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PROTECTIVE BIOACTIVITY OF MORINGA (*MORINGA OLEIFERA* LAM.) SEED OIL AGAINST *CALLOSOBROCHUS MACULATUS* (F.) INFESTATION IN STORED COWPEA (*VIGNA UNGUICULATA* L. WALP.)

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ABSTRACT

Protection of grains against infestation and damage by diverse storage insect pests is an age long practice, as it ensures availability of agricultural produce and guarantees food security. This study assessed the protective bioactivity of moringa (Moringa oleifera Lam.) seed oil (MSO) against infestation by Callosobruchus maculatus (F.) in stored cowpea (Vigna unguiculata L. Walp.). Ten gram grains of three cowpea varieties (Borno brown, Gwalam and Banjara) were treated with four doses (0.1, 0.2, 0.4 and 0.6 ml) of MSO in three replicates, along with un-treated check. Data obtained on the number of eggs laid, adults emerged (F1) and severity of damage were subjected to the analysis of variance (ANOVA). Mean separation at 5% probability level was performed using the Least Significant Difference (LSD). Results indicated statistical significance (P<0.05) in the mean number of eggs laid on un-treated grains compared to grains treated with higher doses from each of the varieties. Similarly, mean number of adults emerged and severity of damage from un-treated grains were statistically significant (P<0.05) relative to the treated grains with all doses of each variety. Statistical differences in the mean number of eggs laid, adult emergence and severity of damage indicated the good potential of MSO in conferring protection to stored cowpea grains. The protective effect of MSO against C. maculatus seemed to be achieved principally through oviposition suppression and reduced or complete inhibition of adult emergence, consequently reducing or eradicating infestation risk, damage and loss of cowpea grains in storage. While the use of plant essential oils against storage insect pests is being advocated, the availability, affordability and the tendency of tainting protected grains need to be considered.

Keywords: Infestation, *C. maculatus*, Moringa seed oil (MSO), Damage, Dose.

Contribution/ Originality

This study contributes in the existing literature, as the results of the study concur with reports of several authors, where plant essential oils was effective as a protectant against the cowpea bruchid infestation; consequently reducing or eradicating the damaging effect of the beetle.

1. INTRODUCTION

The cowpea bruchid, *Callosobruchus maculatus* (F.), is the major pest of stored cowpea in Nigeria [1]and has been responsible for not less than 5% of her stored cowpea grain losses [2]. Grain legume forms the major staple food crops and source of dependence and sustainability for the livelihood of millions of people in many parts of the world; particularly the less privileged people of Africa [3]. In Nigeria, pulses occupy a prominent place in the nutrition of the people, their edible grains form relatively cheap and rich source of alternative protein [4].

The most effective insect pest control measure is the use of synthetic insecticides [5]. Their use is so desired because of the quicker and total protection it offers against diverse storage insect pests, however, the indiscriminate use by especially grain merchants, and farmers to protect grains in storage with its adverse effects on man, the environment, non-target organisms as well as the evolution of resistant strains of insect pests has been a drawback [6].

Over the last two decades, eco-friendly alternatives to synthetic insecticides control measure have been advocated; among these alternatives is the use of essential plant oils against *C. maculatus* infestation. The efficacy of essential plant oils has been demonstrated by a number of authors [5-14]. This study reports the effect of MSO as a cowpea grain protectant against *C. maculatus* infestation.

2. MATERIALS AND METHODS

2.1. Cowpea (*Vigna Unguiculata* L. Walp.) Varieties and Moringa (*Moringa Oleifera* Lam.) Seed Oil

Pristine grains of freshly harvested cowpea varieties namely: Gwalam, Borno brown and Banjara were threshed from cowpea pods obtained from a local farmer in Biu, Borno state, Nigeria. The cowpea grains were sorted out and stored in a refrigerator until required for use. MSO was purchased from a dealer in Damaturu, Yobe, State Nigeria.

2.2. Culturing of *Callosobruchus maculatus* (F.)

Insect culture was raised on Borno brown cowpea grain infested with *C. maculatus* obtained from infested cowpea grain purchased from Monday market in Maiduguri, Borno state, Nigeria. Adult progeny that emerged was used to set up the experiments. The culture was kept under ambient condition of 25-33° C and 27-65% RH.

2.3. Experimental Procedure

Ten grams cowpea grain of each variety was weighed and counted in to a 200 ml bottle in three replicates. The grains of each cowpea varieties were treated with four levels (0.1, 0.2, 0.4, 0.6 ml) of MSO each level having three replicates. Afterward three pairs (opposite sex) adult *C. maculatus* 0-72 hrs old were used to infest grains in each replicate and then removed five days after infestation. The numbers of eggs laid were counted. Adults that emerged during the first filial generation (F_1) were counted and recorded daily.

2.4. Data Analysis

Data obtained on number of eggs laid and adults that emerged from grains of each replicate for the levels of MSO treatments were computed and subjected to analysis of variance (ANOVA). Significantly different means were determined using the Least Significant Difference (LSD) at 5% level of probability. Severity of damage to cowpea grains was calculated using the formula Number of adults that emerged/Number of seeds × 100.

3. RESULTS

Result from Table 1 showed no significant (P>0.05) difference in the mean number of eggs laid on untreated grains and grains treated with 0.1 ml MSO of each of the three varieties (Borno brown, Gwalam and Banjara). Untreated grains from all the varieties were statistically significant (P<0.05) compared to grains treated with higher doses of MSO (0.2, 0.4, and 0.6 ml). Mean number of eggs laid on Gwalam and Borno brown grains treated with 0.4 and 0.6 ml were not significantly different from one another. Mean number of adult emergence from untreated grains of all the varieties were however, statistically significant (P<0.05) relative to treated grains with each MSO dose, as fewer to zero adults emerged (Table 2). Similarly, results of severity of damage indicated high statistical significance (P<0.05) in all treated cowpea grains of each variety compared to untreated grains in the replicates (Table 3).

Table-1. Mean number of eggs laid by adult *C. maculatus* on 10 g treated cowpea grains

Moringa seed oil Dose (ml)	**Cowpea varieties**		
	Gwalam	Borno brown	Banjara
0.0	13.67	14.33	21.67
0.1	11.33	8.00	15.00
0.2	3.67	5.67	11.00
0.4	0.67	2.67	5.33
0.6	0.67	2.67	2.00
SED±	1.30	2.32	2.47
LSD (5%)	2.90	5.17	5.50

Values are means of three replicates

Table-2. Mean number of adult *C. maculatus* that emerged from 10 g of treated cowpea grains

Moringa seed oil Dose (ml)	**Cowpea varieties**		
	Gwalam	Borno brown	Banjara
0.0	18.67	40.03	50.67
0.1	2.00	2.33	0.33
0.2	0.33	0.00	0.00
0.4	1.00	0.00	0.00
0.6	0.00	0.33	0.00
SED±	1.30	2.18	2.94
LSD (5%)	2.90	4.86	6.54

Values are means of three replicates

Table-3. Severity of damaged cowpea grains by *C. maculatus* after the emergence of first filial generation

Moringa seed oil Dose (ml)	Cowpea varieties		
	Gwalam	Borno brown	Banjara
0.0	108.29	84.56	122.40
0.1	5.88	5.69	1.28
0.2	1.10	0.00	0.00
0.4	3.03	0.00	0.00
0.6	0.00	0.74	0.00
SED±	31.49	3.63	21.43
LSD (5%)	70.17	8.08	47.75

Values are means of three replicates

4. DISCUSSION

The lack of statistical significance in mean number of eggs laid on un-treated compared to grains treated with 0.1 ml MSO in all the varieties showed the inefficacy of the oil in conferring protection at this level. On the other hand, higher doses of MSO (0.2, 0.4 and 0.6 ml) were effective in protecting cowpea grains against infestation by the cowpea bruchid, as there was significant reduction in the number of eggs laid on treated grains of each of the test varieties. The oviposition deterrent or inhibitory effect and reduced or total suppression of adult *C. maculatus* emergence by garlic oil from cowpea grain was reported by Dauda, et al. [6]. Udo [15] also, reported that the complete protection of grains from damage by the cowpea bruchid was achieved with groundnut oil, due to its deterrent and repellent effects. Similarly, sesame seed oil (SSO) was also reported to suppress oviposition and confer total inhibition of adult emergence, thereby reducing the risk of infestation and damage to grains by the beetle [8]. According to Lale [13] plant oils have a suffocating effect on insect pests by way of preventing the easy passage of atmospheric air onto them.

The significant suppression and complete inhibition of adult emergence showed the ovicidal and or larvicidal efficacy of MSO in conferring protection against *C. maculatus* damage. Similarly, statistical significance in severity of damage to cowpea grains indicated the potential of MSO in reducing or eradicating the damaging effect of the cowpea bruchid. This result concur with the findings of Ramzan [16] where cotton, sunflower, groundnut, soybean and mustard seed oils mixed with cowpea grain, were reported to have completely suppressed adult emergence. It is important to note that while the use of essential plant oils for the management of *C. maculatus* infestation in cowpea grains is being advocated, the use of plant oils that are medicinal should be cautiously considered [6]. Availability and affordability of essential plant oils used should also be taken into consideration.

The overall results showed the promising effects of MSO as protectant against the cowpea bruchid infestation. Control was achieved mainly through oviposition deterrent/suppression and

reduced/inhibition of adult emergence consequently securing cowpea grains against infestation damage and loss.

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