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CURATIVE BIOACTIVITY OF MORINGA (MORINGA OLEIFERA LAM.) SEED OIL AGAINST CALLOSOBRUCHUS MACULATUS F. INFESTED COWPEA (VIGNA UNGUICULATA L. WALP.) GRAIN IN STORAGE

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ABSTRACT

Farmers, households as well as grain merchants have to contend with infested stored cowpea grain once attacked by Callosobruchus maculatus (F.). They could be compelled to consume, sale at low economic value or find other way of salvaging the grains from total damage and loss. This paper reports the curative effect of moringa (Moringa oleifera Lam.) seed oil (MSO) in mitigating C. maculatus damage and loss to freshly infested cowpea grains in storage. Ten grams cowpea grains of three varieties (Gwalam, Borno brown, and Banjara) were each weighed into a 200 ml bottle in three replicates for un-treated and four levels of MSO treatments (0.1, 0.2, 0.4 and 0.6 ml). Three pairs of opposite sex adult C. maculatus 0-48 hrs old were used to infest grains in each replicate. Insects were removed five days after infestation and the number of eggs laid on grains in each replicate counted. MSO treatments were carried out at five and eight days after infestation. The number of adults that emerged was counted daily throughout the first filial generation (F1). All data were subjected to analysis of variance at 5% level of probability. Significantly different means were determined using Least Significant Difference. Results indicated statistical significances (P<0.05) between treated and un-treated infested grains of each variety. This implied that MSO is effective in mitigating C. maculatus damage to cowpea grain in storage. Grains infested with 1-8 days old cowpea bruchid eggs could be salvage from total damage and loss. Control was achieved mainly through ovicidal action and / or adverse effect of the oil on early larval instars thereby reducing and / or eliminating the damaging effect of C. maculatus.

Keywords: Damage, *C. maculatus*, Infested grain, Moringa seed oil (MSO), Treated grain, Un-treated grain.

Contribution/ Originality

This study is one of very few studies which have investigated the use of moringa seed oil to control *C. maculatus* in freshly infested stored cowpea. The oil was effective in reducing and / or inhibiting damage and loss in cowpea grains infested with freshly laid eggs.

1. INTRODUCTION

Callosobruchus maculatus (F.) is a primary insect pest causing losses to stored cowpeas in West Africa (Ilesanmi and Gungula, 2010). Insects attack of crops from field which is later carried to farmer's stores and homes are liable to depredation, causing substantial damage to grains, such as dry weight losses, impaired nutritional qualities, seed viability reduction and low market value(Ivbijaro *et al*., 1985; Lale, 1992). Several measures have been adopted to curtail/avert these problems of insect infestation, but it remains apparent (Okunola and Ofuya, 2007).

Amongst several management measures taken to mitigate infestation of cowpea grains by *C. maculatus* are the use of synthetic insecticides and other environment-friendly methods. The use of synthetic insecticides is the most popular, their use is so desired due to the quicker and the complete protection it offers against diverse storage insect pests. However the indiscriminate use of pesticides especially by grain merchants and farmers to protect grains in storage with its attendant adverse effects on man, the environment, non-target organisms as well as the evolution of resistant strains of insect pests has been a serious draw back to their use (Dauda *et al*., 2012a).

The protective effect of many essential plant oils against *C. maculatus* infestation has been demonstrated by several authors (Maina and Lale, 2005; Adebowale and Adedire, 2006; Maina, 2006; Okunola and Ofuya, 2007; Maina *et al*., 2012; Dauda *et al*., 2012a; Dauda *et al*., 2012b).

However, the curative effect of plant essential oils with a view to salvaging freshly infested grains has not been sufficiently reported in literature. This paper aims at evaluating the efficacy of moringa (*Moringa oleifera* Lam.) seed oil (MSO) in mitigating *C. maculatus* damage and loss to freshly infested cowpea grains in storage.

2. MATERIALS AND METHOD

2.1 Insect culture, Source of cowpea (*Vigna unguiculata* L. Walp.) grains and Moringa (*Moringa oleifera* Lam.) Seed oil

Adult *C. maculatus* was raised on Borno white cowpea grain obtained in a local market in Maiduguri. The culture was reared under ambient fluctuating temperature range from 30-35° C and 52-65% Rh. Adult *C. maculatus* 0-48 hrs old that emerged from the culture were used to infest grains of experimental replicates. Un-infested 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, cleaned and stored in a refrigerator until required for use. MSO was purchased from a dealer in Damaturu, Yobe State, Nigeria.

3. EXPERIMENTAL PROCEDURE

Experiments were conducted in two batches in the Entomology Laboratory of the Department of Crop Protection, University of Maiduguri under the same conditions that *C. maculatus* culture was raised. Ten grams (10 g) cowpea grains of the three varieties were each

weighed into a 200 ml bottle in three replicates for un-treated and four levels of MSO treatments (0.1, 0.2, 0.4, 0.6 ml). Number of grains from each replicate was also counted and records taken. Three pairs of (0-48 hrs) old *C. maculatus* were used to infest grains of each replicate for un-treated and four levels of MSO treatments. The bruchids were removed after five days and the number of eggs laid was counted. Four levels of MSO (0.1, 0.2, 0.4, 0.6 ml) treatments were applied on eggs laid on the cowpea grains. Number of adults that emerged from grains in each replicate was counted daily throughout the first filial generation (F1). Another similar batch of treatments was also carried out eight days after infestation while same variables were also assessed.

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 sum up, while severity of damage to cowpea grains of each was calculated using the formula: Number of adults that emerged/ Number of seeds×100. All data were subjected to analysis of variance (ANOVA). Significantly different means were determined using the Least Significant Difference (LSD) at 5% level of probability.

5. RESULTS AND DISCUSSION

Results in Table 1 showed the mean number of eggs laid on un-treated grains of all the varieties which showed no significant difference within each variety. Mean number of adult *C. maculatus* that emerged indicated statistical significance between untreated and treated grains in each of the variety. There was a reduction in the mean number of adult that emerged which is dose dependent, as there was zero emergences in higher doses (0.4 and 0.6 ml) of Banjara and Gwalam (Table 2). These result showed the efficacy of MSO in mitigating damage and loss by the cowpea bruchid in cowpea grains riddled with 1-5 days old eggs. All doses were effective in reducing or completely inhibiting damage. This was achieved through ovicidal and or adverse effects of the oil on early larval instars of C. maculatus, thereby salvaging infested cowpea grains. This result concur with reports by Dauda *et al.* (2012a, b) who reported the efficacy of garlic (*Alium sativum* L.) oil and sesame (Sesamum indicum L.) seed oil in reducing and or inhibiting *C. maculatus* adult emergence in cowpea grain infested with 1-5 days old eggs, and also damage by the beetle. It has been reported that plant oils have suffocating effect on insect pests by way of preventing the easy passage of atmospheric air onto them (Lale, 1995). There was also a significant (P>0.05) difference in severity of damage between un-treated and treated infested grains. There was a reduction in the severity of damage as MSO dose increased. Zero severity of damage was recorded in higher doses (0.4 and 0.6 ml) of each variety (Table 3). The results showed that the oil is effective in reducing or inhibiting the damaging effect of *C. maculatus* in grains infested with 1-5 days old eggs. The result presents the promising effect of MSO in mitigating damage by the beetle.

Results in table 4 also indicated statistical significance (P>0.05) in mean number of adult that emerged from infested un-treated grains relative to treated grains riddled with cowpea bruchids eggs. The effect is also dose dependent, with reduction of adult emergence as the dose increased, culminating in zero adult emergences at 0.6 ml dose in each of the variety. The results implied that grains infested with 1-8 days old eggs could be salvage from damage and loss by *C. maculatus*, this reduces the damage potential of the beetle in infested grain. Garlic oil and sesame seed oil was similarly reported to be ovicidal and / or larviciadal on *C. maculatus*, as it reduced and / or inhibited adult emergence, consequently damage and loss in cowpea grains infested with 1-8 days old eggs (Dauda *et al*., 2012a, b). Egg is usually one of insect pest stage that is tolerant to chemical treatment (Giga and Smith, 1987) This report however, indicated MSO to significantly have ovicidal effect on *C. maculatus* eggs. Boateng and Kusi (2008) and Adebowale and Adedire (2006) also reported Jatropha curcas L. seed oil to have had adverse effect on *C. maculatus* eggs. Severity of damage to grains also indicated statistical significance (P<0.05) between infested un-treated and infested treated grains. It was also dose dependent as severity of damage reduced with increase in MSO dose. This also showed the efficacy of the oil in inhibiting and or reducing damage potential of the beetle.

Generally, MSO was effective in reducing and / or inhibiting damage and loss in cowpea grains infested with freshly laid eggs. This was achieved mainly due to the ovicidal and / or larvicidal effects of the oil. All doses of MSO were effective, however, higher doses had greater efficacy in mitigating damage in each of the variety. Additionally, once applied, besides being curative, the effect of MSO could also be protective against re-infestation by *C. maculatus*. This is especially in lower doses where very few adults emerged from treated grains.

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

	Cowpea varieties		
	Gwalam	**Borno brown**	**Banjara**
	36.33	67.33	78.67
	34.33	64.00	76.67
	30.33	63.00	70.00
	30.33	62.67	63.00
	30.00	45.00	47.67
SED±	5.70	6.28	8.22
LSD (5%)	13.14	14.47	18.95

Values are means of three replicates

Table-2. Mean number of adult *C. maculatus* that emerged from 10 g of treated cowpea grains riddled with eggs laid over five days

Moringa seed oil Dose (ml)	Cowpea varieties		
	Gwalam	Borno brown	Banjara
0.0	40.33	46.33	32.00
0.1	3.67	2.00	1.67
0.2	2.67	2.00	1.33
0.4	0.00	1.67	0.00
0.6	0.00	0.33	0.00
SED±	8.39	14.06	5.45
LSD (5%)	19.35	32.41	12.58

Values are means of three replicates

Table-3. Mean severity of damage to treated cowpea grains (10 g) riddled with *C. maculatus* ggs laid over five days

Moringa seed oil Dose (ml)	Cowpea varieties		
	Gwalam Banjara	Borno brown	
0.0	130.63	98.62	63.35
0.1	11.43	4.33	2.95
0.2	8.33	4.21	2.52
0.4	0.00	3.65	0.00
0.6	0.00	0.74	0.00
SED±	30.49	26.67	10.95
LSD (5%)	70.31	61.51	25.24

Values are means of three replicates

Table-4. Mean number of adult *C. maculatus* that emerged from 10 g of treated cowpea grains riddled with eggs laid over fight days

Moringa seed oil Dose (ml)	Cowpea varieties		
	Gwalam		Borno brown
Banjara			
0.0	53.67	72.67	46.33
0.1	11.67	7.67	15.33
0.2	4.67	2.33	1.33
0.4	0.67	0.67	0.33
0.6	0.00	0.00	0.00
SED±	22.07	11.89	16.12
LSD (5%)	50.89	27.41	37.16

Values are means of three replicates

Table-5. Mean severity of damage to treated cowpea grains (10 g) riddled with *C. maculatus* over eight days

Moringa seed oil Dose (ml)	Cowpea varieties		
	Gwalam Banjara	Borno brown	
0.0	160.61	163.13	90.29
0.1	36.04	18.11	29.86
0.2	15.74	5.09	2.53
0.4	2.15	1.36	0.69
0.6	0.00	0.00	0.00
SED±	69.82	27.43	30.85
LSD (5%)	160.99	63.26	71.15

Values are means of three replicates

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