 62.5ul/ml, 5% mortality was recorded after 24hrs, even though there was an increased mortality in the subsequent days, this concentration will not guarantee maximum protection to cassava chips against *P. truncatus*.

On the 7th day, 125 ul/ml, 250 ul/ml and 500 ul/ml gave 100% mortality as the reference insecticide. Ogbonna *et al*. (2014), recorded similar result, according to them no survival (0%) was recorded at 700 ul/ml and 350 ul/ml after 7days of treatment.

The probit analysis which determined the LD50 (lethal dose that will eliminate 50% of the insect) shows that *Z. officinale* has a high level of toxicity. At 24hrs the LD50 recorded was 173.4ul/ml, which means that 173ul/ml of the pesticide eliminated 50% of the insect population after 24hrs. At 48hrs the LD50 recorded was 117.5ul/ml, which means that 117.5ul/ml of the pesticide eliminated 50% of the insect population after 48hrs. At 72hrs the LD50 recorded was 78.7ul/ml. which implies that 78.7ul/ml of the pesticide eliminated 50% of the insect population after 72hrs. On the 7th day the LD50 recorded was 35.5ul/ml. which means that 35.5ul/ml of the pesticide eliminated 50% of the insect population after 7days

CONCLUSION

Z. officinale was effective as the reference insecticide at higher concentration (500 ul/ml). If the concentration of *Z. officinale* used was higher than 500 ul/ml, it may have achieved same result as the reference. Using *Z. officinale* at a concentration below 500ul/ml will not proffer maximum protection to cassava chips in storage against *P. truncatus*

REFERENCES

Dick, K.M; P.P. Rees; K.K. Lay and A. Ofusu, (1989). Occurrence of the larger grain borer, *Prostephanus truncatus* (Horn) in Ghana. FAO *Plant Protection Bulletin* 37: 123-123.

Echendu, T.N.C. and B.J. Ojo, (1997). *Prostephanus truncatus* a pest of stored products in Nigeria: Pheromone trapping in western parts of Nigeria. GTZ. Part1.11. http://www. fastonline.org/CD3WD_40/INPHO/VLIBRARY/MOVE_REP/X0294E/EN/1_11.HTM

EPPO., (2013). PQR database. European and Mediterranean Plant Protection Organization, Paris, France. http://www. eppo.int/DATABASES/pqr/pqr.html

FAO.,(2013). Statistical database-FAOSTAT. Food and Agriculture Organization of the United Nations, Rome, Italy. http://faostat.fao.org/.Golob, P. (1997). Current status and future perspectives for inert dust for control of stored product insects. *Journal of Stored Products Research* 33: 69-79.

Finney, D.J. (1971): Probit analysis. 3rd edn. *Cambridge University Press. Cambridge*, UK, Pp. 333.

GASGA,(1993). Larger garin borer. *Technical Leaflet 1, Group for Assistance on System Relating to Grain after Harvest, Technical Centre for Agricultural and Rural Cooperation, Positions* 380-Netherlands, pp: 50.

Parker, B.L. and R.H. Booth, (1979). Storage of cassava chips (*Manihot esculenta*): insect infestation and damage. *Experimental Agriculture.*, 15: 145-151

Pike, V; J.J.A. Akinnibagbe and N.A. Bosque-Peres,(1992). Nigeria-larger grain borer (*Prostephanus truncatus*) outbreak in western Nigeria. *FAO Plant Protection Bulletin*. 40: 170-173.