

EFFECTIVENESS OF THE LEAF POWDER OF *Ficus exasperata* Vahl. (Moraceae) IN SUPPRESSING THE POPULATION OF TWO MAJOR STORAGE INSECT PESTS

Ogunleye, R.F.

Department of Zoology, University of Ado Ekiti, Nigeria. E-mail : droluwaleye@yahoo.com

ABSTRACT

Laboratory evaluation of the effectiveness of old and young sandpaper leaf, *Ficus exasperata* on *Callosobruchus maculatus* and *Sitophilus zeamais* was carried out for a period of 72 hours. The effect of the leaf powder were observed at different dosage rates; 50g, 40g, 30g, 20g and 10g per 50g seeds of cowpea and maize. The treated and untreated grains were sampled and assessed every 24 hours for mortality rates of the insects. Results obtained showed that the young sandpaper leaf powder had the highest mortality rate of insects for the five different rates, both on *C. maculatus* and *S. zeamais*. The result got from the application of old leaf powder ranged from 0.00 ± 0.00 - 5.00 ± 5.77 , 7.50 ± 5.00 - 19.50 ± 5.00 and 15.00 ± 10.00 - 45.50 ± 15.10 respectively from the first day to the third day post application on *C. maculatus* while that young leaves ranged from 5.00 ± 5.77 - 10.00 ± 8.16 , 37.50 ± 12.58 - 37.50 ± 12.58 and 65.00 ± 5.77 - 90.00 ± 8.16 from the first day to the third day respectively. It was also observed that the mortality rates for *C. maculatus* were generally higher than what was obtained for *S. zeamais*.

KEYWORDS: Effectiveness, Leaf powder, *Ficus exasperata*, *C. maculatus*, *S. zeamais*

INTRODUCTION

The production of legumes and cereals is plagued by many different pests, with insects causing the worst damage. Field insect pests are the pests that affect these crops in field before harvest. (Omakunde, 2004). The main pest during the growing season of cowpea is the aphids (Omakunde, 2004) *Aphis fabae*, cosmopolitan (Hill and Waller, 1988). *Acyrtosiphon pisum*, (Hill and Waller, 1999) pea pod Borer (*Etiella zinkenella*), Bean fly (*Ophiomyia phaseoli*), Pollen Beetles (*Coryna spp.*) *Clavigralla*, Bean seed fly (*Delia platura*) etc (Hill and Waller, 1998).

The most important storage pest of cowpea is *Callosobruchus spp.* It belongs to the family Bruchidae. The larvae bore into the pea or bean throughout most of the tropics and subtropics. (Bohlen, 1978, Hill and Waller, 1999). Three species are the major pests of stored grain, *Sitophilus zeamais* (maize weevil), *Sitophilus oryzae* (rice weevil) and *Sitophilus granarius* (granary weevil) are common. They develop inside kernel and feed on starchy interior. Adults hatch and eat their way out of the grain and continue to feed voraciously on the grain.

Losses caused by storage pests include Weight loss, Loss in quality and Market value, promotion of mould development, Reduced germination in seed material and Reduced nutritional value:- (Lowenberg- Deboer, 2003).

Insecticides are at the moment man's chief weapon against insect pest. Insecticides are chemical that affect the biological processes of many living organism and may thus act as poisons to many animals species (Hayes and Lawes, 1991). In Nigeria, EDB and EDCT have been recommended for fumigation of food grains. These fumigants should be handled with great care and by trained staff only. (Ikisan.com, 2000).

Insecticides have a wide range in mammalian toxicity, toxic doses range from amounts as low as 1mg/kg in the diet of a vertebrate animal to very large amount needed to kill a mammal. (Hardy, 1990).

There have been many serious accidents in which many people have died from insecticides (Hayes and Lawes, 1991) and aquatic organisms by run off and soil erosion (Irvine and Knights, 1974) Edward (1997) reported that crocodiles and their eggs bioconcentrate organochlorine insecticides.

Birds are susceptible to many insecticides (Riseborough, 1986; Hardy, 1990) through feeding on contaminated food, such as seed dressed with pesticides, plants treated with pesticides,

Botanical insecticides are of great interest to many, because they are natural insecticides, toxicants derived from plants. Since the use of chemicals has so many adverse effects on the environment, the botanical insecticides has been adopted by the farmers to control the insect pest that attack cowpea. (Pereira *et al* 1982)

The laboratory evaluation of the repellency of two pepper varieties, *Capsicum annum* and *Caesium frutescens* (cayenne pepper) to cowpea weevil, *Callosobruchus maculatus* was carried out and found effective (Eggunyenga *et al* 2000). The plants *Azadirachta indica* A. Juss (common name: neem) and *Citrus sinensis* (common name sweet orange) have been reported to have some insecticidal properties against pests (Taylor, 1975). For example. *C. Sinensis* pea powder has proved potent against *C. maculatus*, depressing oviposition and progeny emergence on cowpea, although at high doses (Taylor, 1975). Abbiv (1990) reported that crushed *C. odorata* leaves repel insects. (Nieber, 1994).

Some other plant materials are used such as *Chromolaena odorata* (Siarn Weed) which is mixed with stored grain to control common storage pests, such as the larger grain borer (*Prostephanus truncatus*) and maize weevil (*Sitophilus zeamais*). (NRI, Bulletin 65, 1996).

This research work evaluates the effectiveness of *F exasperata* in the control of *C maculatus* and *S zeamais*.

MATERIALS AND METHODS

Fresh young and old leaves of *F exasperata* were plucked in Iworoko-Ekiti, a town in the southern part of Nigeria and were later dried on the laboratory table for one month. With the aid of mortar and pestle, the materials were separately pounded into powder form.

After pounding, the resulting powder was sieved, using 40 mesh screen and kept in the refrigerator to retain its freshness before application. For the purpose of the experiments 3 dozen of plastic cages were provided. Clean and uninfested cowpea and maize seeds were purchased at the Oja Oba market at Ado-Ekiti. They were also kept in the deep freezer to ensure that any existing insect eggs and larvae are killed before the onset of the experiment.

INSECT CULTURE

A culture of the insects was maintained in the laboratory, at ambient conditions of 37⁰C and 50 R.H. This was done by weighing fifty grams (50g) of the seeds of cowpea and maize into a kilner-Jar. Twenty adult *C. maculatus* and *S. zeamais* were then introduced into the containers of cowpea and maize respectively and kept in the laboratory for one month for the insects to lay eggs and multiply. All insects needed for this experiment were taken from this culture.

BIOASSAY

Into each of the plastic cages, 50g of cowpea and maize were weighed separately using a weighing balance in the laboratory. After this, the prepared plant powder were added at varying rate of application ranging from 0g to 50g as follows:

- Control = 50g seed + 0g powder
- Treatment 1 = 50g seed + 10g powder
- Treatment 2 = 50g seed + 20g powder
- Treatment 3 = 50g seed + 30g powder
- Treatment 4 = 50g seed + 40g powder
- Treatment 5 = 50g seed + 50g powder

All the experiments were replicated three (3) times to give four (4) replicates. The same set up was repeated for young leave powder.

Ten (10) newly emerged adults of *C. maculatus* and *S. zeamais* was introduced into cages of cowpea and maize respectively. The cages were covered with nets to ensure aeration. Percentage mortality was calculated on daily basis for four (4) days.

RESULTS

Table 1 shows the mean percentage mortality of *C. maculatus* treated with the powder of old leaves of *F. exasperata* for 72 hours. The result for the control experiment ranged from 0% after 24 hours to 5% after 72 hours. In the experiment involving 50g of plant powder the mean percentage mortality rate of 5%, 17.5% and 47.5% were recorded after 24 hours, 48 hours and 72 hours respectively. In the case of 40g, 5%, 12.5% and 20% were recorded, for the first, second and third day respectively. Lower application rates of 30g, 20g, and 10g produced results ranging from 22.0%-47.50%, 5%-37% and 0%-15% respectively for the three days period.

Statistical analysis shows that when the treatments and control were compared at 5% level of probability using Fisher's Least Significant Difference, after 24 hours, except for the treatment with 30g, all other treatments showed no significant difference from the control. After 48 hours, except for treatment 10g, all other treatments showed significant difference from the control and after 72 hours except for treatment 40g and 10g, other treatments showed significant difference from the control.

Table 1: Mean percentage mortality of *Callosobruchus maculatus* treated with the powder of old leaves of *Ficus exasperata*

TREATMENTS	MEAN % MORTALITY AFTER		
	24 hours	48 hours	72 hours
Control	0.00±0.00a	2.50±5.00a	5.00±5.77a
50g	5.00±5.77a	17.50±5.00abc	47.50±15.00b
40g	5.00±5.77a	12.50±9.57abc	20.00±16.33a
30g	22.50±20.62b	30.00±24.49ab	47.50±37.75b
20g	5.00±5.77a	12.50±9.57abc	37.50±15.00b
10g	0.00±0.00a	7.50±5.00a	15.00±10.00a

Means followed by the same letters are not significantly different at 5% level using Fisher's Least Significant Difference.

Table 2 shows the mean percentage mortality of *C. maculatus* treated with the powder of young leaves of *F. exasperata* for 72 hours.

With the treatment with 50g and 40g of *F. exasperata*, the mean percentage mortality was between 10% and 82.5% and between 45% and 90% from the first day to the third day.

At the rate of 30g, 12.5%, 27.5%, 47.0% mortality rate was obtained after 24, 48 and 72 hours respectively, and for lower doses of 20g and 10g, the result ranged from 15% to 60%, and from 5% to 65% from the first day to the third day.

Statistical analysis shows that when the treatments and control were compared at 5% level of probability using Fisher's Least Significant Difference, after 24 hours all treatments showed no significant difference from the control except for treatment 40g. after 48 hours except for treatment 40g, all other treatments showed no significant difference from the control and after 72 hours treatments showed significant difference from the control except for treatment 50g and 40g.

Table 2: Mean percentage mortality of *Callosobruchus maculatus* treated with the powder of young leaves of *Ficus exasperata*.

TREATMENTS	MEAN % MORTALITY AFTER		
	24 hours	48 hours	72 hours
Control	22.50±18.93a	65.00±23.80a	97.50±5.00a
50g	10.00±8.16a	37.50±12.58a	82.50±9.57a
40g	45.00±20.82b	72.50±12.58b	90.00±8.16a
30g	12.50±5.00a	27.50±5.00a	47.00±5.00b
20g	15.00±5.77a	25.00±5.77a	60.00±8.16b
10g	5.00±5.77a	37.50±12.58a	65.00±5.77b

Means followed by the same letters are not significantly different at 5% level using Fisher's Least Significant Difference.

Table 3 shows the mean percentage mortality of *Sitophilus zeamais* treated with the powder of old leaves of *Ficus exasperata* for 72hours.

The mean percentage mortality rate in the control experiment was 0% for the first two days and rose to 2.5% after 72 hours. In the experiment involving 50g of plant powder, the mean percentage mortality ranged from 5% in the first day to 7.5 in the third day (72hrs). In the case of 40g dose, the mean percentage mortality was 5% after 24 hours, 10% after 48 hours and 15% after 72 hours.

For 30g dose, the mean percentage mortality were 0%, 5%, 7.5% after 24, 48 and 72 hours respectively. For experiment with 20g dose, the mortality rate was 5% throughout the three days period, and for 10g dosage, the mortality rate of 0% after 24 hours, 5% after 48 hours and 5% after 72 hours were recorded.

Statistical analysis shows that when the treatments were compared with the control at 5% level using Fisher's Least Significant Difference, after 24 hours all treatments showed no significant difference, from control. After 48 hours, all treatments showed no significant difference from the control except for treatment 40g. After 72 hours except treatments 20g and 10g, other treatments showed significant difference from the control

Table 3: Mean percentage mortality of *S. zeamais* treated with the powder of old leaves of *Ficus exasperata*.

TREATMENTS	MEAN % MORTALITY AFTER		
	24 hours	48 hours	72 hours
Control	0.00±0.00a	0.00±0.00a	2.50±5.00a
50g	5.00±5.77a	7.50±9.57a	7.50±9.57b
40g	5.00±5.77a	10.00±8.16b	15.00±5.77b
30g	0.00±0.00a	5.00±5.77a	7.50±5.00b
20g	5.00±5.77a	5.00±5.77a	5.00±5.77a
10g	0.00±0.00a	5.00±5.77a	5.00±5.77a

Means followed by the same letters are not significantly different at 5% level using Fisher's Least Significant Difference.

Table 4 shows the mean percentage mortality of *S. zeamais* treated with the powder of young leaves of *F. exasperata* for 72hours. There were no significant differences in all the treatments and the control for the first two days post treatment. For the third day however, the higher doses of 30g, 40g, and 50g produced significantly higher mortality of 45.00%, 35.00%, and 35.00% respectively when compared with control 7.50%.

Table 4: Mean percentage mortality of *Sitophilus zeamais* treated with the powder of young leaves of *Ficus exasperata*.

TREATMENTS	MEAN % MORTALITY AFTER		
	24 hours	48 hours	72 hours
Control	0.00±0.00a	7.50±5.00a	7.50±5.00a
50g	5.00±5.77a	7.50±9.57a	45.00±5.77b
40g	2.50±5.00a	2.50±5.00a	35.00±2.91b
30g	0.00±0.00a	2.5±5.00a	35.00±6.46b
20g	0.00±0.00a	5.00±5.77a	22.50±17.08a
10g	0.00±0.00a	2.50±5.00a	27.50±9.57a

Means followed by the same letters are not significantly different at 5% level using Fisher's Least Significant Difference.

DISCUSSION

The result of the experiments show that the powder of the leaves of *F. exasperate* especially the young leaves were capable of having significant mortality effects on *C. maculatus*. Plant powders have been used to suppress the population of storage pests (Ogunleye,2000.,Ogunleye et al., 2004 and Onu and Baba, 2003).It has been reported that powders of plant materials are capable of blocking the spiracle of insects (Steve,2010, Lale,2002). This can lead to suffocation and death. Secondly, these powders, when stocked under the wings of insects in the

store complied with the fact that the plant has great itching effects are capable of causing great discomfort to them. This may prevent them from feeding well and eventually leads to death. It has been suggested that abrasions can lead to loss of fluids and consequently, death of insects and It may also significantly reduce the rate of oviposition (Ogunwolu *et al.*, 1998).

The high mortality rate could also be as a result of direct feeding of the insects on the plant materials. The insects could not have been able to derive enough nourishment that will support its normal growth and development from the plants and this may lead to insect mortality.

It is also evident in this research work that *C. maculatus* is more susceptible to the adverse effects of the plant materials. This may be because the cuticular coverings of *C. maculatus* is less sclerotized than the case of *S. zeamais*. Kramer *et al* 1989 reported that the cuticle of *S. zeamais*, *S. oryzae* and *S. granarium* is found to be highly sclerotised. This could have accounted for high level of resistance recorded for *S. zeamais*.

In addition to this, all insects of the genus *Sitophilus* have the habit of moving away from their substrate to hide either at the upper cover of kilner-jars or at any available crevices. This reduces the miggling of the insects with the powder and hence, low mortality rate.

Finally, the younger leaves were observed to be more effective than the old leaves. The powder materials from the younger leaves are finer than that of the old leaves. According to Olotua *et al* (2009) , particle size of powder materials has great influence on the mortality of insects. According to them, the smaller the particle size, the higher the mortality. This may be attributed to the fact that finer particles find an easy way through into the spiracles than the larger ones.

REFERENCES

- Abbiv D. (1990) Useful plants of Ghana. International Technical publisher and Royal Botanic Gardens, Kew, 1990: 164
- Bohlen E, (1978) *Crop pests in Tanzania and their control* (2nd ed) verlag Paul parey: Berlin and Hamburg. Pp. 142.
- Hill, D. S. and Waller, J. M, (1998) *Pests and Diseases of Tropical crops volume 2*. Field Handbook chapter 24 and 34 pg 258 – 267, 397 – 406, 202- 212.
- Hill, D.S. and Waller, J.M. (1999) *Pests and Disease of Tropical crop volume 2*. Field Handbook chapter 24 and 34 pg 258 – 267, 397 – 406, 202- 212, 258 – 267.
- Edwards, C.A. (1997) Nature and Origin of Pollution of Aquatic systems by pesticides. In *Insecticides in aquatic environments*. M.A.O Khan (ed) Plenum Press, New York. 1977. 11-37
- Hayes, J. and Lewis (1991) *Handbook of Pesticide toxicology* vol I, II and III, Academic Press, San Diego, London, Sydney, Toronto, 1527 pp
- Hardly, A. R, (1990) Estimating exposure: the identification of species at risk and routes of exposure in: Effects of pesticides Terrestrial wildlife L. Somerville and C.H Walker (Eds) Taylor and Francis, London 81 – 97.
- Ikisan .com (2000) History of maize www.ikisan.com Assessed in 2010.
- Irvine, D. E. G. and Knights B. (1974) *Pollution and the use of chemicals in agriculture*. Butterworth's, London, 136 pp.
- J. Lowenberg – De Boer personal communication (2003) Cowpea: Post Harvest operation : chapter 3 (storage losses). Inpho email: Inpho@fao.org.
- Kramer, J.K., Morgan, T. D., Hopkikins, T.L., Christensen, M.A and Schaefer, J (1989). Solid state ¹³C-NMR and diphenol analyses of Sclerotised cuticle from stored product Coleoptera Insect. *Biochemistry* 19(8) 753-757.

- Lale, N.E.S. (2002) *Stored –Product Entomology and Acarology in Tropical Africa*. Pg 204. Mole Publications.
- Nieber Tiert B., (1994) The Ability of powders and Slurries from ten plant species to protect Grain from attack 30; 287- 301
- NRI Bulletin(1996) Preview of plant materials used for controlling insect pest of stored products. *Bulletin* 65, ISBN 08 59 544206
- Ogunleye, R.F.(2000). Effectiveness of some plants against *Callosobruchus maculatus* (F) (Coleoptera : Bruchidae). *Applied Tropical Agriculture* 5(1) 72-76.
- Ogunleye, R.F., Adesuyi, S.A. and Adedire, C.O. (2004). Toxicity of some underutilized Tropical plants to the storage pest of maize, *Sitophilus zeamais* (Mots)(Coleoptera : Curculionidae). *Journal of Biological and Physical Sciences*. 2: 22-27.
- Ogunwolu, E. O., Igoli, J.O. and Longs., N.N. (1988) Reduction in Reproductive fitness of *Callosobruchus maculatus* F. exposed to *Zanthoxylum zanthoxyloides* (Lam) Watern. *Journal of Herbs, Spices and Medicinal Plants* 6(1), 19-27.
- Olotua, O.F., Ofuya, T.I. and Aladesanwa, R.D. (2009). Effects of particle size on insecticidal activity of dusts of *Eugenia aromatic* and *Piper guineense* against *Callosobruchus maculatus* : Proceedings of the Humboldt Kellog 5th annual Agric. Conference. 67-81.
- Onu, I and Baba, G.O. (2003) Evaluation of Neem products (A Juss : Meliaceae) for the control of Dermestes beetle (*Demestes maculatus* Degger) (Coleoptera : Dermestidae on dried fish. *Nig. Journ. of Entomol.* 20 : 105-115.
- Omakunde Oshiwambo, (2004) Cowpea pests (the minor and major pest in cowpea production). *Azadirachta indica*
- Pereira J and R. Wohlgemuth (1982) Neem (*Azadirachta indica* A. Juss) of West African Origin as a protectant of stored maize *Z. Ang. Ent.* 94; 208 – 214.
- Riseborough R. W., (1986) *Pesticides and Bird populations*. In current ornithology R. F. Johnston (Ed), Plenum Press, London and New York, 397-427
- Steve, I (2010) A few of my Favourite offensive weapons of Pest Control Tools or Pestisafe! www.thebestcontrol.com. Assessed 2010
- Taylor T. A (1975) Effects of Orange and Grape fruit peel, on *Callosobruchus maculatus* infestation of cowpea. *Ghana J. Agric, Sci.* 8 169- 172.

Received for Publication: 22/02/2011

Accepted for Publication: 28/03/2011