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# Pesticidal Effect of Bitter Leaf Plant *Vernonia amygdalina* (Compositae) Leaves and Pirimiphos-methyl on Larvae of *Callosobruchus maculatus* (Coleoptera: Bruchidae) and *Sitophilus zeamais* (Coleoptera: Curculionidae)

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## ABSTRACT

The insecticidal potency of dust from leaves of *Vernonia amygdalina* was compared with Pirimiphos-methyl powder on the larvae of *C. maculatus* and *S. zeamais*. Both toxicants gave substantial control. Analysis of variance for regression gave significant difference ($P < 0.05$) between application rates of toxicant and mortality rate of the pests. It was further observed that slope of regression for effect of the herbal toxicant on larvae of *S. zeamais* was compared favorably ($P > 0.05$) with that of *C. maculates*, but differed significantly ($P < 05$) with effect of Pirimiphosmethyl on the two pest species. Pirimiphos methyl powder gave better control with $LC_{50}$ = 0.11 g and 0.15 g on *Sitophilus* and *Callosobruchus* species, respectively as against 0.30 g and 0.39 g for *Vernonia* on same pest species.

**Key Words:** Pesticidal; Compositae; Leaf plant; *Callosobruchus macultus*

## INTRODUCTION

Produce storage is traditional in Nigeria, where grains are stored principally for future consumption and securing seeds for next cropping season (Udo *et al.*, 1994; Lale, 2001). Insect pests associated with stored products include *S. zeamais* and *C. maculatus*, which are pests of maize and cowpeas respectively (Nilsa & Bosque-Perez, 1992; Dike, 1993; Markham *et al.*, 1994). Kossou *et al.* (1993) observed that larvae of *S. zeamais* feed and develop within a single maize grain. After pupation, adults bite their way out of the grain, similarly larvae of *C. maculatus* bore into cowpea, while feeding (Yowotor *et al*., 1994; Lale, 1995, 2001).

Optimum temperature of 30 $\pm$ 3°C, relative humidity of 70 $\pm$ 5%, moisture content of these grains and genetic constituent favor oviposition, rate of development and degree of infestation (Markham *et al.*, 1994; Yusuf *et al.*, 1998). During storage, these pests cause deterioration in the quality and quantity of the grains, about 30 – 50% annual loss was reported for tropical Africa (Singh *et al.*, 1990; Lale, 1995, 2001). Often the use of synthetic insecticides, have been the means of combating these obnoxious pests. But there have been reported cases of resistance, pest resurgence and secondary pest outbreaks. More so, they are highly persistent, broad spectrum and carcinogenic (Metcalf, 1980; Dinham, 1993). Hence the search for natural methods of control, which are environmentally friendly, affordable and provide supply to meet the insecticide shortage (Ivbijaro, 1990).

The bio-assayed pesticidal materials used in this study are Pirimiphos-methyl (Actellic) an organophosphate with low mammalian toxicity ($LD_{50}$) oral to rats is 2000 mg $kg^{-1}$ body weight (Mabbet, 2000). The bitter leaf plant *Vernonia amygdalina* (composite) is a soft wooded shrub that grows all over Nigeria. The leaves posses Lactone, oxalic acid and hydrocyanic acid (HCN) reported to be active principles extractable non-quantitatively by different solvents, while the hydrocyanic acids are very volatile (Uliagbafusi, 1980; Malik & Naqvi, 1994). The objectives of this study were to screen *V. amygdalina* for pesticidal activity and determine its potency in comparism to Pirimiphos-methyl.

## MATERIALS AND METHODS

Five produce stores were sampled. Infested cowpea [*Vigna unguiculata* (L.) Walp] and flint maize {*Zea mays* L.) were obtained from open market in Jalingo, Nigeria. A 400 g of the samples were separately crushed and larvae of the different pest species recorded. Furthermore, 100 g of each sample was weighed out separately into 56 Kilner jars.

Graded weight of the grounded leaves of *V. amygdalina* (0.25, 0.50, 1.00, 2.00, 4.00 & 8.00 g) and the conventional insecticide (0.625, 0.125, 0.25, 0.50, 1.00 & 2.00 g) were measured. Mortality effects were predetermined after an acute toxicity test. All tests utilize randomized complete block design (RCBD) with four replications (blocks), there were six treatments. Each set was monitored for two weeks. After sampling, the contents of each jar were lightly crushed using a pestle and mortar, number of dead larvae were recorded. The insecticidal materials were administered per salt sprinkler in sandwich pattern. Jars were vigorously shaken for proper mix up of grains and toxicant. Mouth of the Kilner jars often covered with muslin to restrict escape of emergent adult, prevent entry of other pests and enhance proper ventilation. Experimental set up were maintained at room temperature, while daily temperatures and relative humidity were recorded. Statistical method of regression analysis tested for dependence of mortalities on the toxicant application rate, the student t-test compare performance of the toxicant and the mortality rates. Probit graphs were plotted and $LC_{50}$ of the toxicants on these stored produce pests compared.

## RESULTS

Infestation level of the produce gave more larvae of *C. maculatus* from cowpeas, store D had highest infestation. While peak infestation was in store A for *S. zeamais* in maize, with a mean 55.36 and 64.48 for *C. maculatus* larvae (Table I). The mean mortalities increased with application rates of toxicant. Mortalities percentage in the control of *C. maculates*, was high hence corrected using Abbott's formular (values in parenthesis in Table II). Percentage mortalities of the pests were plotted on logarithmic graph against application rates. The regression slope of mortality curves and $LC_{50}$ for *C. maculatus* were 5.16 and 0.39 g respectively, although non-significant when compared with values for *S. zeamais* to 4.59 and 0.30 g. However, a significant effect was recorded when compared with 24.09 and 0.15 g and 17.38 and 0.11 g for effect of Pirimiphos-methyl on same pest species, respectively (Table III).

**Table I. Mean of *C. maculatus* and *S. zeamais* larvae recorded from 400 g of infested cowpea and maize in Jalingo Market 2004**

| Stored Sampled | *C. maculatus* larvae | *S. zeamais* larvae |
|---|---|---|
| A | 64.3 | 67.0 |
| B | 64.3 | 45.0 |
| C | 58.8 | 52.3 |
| D | 69.0 | 52.5 |
| E | 66.0 | 60.0 |
| Mean CV (%) = 7.8 | 64.48 | 55.36 |

**Table II. Mortality effect of toxicant on *C. maculatus* and *S. zeamais* larvae after two weeks exposure**

| Toxicant | Application rates in grams | *C. maculatus* | *S. zeamais* |
|---|---|---|---|
| | | **Corrected percentage mortalities** | |
| Bitter leaf dust | 0.00 | 07.5- | 03.3 (05.94) |
| | 0.25 | 33.5 (43.59) | 27.5 (47.22) |
| | 0.50 | 41.3 (53.19) | 35.5 (58.67) |
| | 1.00 | 47.0 (65.15) | 38.0 (61.30) |
| | 2.00 | 56.8 (83.87) | 41.3 (70.50) |
| | 4.00 | 61.0 (86.46) | 52.8 (83.74) |
| | 8.00 | 63.0 (89.82) | 51.8 (86.26) |
| Pirimiphos-methyl powder | 0.00 | 08.0- | 03.5 (05.95) |
| | 0.625 | 32.8 (42.42) | 29.3 (48.55) |
| | 0.125 | 33.8 (45.46) | 30.5 (52.13) |
| | 0.25 | 41.0 (55.69) | 35.0 (59.85) |
| | 0.50 | 47.0 (64.13) | 37.8 (63.48) |
| | 1.00 | 51.0 (72.64) | 44.3 (72.25) |
| | 2.00 | 63.3 (91.61) | 51.0 (84.60) |

Foot note: Figures in parenthesis are percentage mortalities, while in *C.maculatus* it is corrected using Abbott's formula.

**Table III. The slope of mortality curves and mortality effect of toxicant on larvae of the pest species**

| Toxicant | Pest species | Slope | LC 50 |
|---|---|---|---|
| Bitter leaf dust | *S. zeamais* | 4.59 | 0.30 g |
| | *C. maculatus* | 5.16 | 0.39 g |
| Pirimiphos-methyl powder | *S. zeamais* | 17.38 | 0.11 g |
| | *C. maculatus* | 24.09 | 0.15 g |

## DISCUSSION

This may be the first attempt to screen the plant for any pesticidal principle. Uliagbafusi (1980) suggested that leaves of this herb possess fumigant property, hence a potential pesticide. By visual observation, the cowpeas are more damaged, however there was no significant difference between infestations by larvae of two pest species. These findings may be attributed to maize being more compact with fused testa, prolific habit of cowpea beetle and differences in developmental temperatures of these pests.

Although repellency study was not conducted, emergent adults usually migrate out of the grains and become trapped within the muslin in the herbal toxicant treatments. This above was not observed in Pirimphos-methyl treatments. Therefore, it is likely that the dust might possess some repellent principles. Except for the effect of bitter leaf dust on percentage mortalities of *C. maculatus*, all other results gave significant difference, indicating a proportional relationship between application rates of the toxicants and mortality rates of the pest species.

Findings from t-test, the regression slope for effect for bitter leaf dust on *S. zeamais* and Pirimiphos-methyl powder on *C. maculatus* differed significantly. Similarly significant difference was recorded for effect of Pirimiphos-methyl on *S. zeamais* and bitter leaf dust on *C. maculatus*. From their $LC_{50}$ values, we may infer that bitter leaf dusts lethal effect was high on *Sitophilus* and *Callosobruchus* species respectively, but much lower than the effect of Pirimiphos-methyl powder on the larvae of same pest species.

Usually as temperature decreases, relative humidity increases in the laboratory. Although these greatly affects the activity of the adult insect in progeny production and feeding habits, they more or less have little or no effect on the performance of the toxicant with a mean relatively humidity 74 $\pm$ 4% and average of temperature range of 31 $\pm$ $2^0$C. Proper ventilation of the Kilner jars inhibited mould growth. Furthermore, germinal sites of the grains were not damage by the larva, hence viability was guaranteed. Survivors recorded could be accounted for by any significant cross or multiple resistance models of Ivbijaro (1990), Markham *et al.* (1994) and Lale (2002). Probably either the toxicant has not reached the larvae or some resistant strains have emerged against the herbal toxicant.

The active principles hydrocyanic acid and oxalic acid act as toxicant and antifeedant, and are probably responsible for the mortality effects. Use of potent extractives to concentrate these active principles is most recommended.

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## REFERENCE


Dike, M.C., 1994. *An Annotated Checklist and the Identity of Major Storage Insect Pests in Nigeria*. Samaru Misc. Publication no. 130

Dinham, B., 1993. *The Pesticide Hazard: A Global Health and Environmental Audit*. Zed, Books London

Ivbijaro, M.F., 1990. *Natural Pesticides: Role and Production Potential in Nigeria,* P: 24. Paper presented at the Nat. Workshop on Pesticide Industry in Nigeria. UI, $24^{th}$ - $27^{th}$ September

Kossou, D.K., J.H. Mareck and N.A. Bosque-Perez, 1993. Comparison of improved and local maize varieties with emphasis on susceptibility to *Sitophilus zeamais Motsch. J. Stored Prod. Res.,* 29: 333–43

Lale, N.E.S., 1995. An overview of the use of plant products in the management of Stored products Coleoptera in the tropics. *Post Harvest News and Information,* 6: 69-75

Lale, N.E.S., 2001. The Impact of Storage insect pests on post harvest losses and their management in the Nigerian Agricultural System. *Nigerian J. Expt. Biol.,* 2: 231–9

Lale, N.E.S., 2002. Bio-activity and limitation against widespread use of neem product as alternative to synthetic insecticides for the management of insect Pests of Stored Agricultural Products in Nigeria. *Nigerian J. Appl. Biol.,* 3: 115–24

Mabbet, T., 2000. Pirimiphos-methyl – long term solution to problem of stored product pests. *Int. Pest Control,* Pp: 203–4

Malik, M.M. and S.H.M. Naqvi, 1984. Screening of some indigenous plants as repellent or antifeedants for stored grain insects. *J. Stored Prod. Res*., 20: 41–4

Markham, R.H., N.A. Bosque-Perez, S. Borgemeisters and W.G. Meikle, 1994. Developing Pest Management Strategies for *S. zeamais* Mostch., and *Protephanus truncatus* (Horn.) in the tropic. *F.O.A. Pl. Prot. Bull*., 42: 97–116

Metcalf, R.L., 1980. Changing role of insecticides in Crop Protection. *Ann. Rev. Entomol*., 5: 219–56

Nilsa, A. and N.A. Bosque-Perez, 1992. *Major Insect Pest of Maize in Africa,* P: 28. Biology and Control, IITA Research Guide, No: 30

Singh, S.R., L.E.N. Jackai, J.H.R. Dos Santos and C.B. Adalla, 1990. Insect Pests of Cowpea. *In*: Singh, S.R. (ed.), *Insect Pests of Tropical Food Legumes*, P: 43.-89. John Wiley and Sons, Chichester U.K

Udo, J., T. Ikafun and K.F. Cardwell, 1994. Storage systems of Maize, *Zea.mais* L. In: Nigeria from five ecological zones. *In:* Highley, E., E.J. Wright, H.J. Banks and B.R. Champ (eds.), *Stored Product Protection*, Vol. 2, pp: 960–5. Entomol. CAB Int., U.K

Uliagbafusi, B.M., 1980. Determination of the chemical composition of the leaves of *Vernonia.amygdalina. M.Sc. Thesis* University Jos, Nigeria

Yowotor, K.A., N.A. Bosque-Perez and J.A. Ayertey, 1994. Effect of Maize variety and storage form on oviposition and development of the maize weevil. *In*: Highley, E., E.J. Wright, H.J. Banks and B.R. Champ (eds.), *Proc. of $6^{th}$ Int. Conf. on Stored Product Prot. Entomol.*. CAB Int., U.K

Yusuf, S.R., B.I. Ahmed, J.P. Chaudhary and A.U. Yusuf, 1998. Laboratory evaluation of some plant products for the control of Maize weevil (*Sitophilus zeamais* Motsch.) In stored maize. *ESN Ocassional Pub.,* 31: 203–13


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