THE INSECTICIDAL ACTIVITY OF EXTRACTS AND OILS OF SOME TROPICAL PLANTS AGAINST THE YAM MOTH *EUZOPHERODES VAPIDELLA* MANN (LEPIDOPTERA: PYRALIDAE)

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Abstract

The ethanolic extracts and oils of eight tropical plants were evaluated under laboratory conditions for their relative toxicities to the eggs and larvae of the yam moth, *Euzopherodes vapidella Mann.*

Contact toxicity of the extract and oil on the eggs and larvae of the yam moth was tested by treating 15g of *Dioscorea alata* measuring (4cmx4cmx1.5cm) with 0.5ml and 0.1ml of ethanol and oil extract in separate Petri dishes. This represents 3.3 and 0.6% concentration respectively. Each treatment was replicated three times. Each Petri dish containing the treated yam slice was infested with freshly laid eggs of *E. vapidella* on one hand and 15 third instar larvae on the other hand. Petri dishes containing the eggs and the larvae were left inside the insect-breeding cage until adult emergence.

Ethanolic extract of *Aframonmum melegueta Schum* and *Thonn*; *Eugenia aromatica Baillion*; and *Zingiber officinales Rosco* were able to inhibit egg hatch and adult emergence. *E. aromatica* and *Z. officinales* were also able to prevent adult emergence when treated 4 days before eggs were introduced. The effect of ethanolic extract on larvae of *E. vapidella* at an application rate of 0.6 and 3.3% were low since there was no significant difference ($P > 0.05$) when compared with the control. The effect of oil extract was greater in the slices protected with *Monodora tenuifolia* and there was no egg hatch and adult emergence. The oil extracts from *Arachis hypogaea* and *Elaeis guineensis* had 20.0% and 13.3% adult emergence and there were significant differences ($P < 0.05$) when compared with the control which had 66.7% adult emergence. The oil can be applied on bruises or wound in yam tubers.

Keywords: Ethanolic extract, tropical plants, *Euzopherodes vapidella,* toxicity, hatchability

1. Introduction

Yams are members of the genus *Dioscorea*, which produce bulbils, tubers, or rhizomes that are of economic importance. Yams are staple food for millions of people in the tropical region of the world including those of West Africa being indeed the preferred source of carbohydrate among many ethnic groups (Ashamo, 2000). In spite of the great economic impotence of this food item in the diet of the people, 20-30% are lost during storage (FAO, 1985). Storage losses can result from physical, physiological or pathological factors or a combination of all three (Booth, 1974). *Euzopherodes vapidella* Mann is one of the moths which attack stored yam tubers. Dina (1976) studied the biology of *E. vapidella* and reported that only mechanically damaged tubers were susceptible to attack by the moth.

Chemical method still remains the most effective means of controlling both field and stored products pests. Despite the dramatic successes recorded in the control of insect pests by the use of insecticides, it has a number of disadvantages. For example, high toxicity in mammalian tissues, high level of persistence in the environment, health hazards, residual effect of synthetic insecticides on mammals, adverse effect on non-target organisms and pest resistance among pests (Sighamony *et al.*, 1986). These have necessitated the use of other control measures which have little or no negative impact on the environment.

One way is to replace the insecticides with compounds, which occur naturally in plants (Olaifa *et al.*, 1987). This involves the use of plant products in the form of powders, extracts, edible and non-edible vegetable oils and essential oils (Adedire and Lajide, 1999). Many reports on toxicity and deterrent activity of plant products on pests of stored products exist only for beetle pests (Lale, 1992; Adedire and Lajide, 1999) there is little or no report on the use of plant materials to control moths especially those affecting stored yam tubers.

This work investigated the toxicity of ethanolic and oil extracts of some tropical plants on the eggs and larvae of the yam moth, *E. vapidella.*

2. Materials and Methods

Culture of *Euzopherodes vapidella*

The initial source of culture was obtained from infested water yam tubers, *Dioscorea alata L.* collected from markets and farms. Signs of moth infestation included pres-

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ence of black granules of larval faecal matter held together by silken threads and the presence of empty pupal cases on surfaces of the tubers. These infested tubers were kept in Kilner jars. The openings of the Kilner jars were covered with muslin cloth held in place by rubber bands to prevent the escape of emerged adult moths. The Kilner jars were then kept inside insect breeding cages made of wood and ½ inch wire mesh. A culture of *Euzopherodes vapidella* was established and maintained with fresh water yam tubers as old ones deteriorated. The culture and the experiments were kept at a temperature and relative humidity of 26±2°C and 75±5% respectively.

Effect of Ethanolic Extracts and Oil Extracts on Development of *E. vapidella* eggs and larvae

The ethanolic extracts of *P. guineense* (seed), *A. melegueta* (seed), *Z. officinales* (corm), *E. aromatica* (fruit) and *H. sauvolens* (leaves) were obtained by weighing 20g of each powdered material into round bottom flasks. The plant parts had previously been cleaned, sundried and then pulverised into fine powder using electric blender. They were soaked in 100ml of absolute ethanol for 24 hr. and then boiled at 60°C for 30 minutes on a heating mantle (Adedire and Lajide, 1999). The solution was then filtered through Whatman No 12 filter paper. The filterate was kept in a brown bottle until needed. Table 1 shows the list of plants evaluated for their insecticidal activity.

Oil was extracted from the seeds of the plants using soxhlet extractor and tested as insecticides against the eggs and larvae of *E. vapidella*. The plants whose seeds were used are *A. hypogaea*, *E. guineensis* and *M. tenuifolia*. The different seeds were cleaned, sun dried and pulverized into fine powder using electric blender. 20g of each powdered materials was weighed into a thimble and extracted with ethanol in a soxhlet extractor. The extraction was carried out for about four hours. Thereafter, the thimble was removed from the units and the ethanol was recovered by redistilling the content of the soxhlet extractor at 40-60°C. The resulting extract was air dried in order to remove traces of the solvent. A slice of yam (*D. alata*) measuring (4cm x4cmx1.5cm) and weighing 15g was kept in individual Petri dishes. 0. 5ml of ethanolic extract and oil extract (representing 3.3%) from different materials was spread evenly on top of the yam slice. Freshly laid eggs (30 eggs) of *E. vapidella* were introduced on top of each of the treated yam slices. The development was observed from the treated slice and the number of adults emerging was verified. In another experiment, thirty freshly laid eggs of *E. vapidella* were placed on top of the slice of *D. alata* 4 days after treatment with ethanol and oil extracts. Observation was made daily until adult emergence and the number reaching adult stage was recorded. In the same manner as described above, fifteen third instar larvae were introduced on top of treated yam slice. The number of larvae reaching adult stage was recorded. Each experiment was replicated thrice. A control experiment without ethanol and oil extract was also set up in triplicate.

Analysis of Data

All the data were subjected to analysis of variance and where significant differences existed, treatment means were compared at 0.05 significant level using the New Duncan's Multiple Range Test (Zar, 1984).

3. Results

Effect of ethanolic extract on egg survival

Table 2 shows the effect of ethanolic extract on survival of *E. vapidella* egg treated and left for 20 minutes before eggs were introduced. The extract was effective in inhibiting hatchability and adult emergence. No eggs hatched and consequently no adult emerged from those slices treated with *A. melegueta, E. aromatica* and *Z. officinales*. However, 36.7% eggs hatched in slices treated with *H. sauvolens* and *P. guineense* and 80% for control. There was no significant difference $P>0.05$ in percentage adult emergence from the slices treated with *H. sauvolens* (30.0%) and *P. guineense* (33.3%) but significantly different $P<0.05$ from the control (70.0%).

The effect of ethanolic extract on development of *E. vapidella* eggs treated and left for 4 days before eggs were introduced is shown in Table 3. Ethanolic extract of *E. aromatica* and *Z. officinales* prevented adult emergence. This shows that they were still effective in preventing adult emergence when applied 4 days before eggs were introduced. The other extracts were not effective since there was no significant difference $P>0.05$ when compared with the control.

Effect of Ethanolic Extract on larva survival

Table 4 shows the effect of ethanolic extract on third instar larvae of *E. vapidella*. There was no significant difference ($P > 0.05$) in adult emergence in the treated samples and control.

Effect of oil extract on egg survival

Table 5 shows the effect of oil extract on eggs of *E. vapidella*. All the oil extract were effective in preventing adult emergence of the moth since there was significant different ($P < 0.05$) when compared with the control. *M. tenuifolia* oil was the most effective because it inhibited hatchability and emergence of the adult moth.

Effect of oil extract on larva survival

When 15 third instar larvae of *E. vpidella* were introduced on the slice of yam treated with various oil extracts, the oils had significant effect on the third larvae when compared with control. The most effective of all the larvicides was *Arachis hypogea* with 26.7% adult emergence. However, there was significant difference ($P < 0.05$) in the mean number of adult emergence when compared with the control which had 100% adult emergence (Table 6).

4. Discussion

In this study, the extract of *A. melegueta*, *E. aromatica* and *Z. officinale* showed the greatest insecticidal potential on egg hatchability and adult emergence in *E. vapidella* when eggs are introduced about 20minutes after application of extracts to the yam slices. There were significant differences ($P<0.05$) when compared with the control. However, intro-

Table 1: Plants evaluated for their insecticidal activity.

Scientific Name	Common name	Family	Parts used
Arachis hypogeae L	Groundnut	Papilionaceae	Seed
Elaeis guineensis Jacq.	Oil palm kernel	Palmae	Seed
Piper guineense Schum and Thorn.	Black pepper	Piperaceae	Seed
Aframomum melegueta Schum, Roscoe	Alligator pepper	Zingiberaceae	Seed
Monodora tenuifolia Benth.	Awoo ***	Annonaceae	Seed oil
Eugenia aromatica	Kanafuru **	Myrtaceae	Fruit
Zingiber officinales Roscoe.	Ginger	Zingiberaceae	Corm
Hyptis sauvolens Poit	Curry leaves	Labiatae	Leaves

** Hausa Name
*** Yoruba Name

Table 2: Percentage hatchability and percentage adult emergence of eggs raised on yam slices which were treated with 3.3% ethanolic extracts and left for 20mins before the eggs were introduced

Plant Ethanol Extract	No of Eggs Introduced	% egg Hatchability Mean ± SD	% Adult Emergence Mean ± SD
Aframomum melegueta	30	0.0 ± 0.0^{a}	0.0 ± 0.0^{a}
Eugenia aromatica	30	0.0 ± 0.0^{a}	0.0 ± 0.0^{a}
Hyptis sauvolens	30	36.7 ± 0.5^{b}	30.0 ± 0.5^{b}
Piper guineense	30	36.7 ± 0.5^{b}	33.3 ± 0.3^{b}
Zingiber officinales	30	0.0 ± 0.0^{a}	0.0 ± 0.0^{a}
Control	30	80.0 ± 1.0^{c}	70.0 ± 1.0^{c}

Means followed by the same letter are not significantly different P > 0.05 from each other using New Duncan's Multiple Range Tests.

Table 3: Percentage and percentage adult emergence of eggs raised on yam slices which were treated with 3.3% ethanolic extracts and left for 4 days before eggs were introduced

Plant Ethanol Extract	No of Eggs Introduced	% egg Hatchability Mean ± SD	% Adult Emergence Mean ± SD
Aframomum melegueta	30	46.7 ± 1.1^{b}	30.0 ± 1.1^{ab}
Eugenia aromatica	30	0.0 ± 0.0^{a}	0.0 ± 0.0^{a}
Hyptis sauvolens	30	66.7 ± 2.1^{b}	36.7 ± 1.0^{ab}
Piper guineense	30	60.0 ± 2.0^{b}	33.3 ± 1.0^{ab}
Zingiber officinales	30	6.6 ± 0.2^{a}	0.0 ± 0.0^{a}
Control	30	73.3 ± 1.5^{b}	53.3 ± 1.1^{b}

Means followed by the same letter are not significantly different P > 0.05 from each other using New Duncan's Multiple Range Tests.

Table 4: Effects of ethanolic extract on development of larvae.

Plant Extract	No of Larval Introduced	% Adult Emergence Mean ± SD 0.6%	% Adult Emergence Mean ± SD 3.3%
Aframomum melegueta	15	93.3 ± 1.1^{a}	53.3 ± 1.1^{a}
Eugenia aromatica	15	66.7 ± 1.1^{a}	53.3 ± 1.1^{a}
Hyptis sauvolens	15	86.7 ± 1.3^{a}	60.0 ± 1.6^{a}
Piper guineense	15	73.3 ± 1.5^{a}	46.7 ± 0.5^{a}
Zingiber officinales	15	86.7 ± 1.3^{a}	46.7 ± 1.1^{a}
Control	15	93.3 ± 1.1^{a}	73.3 ± 1.1^{a}

Means followed by the same letter are not significantly different P > 0.05 from each other using New Duncan's Multiple Range Tests.

Table 5: Effects of 3.3% oils extract on eggs survival to adult

Oil Extract	No of Eggs Introduced	% Hatchability Mean ± SD	% Adult Emergence Mean ± SD
Arachis hypogaea	30	33.3 ± 2.3^{b}	20.0 ± 2.0^{a}
Elaeis guineensis	30	13.3 ± 1.1^{ab}	13.3 ± 1.1^{a}
Monodora tenuifolia	30	0.0 ± 0.0^{a}	0.0 ± 0.0^{a}
Control	30	73.3 ± 1.1^{c}	66.7 ± 1.1^{b}

Means followed by the same letter are not significantly different P > 0.05 from each other.

Table 6: Effects of 3.3% oils extract on larval survival to adult.

Oil Extract	No of Larva Introduced	% Adult Emergence Mean ± SD
Arachis hypogaea	15	26.7 ± 1.1^{a}
Elaeis guineensis	15	33.3 ± 1.1^{a}
Monodora tenuifolia	15	60.0 ± 2.0^{b}
Control	15	100.0 ± 0.0^{c}

Means followed by the same letter are not significantly different P > 0.05 from each other.

duction of eggs of *E. vapidella* after 4 days of treatment with the extracts of *E. aromatica* and *Z. officinales* were the most effective against egg hatchability and adult emergence while *A. melegueta*, *H. sauveolens* and *P. guineense* reduced egg hatchability and adult emergence.

Aku *et al.* (1998) reported that extract from *A. senegalensis* root bark was more effective than the powder in the control of *C. maculatus.* Insecticidal activity of *A. melegueta* was attributed to the presence of paradol, an alkyl-phenol (Lale, 1992). Adedire and Lajide (1999) reported that ethanol extract of *Piper umbellatum* evoked 100% mortality at 5% and 10% concentration at 24 hours post treatment against *Callosobruchus maculatus.* The oil of *Elaeis guineensis, Arachis hypogaea* and *Monodora tenuifolia* were found effective in inhibiting egg hatch in *E. vapidella.*

Monodora tenuifolia oil was the most effective among the oils evaluated because development of egg and emergence of adult were completely inhibited. The oil was not very effective in preventing adult emergence in larvae. This performance corresponded to the findings of Don-Pedro (1989) that plant oil are toxic to young larvae of *C. maculatus*. The bioinsecticidal action of this oil could be attributed to the fact that *C. maculatus* eggs have respiratory pore with a gas– exchange function, which is blocked by the plant oil. Many vegetable oils have been assessed for use in preventing post-harvest losses due to insect (Golob and Webley, 1980). The findings of this study showed that *A. hypogaea*, *E. guneensis* and *M. tenuifolia* seed oil were highly toxic to the eggs and larvae of *E. vapidella*, thus effective in the protection of stored yam tubers from insect desprilation and damage. The toxic effect of plant oils on adult insects and immature forms is by asphyxiation as reported by Schoonhoven (1978). Based on this, it could be deduced that the eggs and larvae used in this study were suffocated as a result of the volatile components in the oil.

The toxicity of *M. tenuifolia* in this study could be ascribed to the presence of high molecular weight fatty acids in the seed oil as well as the presence of sterols and triterpene alcohol, which was earlier identified in the oils by Esuoso *et al.* (2000). Generally, the plants whose efficacies were tested against *E. vapidella* were available locally, not expensive, edible and form important part of the diet of tropical people since they are used as ingredient for soup or other medicinal purposes and can therefore be integrated with other pest control procedures. These plant products could be used among low- income farmers who store relatively small number of yam tubers for consumption and planting. The oils can be applied on bruises or wounds in yam tubers.

The extracts and oils can be applied on whole yam tubers before storage as well as spraying yam tubers on barn during storage may prevent the development of this pest of yam tubers.

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REFERENCES

Adedire, C. O and Lajide, L., 1999. Toxicity and oviposition deterency of some plant extracts on cowpea storage bruchid, *Callosobruchus maculatus* (F.) *Journal of Plant Diseases and Protection* 106 (9): 647-653.

Aku, A.A., Ogunwolu, E.O. and Attah, J. A., 1998. *Annona Senegalensis* L. (Annonaceae): Performance as botanical insecticide for controlling cowpea bruchid *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) in Nigeria. *Journal of Plant Diseases and Protection* 105 (5): 513-519.

Ashamo, M.O., 2000. Bionomics and control of the yam moth, *Dasyses rugosella* Stainton (Lepidoptera: Tineidae) Ph.D. Thesis, Federal University of Technology, Akure, Nigeria, 187pp.

Booth, R.H., 1974. Post-harvest deterioration of tropical root crop: Losses and their control. *Tropical Science* 16 (2): 49-63.

Dina, S.O., 1976. Observations of *Euzopherodes vapidella* Mann (Lepidoptera: Pyralidae) infesting yam tubers in Ibadan, Nigeria. *Nigerian Journal of Entomology* 1 & 2: 35-41.

Don-Pedro, K .N., 1989. Insecticidal activity of some vegetable oils against *Dermestes maculatus* Degeer (Coleoptera: Dermestidae) on dried fish. *Journal of Stored Products Research* 25 (2): 81 – 86.

Esuoso, K. O., Lutz, H., Bayer, E. and Kutubuddin, M., 2000. Unsaponifiable lipid constituents of some under utilized tropical seed oils *Journal of Agriculture and Food Chemistry* 48: 231–234.

FAO, 1985. Action programme for the prevention of food losses, Improving post harvest handling, storage and processing of root and tuber crops. Rome.

Golob, P. and Webley, D.T., 1980. The use of plants and minerals as traditional protectants of stored products. *Rep. Trop. Prod. Inst.* 138, 32pp.

Lale, N.E.S., 1992. A laboratory study of the comparative toxicity of products form three spices to the maize weevil *Sitophilus zeamais Post-Harvest Biology and Technology* 2: 61-64.

Olaifa, J.I., Erhum, W.O. and Akingbohungbe, A.E., 1987. Insecticidal activity of some Nigerian plants. *Insect Science and Its Application,* 8: 221-224.

Schoonhoven, A.V., 1978. Use of vegetable oils to protect stored beans form bruchid attach. *Journal of Economic Entomology*. 71: 254-256.

Sighamony, S., Annes, I., Chandrakala, T. and Osmani, Z., 1986. Efficacy of certain indigenous plant products as grain protectant against *Sitophilus oryzae* L. and *Rhizopertha dominica* F. *Journal of Stored Products Research* 22:21- 23.

Zar, J.H., 1984. Biostatistical Analysis. 2nd ed. Prentice-Hall International, Englewood Cliffs, N.J.