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Original Research Article

Ethnobotanical Studies of the Efficacy of Five Oils at Graded Levels on Adult Callosobruchus Maculatus Reared on Cowpea

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ABSTRACT

The cowpea weevil, *Callosobruchus maculatus* is one of the major pests infesting stored pulse and is distributed worldwide. The efficacy of different dosage of botanical oils for the control of *C. maculatus* in a stored grain (cowpea) was evaluated in Yola, Adamawa state Nigeria. Laboratory experiments were conducted on cowpea grain by treating them with five different botanical oils (Olive oil, Groundnut oil, Soya bean oil, *Khaya ivorensis* oil and Neem oil) for the protection of stored cowpea against *C. maculatus.* Cowpea used for the experiment were subjected to different oil treatments applied at different concentrations (0.5 ml, 1.0 ml, and 1.5 ml) per 10 grams of cowpea seeds. Randomized Complete Block Design was used and the treatments were replicated three times. Mortality counts were carried out across 24, 48 and 72 hours after treatment as well as oviposition after 14 days of exposure. The result obtained showed that all the botanical oils showed some promising effects on the mortality as well as the oviposition deterrent on adult *C. maculatus* (especially at 1.0 ml and 1.5 ml) when compared with the control experiment. This study demonstrates that plant oils can play an important role in protecting cowpea from insect's invasion during storage.

Key Words: *Callosobruchus maculatus*, cowpea, ethnobotanical, oils, weevils.

INTRODUCTION

The bean weevil, Callosobruchus maculatus, is a major pest of economically important leguminous grains, such as cowpeas, green grain and black gram. [1] The larva bore into the pulse grain which becomes unsuitable for human consumption, viability for replanting or for the production of sprout. They are important pests of pulse crops in Asia and Africa under storage conditions. [2]

Cowpea (*Vigna unguiculata*) belongs to the family Leguminosea, sub-family Faboideae, and tribe *Phaseoleae,* genus *Vigna*. Members of the *Phaseoleae* includes many of the economically important warm season grain and oil seed legumes such as soya beans, common bean and mung bean. [3] It has a number of common names but generally called beans in Nigeria. Cowpea is grown in the tropical and subtropical regions of the world. In Nigeria, it is grown mainly

in the drier region of Northern Nigeria, though; recently the cultivation has gained ground in Southern Nigeria, in the West and East. [4] Cowpeas provide a rich source of protein and calories as well as minerals and vitamins. A cowpea seed can consists of 25% protein and it is low in anti-nutritional factor. [5] According to Singh *et al*. [6] cowpeas were estimated to be cultivated on 12.5 million. Cowpea also plays a key role in subsistence farming and livestock fodder. The cowpea is also seen as a major cash crop by central and West African farmers with estimated 2 million people consuming cowpea on a daily basis. [7]

Insect pest pose the greatest threat to cowpea production. The crop is severely attacked at every stage of its growth by insect. High pest densities occur at many locations with complete loss of grain yield if no control measures are taken. [8] *C. maculatus* has over the years been a major problem to farmers and most pest managers, since they destroy most of the cultivated plant products. A lot of methods have been employed in controlling these insects which include the use of pesticides. However, the high cost of synthetic chemicals or insecticide misuse and toxic residues in foods have resulted in the search for botanicals which can serve as alternative biocides for the control of these stored product pests. [9] Grain storage techniques including the use of seed-dressing with olive oil to kill infesting insects have been recommended. [10] Several plant oils have been screened for preventing post-harvest losses due to insect pest [11] with varying degree of successes. Groundnut and other oils applied at 0.3% w/w give complete protection of green gram, *Vigna aureus* (Roxby) against *C. maculatus* in laboratory bioassays. [12] However Singh *et al.* [13] reported that groundnut oil applied to cowpeas has no effect on mortality or longevity of adult *C. maculatus.* Similarly, topical application of several vegetable oils, including groundnut and coconut oils had no effect on mortality of adult *C. chinesis.* [14] It was found out that palm oil killed adult *C. maculatus* [15] Neem seed oil, Mustard, Sesame, Castor, *Khaya ivorensis* and olive oil are known to control the cowpea bruchids. [16] Oil extracts of plants reduces oviposition rate, suppress adults emergence of bruchids and also reduce seed damage rate. [17] Therefore, in this study, ethnobotanical studies of five botanical oils viz: olive oil, neem seed oil, groundnut oil, soya beans oil and mahogany oil for their efficacy againts adult *C.maculatus* were performed.

MATERIALS AND METHODS

Source of Cowpea: Clean cowpea seeds were obtained from the local market in Yola, Adamawa State and were transferred to the laboratory. The seeds were treated as follows; first, it was oven-dried for 7 days and refrigerated for 24 hours, after which it was air-dried for 1 hour in order to free it from foreign infestation by *Callosobruchus maculatus* before setting the experiment. [18]

Plant Oil Source: Five plant oils (Olive oil, Groundnut oil, Soybean oil, Mahogany oil and Neemseed oil) which are readily available were sourced from the local market of Yola South L.G.A and were used for the experiment.

Insect Culture: Initial stock of *C.maculatus* was obtained from an infested cowpea in a store and maintained on beans in about 500 cm^3 rearing jar under laboratory conditions. The jar was sealed and a maximum of 7 days was allowed for mating and oviposition. Then parent stocks were removed and the cowpea seeds containing eggs were covered with muslin cloth fastened with rubber bands to prevent the contamination and escape of insects. The subsequent progenies of the beetles were used for all experiments.

Bioassay: Four replicates of each of the treatment concentration (0.25ml, 0.50ml and 0.75ml) were constituted as follows: 0.25ml, 0.50ml and 0.75ml were introduced into 300ml rearing plastic jars with the aid of syringe which was well calibrated. Filter paper was put on top of each treatment before 10g of the cowpea seeds were introduced. This was necessary in order to avoid direct contact of the treatment with the cowpea grains. Thereafter, ten newly emerged adult *C. maculatus* obtained from the cultured jar were introduced into the experimental jars and were covered with muslin cloth using rubber ring, to allow proper ventilation. The experiment was noted for *C. maculatus* survival/mortality and oviposition.

Data Collection:

Mortality: Adult *C. maculatus* survival count was investigated and recorded daily for 4 days after treatment. Mortality was accessed by the inability of the insect to move or respond to gentle touch. This was done by emptying the content of the rearing containers on a tray and noting the number of death insect. The content of the container was subsequently put back after death insects have been removed.

Absolute mortality = Total no of dead insects

Oviposition: Oviposition of *C. maculatus* was accessed 14 days, after setting up the experiment.10 cowpea seeds were randomly picked from each rearing containers and investigated for *C. maculatus* egg. The number of eggs noticed on the 10 seeds was extrapolated for the entire container using an average number of (70) seed per container.

Data Analysis: All data obtained were compared with the control by subjecting them to oneway analysis of variance, and the treatment means were separated using LSD. $P<0.05$ was considered significant.

RESULTS

Table 1 shows the effect of five botanical oil treatments on the mortality of adult *C. maculatus.* The treatments showed some promising effects as they recorded conspicuous and significantly higher mean mortality value than the control experiment (2.00 ± 0.00). In comparison of the treatments, there was no significant difference between *Khaya ivorensis* oil and Soya beans oil after 24 and 48 hours of treatment. Among all the five treatments, Olive oil and *Khaya ivorensis* had the highest absolute mortality rate, with the control having the least adult mortality rate.

Table 1: Effect of treatments on mortality of adult *C. maculatus* after 24hr, 48hr and 72hr, and absolute mortality

		Mortality (Mean±SD)			Absolute mortality
Treatment	Conc. (ml)	24h	48h	72h	
Control	0.00	2.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	4.00±0.00^{a}
Neem Oil	0.50	4.33±2.08^{ab}	3.67±1.16^{b}	1.33±1.15^{a}	9.33±0.58^{b}
	1.00	5.67±2.3^{b}	3.67±1.16^{b}	0.67±1.16^{a}	10.00±0.00^{c}
	1.50	6.33±1.53^{b}	3.00 ±1.73^{b}	0.67±1.16^{a}	10.00±0.00^{c}
Groundnut Oil	0.50	6.33±1.16^{b}	1.67±0.58^{ab}	1.00±0.00^{a}	9.00±1.73^{b}
	1.00	6.67±1.53^{b}	3.00±1.00 ^{b}	0.33±0.58^{a}	10.00±0.00^{c}
	1.50	7.00±1.00^{b}	2.33±1.53^{ab}	0.67±1.58^{a}	10.00±0.00^{c}
Olive Oil	0.50	5.33±0.58^{b}	3.00±1.73^{b}	1.33±1.53^{a}	9.67±0.58^{b}
	1.00	6.67±1.53^{c}	2.33±0.58^{ab}	0.00±0.00^{a}	10.00±0.00 ^{c}
	1.50	7.67±0.58^{c}	2.33±0.58^{ab}	0.00±0.00^{a}	10.00±0.00^{c}
Khaya Oil	0.50	5.33±1.16^{b}	3.67±2.08^{b}	0.67±1.16^{a}	9.67±0.58^{b}
	1.00	5.67±1.53^{b}	3.00±1.00^{ab}	1.33±0.58^{a}	10.00±0.00^{c}
	1.50	7.67±0.58^{c}	1.33±0.58^{ab}	1.00±1.00^{a}	10.00±0.00 ^{c}
Soya Bean Oil	0.50	5.33±1.53^{b}	3.00±1.73^{a}	1.00±1.00^{a}	9.33±0.58^{b}
	1.00	6.67±0.58^{b}	1.67±0.58^{a}	0.67±0.58^{a}	9.00±0.00^{b}
	1.50	6.67±1.53^{b}	3.33±1.53^{a}	0.00±0.00^{a}	10.00 ±0.00^{c}

Values are means (Means ± SD) of three replicates. Means carrying the same superscript alphabets are not significantly (P =0.05) different.

Table 2 shows the mean number of eggs laid in both treated and untreated cowpeas. Oviposition was very much reduced in treated sample when compared with the control. A slightly higher value was recorded for Soya beans oil, Neem seed oil, and Groundnut oil with a higher mean facundity, followed by Olive oil and then *Khaya ivorensis* oil treatment.

Table 2: Effect of treatments on the egg-laying (oviposition) of adult *C. maculatus*.

Treatment	Concentration (ml)	Oviposition
Control	0.00	10.80 ± 1.64^{c}
Neem Oil	0.50	2.00 ± 1.00^{b}
	1.00	1.00 ± 1.00^{ab}
	1.50	0.33 ± 0.58^{a}
Groundnut Oil	0.50	2.00 ± 2.65^{a}
	1.00	0.33 ± 0.58^{a}
	1.50	0.67 ± 1.16^{a}
Olive Oil	0.50	1.67 ± 1.53^{b}
	1.00	0.33 ± 0.58^{ab}
	1.50	0.00 ± 0.00^{a}
Khaya Oil	0.50	0.67 ± 0.58^{a}
	1.00	0.33 ± 0.58^{a}
	1.50	0.33 ± 0.58^{a}
Soya bean Oil	0.50	2.67 ± 1.53^{b}
	1.00	1.00 ± 1.00^{ab}
	1.50	0.33 ± 0.58^{a}

Values are means (Means ± SD) of three replicates. Means carrying the same superscript alphabets are not significantly (P =0.05) different.

DISCUSSION

The findings of this present study indicate the repellent and deterrent effects of the five botanical oils on mortality and oviposition of *C. maculatus.* All the vegetable oils evaluated were able to suppress the survival and egg laying of *C. maculatus* on cowpea. Neem seed oil and *Khaya ivorensis* seed oils were more toxic to adult *C. maculatus* and were also effective in suppressing the oviposition of *C. maculatus*. This agrees with the works of Wahedi *et al.* [18] that reported a high mortality in adult *C. maculatus* treated with neem seed oil, and was able to suppress and delayed the laying of eggs by the adult *C. maculatus*. This is also in agreement with the works of Wahedi *et al.* [19] who also reported anti ovipository activities of *Khaya ivorensis* on adult *C. maculatus* in Mubi, Nigeria. Generally, the five botanical oils tested were all effective against the pulse beetle, *C. maculatus,* which contradicts the earlier assertion by Singh *et al*., [13] Tikku *et al*. [14] and Don Pedro, [20] who reported that groundnut oil was not effective against the pulse beetles, and that the mortality recorded by the oil was because of the suffocation caused by the oil. [20] But it also supports the work of Sha'aya *et al.* [9] who reported that edible oils are potential control agents against *C. maculatus* and can play an important role in stored grain protection. The insecticidal effect of the vegetable oils agree with the work of Ajayi and Adedire [21] who reported that the sand-box seed oil has contact toxic effect on adult *C. maculatus* with 40% bruchids mortality at the lowest oil treatment at 0.1% at 1 day after treatment. The order of the efficacy of the five botanical oils tested with adult *C. maculatus* mortality is as follows: Khaya Oil=Olive Oil>Neem Oil=Soyabean Oil> Groundnut Oil, while the order of the efficacy of the botanical oils tested on oviposition is as follows: Khaya Oil> Olive Oil> Groundnut Oil> Neem Oil> Soyabean Oil. This shows generally that Khaya Oil was superior in the control of adult *C. maculatus.*

CONCLUSION

In conclusion, the result of this study will serve as a baseline information on the importance of using botanical oils especially Khaya oil as insecticide in the control of insect pests which are biodegradable than the use of chemical insecticide which are toxic and harmful to humans and the environment.

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