

Toxicity Potentials of Leaf Powders of Wild Lemon (*Afreagle paniculate*) and African Rock Fig (*Ficus congensis* Engl.) Against the Cowpea Seed Bruchid (*Callosobruchus maculatus* Fab.)

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Abstract

The toxicity potentials of the wild lemon (*Afreagle paniculate*) and the African rock fig (*Ficus congensis* Engl.) leaf powder as an alternative source of control against the cowpea seed bruchid (*Callosobruchus maculatus* Fab.) on stored cowpea was evaluated. The results obtained shows that, these plant material powdered leaves had remarkable effects on all the parameters measured. There were 76.34% and 77.20% undamaged seeds recorded respectively, when cowpea seeds were stored with these plant material powdered leaves compared to the control, 7.50%. High mortality of 84.61% and 85.51% respectively, was obtained in these plant material powdered leaves and the least was in the control, 16.84%. Likewise, there was only 7.67 and 6.01 number of adults that emerged while the control had 23.85. High number of eggs laid was recorded in the control. It was also found out that, these plant material powdered leaves are promising candidates for developing botanical, biodegradable and ecologically friendly insecticides which can be integrated with other pest management procedures and could replace the use of synthetic insecticides on small farmers holding. Therefore, the leaf powders are recommended for storing cowpea seeds for at least 12 weeks giving the grains perfect state of wholesomeness.

Keywords: *Afreagle*, bruchid, control, cowpea, damage, *Ficus*, insect, mortality

1. Introduction

The importance of pulses and legumes as the world's major source of plant protein is rapidly increasing especially in the tropics due to population explosion coupled with food shortages (Ahmed & Ahamad, 1992). Food legumes occupy a prominent place in the nutrition of Nigerian people because their edible seeds form a cheap alternative source of protein diet (Ofuya, 2001). The cowpea seed beetle (*Callosobruchus maculatus* Fab.), a multivoltine, principal storage pest of cowpea in the tropics, is responsible for about 30-60% of the storage losses incurred on cowpeas stored for 3-6 months in Nigeria (Caswell, 1970).

The use of conventional synthetic insecticides still remains the most effective means of controlling field and stored product insect pests despite their draw backs inclusive of high mammalian toxicity and environmental pollution (Adedire & Ajayi, 2003; Lale, 2002). Currently, researches on insecticide product development focussed on materials of plant origin which are effective, readily available, affordable and environmental friendly (Nibber, 1994; Nibber et al., 1992).

A large number of plant-derived substances exert various physiological and behavioural activities on stored product insects and notable among these plants are various spices and medicinal plants used traditionally for protecting foodstuffs against insect pests in store (Ho et al., 1996). Steam distillates and organic extracts of different aromatic medicinal plants have been reported to be effective against several insect species (Adedire & Ajayi, 2003; Adedire & Lajide, 2003; Adedire et al., 2003; Boussaada et al., 2008; Ho et al., 1995; Rahman & Talukder, 2006; Strivasta & Gupta, 2007). Oaya et al. (2011) reported that, the leaf powder of wild lemon (*Afreagle paniculate*) effectively reduced oviposition and drastically controlled the developmental stages of *Callosobruchus maculatus* Fab. in stored cowpea seeds. The report also shows that, the African rock fig (*Ficus congensis* Engl.) leaf powder significantly reduces egg laying and larval development of the bruchid. There was

also more than 50% mortality recorded. The present study examined the toxicity potential or capacity of the wild lemon (*Afreagle paniculate*) and the African rock fig (*Ficus congensis* Engl.) on stored cowpea (*Vigna unguiculata* L. Walp).

2. Materials and Methods

2.1 Insect Culture

The insects used for the establishment of colony of *Callosobruchus maculatus* came from a batch of infested cowpea seeds purchased at Ganye, Adamawa State, Nigeria. Bruchids were reared subsequently by replacement of devoured and infested cowpea seeds with fresh uninfected brown cowpea seeds in 2 -L Kliner jars covered with muslin cloth to allow air circulation. Insect rearing was carried out at an ambient temperature of 29-33°C and relative humidity of 54-56%. One day old teneral adult bruchids were obtained by sifting the stock culture a day before the experiment.

2.2 Preparation of Plant Leaf Powders

Relatively matured leaves of wild lemon and the African rock fig were shade dried and pulverized to powder using a Binatone electric blender (model BLG-400). The leaf powders were kept in a brown bottle ready for use.

2.3 Toxicity Tests

All tests were carried out in the Laboratory of the Department of Agricultural Technology, Adamawa State College of Agriculture, Ganye between January and April in 2011. Ten pairs of freshly emerged adults of *Callosobruchus maculatus* Fab. were introduced into 100 grams of clean cowpea seeds of a local variety (kananado) to which the plant materials leaf powders and the chemical actellic dust were added in a 100 ml conical flask. The conical flasks were covered with muslin cloth to prevent the escape or the entry of other bruchids. The flasks were manually stirred with a glass rod to ensure uniform coating of seeds. The initial weight of the cowpea seeds was taken and the moisture content of the cowpea was 12%.

2.4 Treatments

Treatments used included *Afreagle paniculate*, *Ficus congensis*, chemical and control, which were replicated three (3) times. These were arranged on the table in the Laboratory at a room temperature of 36-38°C and relative humidity (RH) of 44-46%. The experimental design used was the Completely Randomized Design (CRD). Mean percentage of damaged seeds and undamaged seeds, mean number of eggs laid, mean percentage mortality and weight loss were taken and expressed as percentage according to Oaya et al. (2012).

Data collected were subjected to analysis of variance appropriate to Completely Randomized Design according to Gomez and Gomez (1984), while means were separated using the Student Newman-Keuls (SNK) method of mean separation.

3. Results

Highest mean percentage damaged seeds were observed in the control (92.50%), followed by plant material powdered leaves, *Afreagle paniculata* (23.66%), *Ficus congensis* (22.80%) and the least was recorded in the cowpea administered with chemical actellic dust (10.54%). On the other hand, cowpea stored with the chemical actellic dust gave the highest mean percentage undamaged seeds (90.46%), followed by cowpea stored with the plant material leaf powders, *Ficus congensis* (77.20%), *Afreagle paniculata* (76.34%) and the least was observed in the control (7.50%). Moreover, chemical means of control (actellic dust) also gave highest mean percentage mortality (94.67%), followed by plant material leaf powders, *Afreagle paniculata* (84.61%), *Ficus congensis* (83.50%) and the least was obtained in the control (16.84%) as seen in Table 1 at $P \leq 0.05$ using the Student Newman-Keuls (SNK) test for variables.

Highest mean number of adults alive and mean number of eggs laid was recorded in the controls (23.85 and 610.00) respectively. Significant difference exists among the treatments, however, there was no significant difference between the plant extracts (*Afreagle paniculate* and *Ficus congensis*). This was followed by the plant material leaf powders *Afreagle paniculata* (7.67 and 168.00), *Ficus congensis* (6.01 and 159.00) and the least was recorded in the cowpea stored with the chemical actellic dust (2.67 and 96.33). Likewise, the mean percentage weight loss was higher in the control (63.12) significantly followed by the plant material powdered leaves *Afreagle paniculata* (18.47), *Ficus congensis* (16.50) and the least was observed in the cowpea seeds stored with the chemical actellic dust at $P \leq 0.05$ using the Student Newman-Keuls (SNK) test for variables.

Table 1. Mean percentage damaged seeds, undamaged seeds and mortality

Treatments	Mean percentage damaged seeds	Mean percentage undamaged seeds	Mean percentage mortality
<i>Afreagle paniculata</i>	23.66 ^b	76.34 ^b	84.61 ^b
<i>Ficus congensis</i>	22.80 ^b	77.20 ^b	85.50 ^b
Chemical	10.54 ^c	90.46 ^a	96.67 ^a
Control	92.50 ^a	7.50 ^c	16.84 ^c
Mean	37.38	62.89	70.41

Means followed by the same letter (s) in the same column are not significantly different at $P \leq 0.05$ using the Student Newman-Keuls (SNK) method of mean separation.

Table 2. Mean number of adults alive, number of eggs laid and percentage weight loss

Treatments	Mean Number of Adults alive	Mean Number of Eggs Laid	Mean Percentage Weight Loss
<i>Afreagle paniculata</i>	7.67 ^b	168.00 ^b	18.47 ^b
<i>Ficus congensis</i>	6.01 ^b	159.00 ^b	16.50 ^b
Chemical	2.67 ^c	96.33 ^c	6.01 ^c
Control	23.85 ^a	610.00 ^a	63.12 ^a
Mean	10.05	258.33	26.03

Means followed by the same letter (s) in the same column is not significantly different at $P \leq 0.05$ using the Student Newman-Keuls (SNK) method of mean separation.

4. Discussion

Previous studies by Adedire (2002) and Oaya et al. (2011) have shown insecticidal activity in Wild Lemon, *Afreagle paniculata* and African Rock Fig, *Ficus congensis* Engl. In the present study, synthetic insecticide (actellic dust) was the most toxic to the bruchid in all the parameters measured. This was because, chemical control is still the most effective method of insect pests control despite the serious hazard they cause to humans, wildlife and the environment, in addition to the development of resistant insect pests strains (Singh, 1991; Daghish et al., 1993). Oaya et al. (2011) reported that, chemicals have oviposition deterrence which inactivates the insect pests by their toxic effects leading to mortality prior to oviposition and also prevents egg and larval development. This research provides evidence that indigenous strategies of using plant extracts will assist farmers with their stored cowpea by protecting it from the cowpea seed bruchid.

Meanwhile, the wild lemon and the African rock fig gave significant control of the cowpea seed bruchid in store. These plant material leaf powders significantly reduced the egg laying ability and clearly suppressed adult emergence. This agrees with findings by Ofuya et al. (2001) that, plant material powdered leaves with toxic constituents (such as methyl salicate and methanol extracts) are effective in suppressing egg laying ability and the observed result could be direct consequences of reduction in egg production or inhibition of egg laying or both. The work shows that, the plant materials had insecticidal properties and effects that inhibit egg laying and hatching which agrees with Zizka (2008), who stated that, the repellent and the pungent odour produced by the plant material powdered leaves inactivates the bruchids as a results, their ability to bore into the seeds was significantly minimized. Thus, the number of eggs laid and mean percentage damaged seeds was less compared to the control. There was also less weight loss recorded in plant material powder treated seeds, which is in agreement with Lale (2002) that protective plant extracts reduces damages caused by stored insect pests attacks.

5. Conclusion

Although, many studies have addressed the toxicity potential of protectants of plant origin, this may be the first time that, the leaf powders of the Wild Lemon, and the African Rock Fig have been evaluated for insecticidal and oviposition deterrence activity in the study area. This study has shown that, these plant materials are promising candidates for developing botanical, biodegradable and ecologically friendly insecticides, which could be used by small holder or subsistence farmers against the cowpea seed bruchid on stored cowpea since it is effective and safe for human consumption. They are easily obtained and can be integrated with other pest management procedures.

The results obtained from this research work reveal that, the Wild Lemon and the African Rock Fig gave significant control of the cowpea seed bruchid on stored cowpea. These plant material leaf powders are therefore recommended for cowpea storage for at least 12 weeks giving the grains perfect state of wholesomeness.

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