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CONTROL OF *CALLOSOBRUCHUS MACULATUS*(F.) [COLEOPTERA: BRUCHIDAE] USING LEAF POWDERS OF *EUPHORBIA BALSAMIFERA* L. AND *LAWSONIA INERMIS* L.

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Abstract: Experiments were conducted in the Biology Laboratory 1 of the Department of Biology of Umaru Musa Yar'adua University (UMYU), Katsina, Nigeria, to test the insecticidal effects of leaf powders of *Euphorbia balsamifera* L. and *Lawsonia inermis* L. Doses of 0.25, 0.50 and 1.00 g of each of the leaf powders and 0.12 g of Permethrin were applied to 20 g each of cowpea seeds in which five pairs of adult *Callosobruchus maculatus* Fab were released for adult mortality, fecundity and seed damage tests. The results showed that the highest (90.00%) mortality of *C. maculatus* was obtained when 1.00 g of *E. balsamifera* was applied while the least (66.70%) was recorded from treatments of 0.25 g *L. inermis.* The adult mortality of *C. maculatus* was significantly ($P \leq 0.05$) different between the leaf powders applied and the control. The findings of this study also showed that increase in the amount of the leaf powders applied decreased the number of eggs laid with the least (3.33) number in 1.00 g *E. balsamifera* and the highest (8.33) in 0.25 g *L. inermis*. The leaf powders were found to be effective in reducing cowpea seed damage which increased with increase in the amount applied. Findings of this study showed that the leaf powders of *E. balsamifera* and *L. inermis* were very effective in protecting cowpea seeds against *C. maculatus* infestation. Therefore, more research is recommended on toxicity effect of these plant powders on other insect pests.

Keywords: *Callosobruchus maculatus,* Control, *Euphorbia balsamifera,* Fecundity, *Lawsonia inermis.*

INTRODUCTION

Cowpea is prone to pest infestation during pod and dry seed stages in the field and in storage. It has been reported that both quantitative and qualitative losses arising from physical, chemical and biological factors (e.g. fungi, rodents, birds and insects) occur during storage of grains (Emeasor *et al.,* 2005).

The cosmopolitan pest of cowpea is *C. maculatus*, and is particularly of economic importance, as its infestation often results in dry weight loss, reduction in nutritional value (denaturing of protein) or physical quality (disfigured with egg covers or riddled with adult exit holes) and poor seed germination ability (Ofuya, 2001). *C. maculatus* has caused

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enormous weight loss, reduced viability and reduced commercial value of cowpea seeds (Adedire *et al.,* 2004; Emeasor *et al.,* 2005). *C. maculatus* attack of cowpea initially begins in the field, and rapidly builds up during storage. Up to 100% infestation of cowpea can occur after three to six months storage (Maina *et al*., 2011), resulting in about 60% weight loss (Umeozor, 2005).

Although synthetic insecticides such as Pirimiphos methyl and Permethrin are effective against *C. maculatus* infestation in storage, human health and environmental hazards associated with their use makes them less desirable (Swella and Mushobozy, 2007). Botanical insecticides, therefore, continue to receive increased attention for use as safe and effective protectants of stored grains against insect pests infestation and damage (Alberto *et al*., 2005; Ngamo *et al*., 2007).

Genus Lawsonia bears one species, *L. inermis* (Henna) till date, belonging to the family Lythraceae. It is a biennial dicotyledonous herbaceous shrub. A native of North Africa and South-West Asia, the plant is now widely cultivated throughout the tropics as an ornamental and dye plant (Chaudhary *et al.,* 2010). It is a much branched glabrous shrub or small tree (2 to 6 m in height). Leaves are small, opposite in arrangement along the branches, sub-sessile, about 1.5 to 5 cm long, 0.5 to 2cm wide, greenish brown to dull green, elliptic to broadly lanceolate with entire margin, petiole short and glabrous and acute or obtuse apex with tapering base (Chauhan *et al.,* 2007).

E. balsamifera (Balsam spurge) is a perennial shrub in the Euphorbia genus growing 3 - 6m from the ground. It is a Saharan-Arabian species, occurs from the Canary Island across Northern Africa to Somalia, Nigeria, Saudi Arabia and Oman. It grows on dry rocks and stone slopes, common in coastal regions (Cox, 1997). *E. balsamifera* has sap (latex) which is rather poisonous if ingested but not corrosive, and widely used in odontology as traditional antalgic treatment of acute dental pulpitis (Yam *et al.,* 1987).

These plant powders were tested against *S. zeamais* (Suleiman *et al.,* 2012) and found effective in reducing sorghum grain damage caused by the weevil. This research is therefore, aimed at studying the efficacy of leaf powders of *E. balsamifera* and *L. inermis* in the control of *C. maculatus* on cowpea seeds during storage.

MATERIALS AND METHODS

Rearing of *C. maculatus*

Adult *C. maculatus* were obtained from infested cowpea seeds from a local store. The insects were sieved out from the infested cowpea seeds. Fresh, healthy cowpea seeds used as food

media for the insects were obtained from Katsina Central Market, Katsina State, Nigeria. The seeds were disinfested from any insects, mites or microorganisms that might be present in an oven at 40°C for 4 hours. A sample of 250 g of the disinfested cowpea seeds were placed in each of five rearing bottles of 50cm^3 capacity after which 50 pairs of the adult *C. maculatus* were added. The rearing bottles were covered with muslin cloth and secured with rubber bands to prevent escape of the insects and allow gaseous exchange and were then kept in incubator at 28 ± 2°C and 70 ± 5% R. H. The adult beetles were sieved out after 7 days of oviposition period leaving the cowpea seeds only. The bottles containing the seeds were maintained under the constant condition until the emergence of adults. The newly emerged adults were used for the experiments.

Collection and Preparation of the Plant Powders

Euphorbia balsamifera (L.) and *Lawsonia inermis* (L.) plant species were collected from their natural habitat (bush) and taken to the Department of Biology, UMYU, Katsina, for identification. The leaves of the two plant species were collected and dried separately under the shade on a laboratory bench for 10 days. Thereafter, the leaves were ground using laboratory blender (Model 8010ES) and sieved with 80µm laboratory sieve to obtain fine powders. The pulverized contents obtained in each case was kept in separate black polyethylene bags and kept under laboratory condition. The conventional insecticide (Permethrin 0.60%) was purchased from Katsina Central Market for the experiments as chemical check.

Adult Mortality Test

Twenty gram of the healthy and disinfested cowpea seeds were measured and placed in each of five petri dishes. Doses of 0.25, 0.50 and 1.0 g (equivalent to 1.25, 2.50 and 5.00% w/w) of leaf powder of *E. balsamifera* were added to the first, second and third petri dishes, while 0.12 g (0.60%) of the chemical insecticide was added to the fourth petri dish. No powder was added to the fifth petri dish, and this served as control. The seeds and the powders were mixed thoroughly to ensure proper admixture. Five pairs of newly emerged adult *C. maculatus* were introduced into each of the petri dishes. The same experiment was repeated for *L. inermis,* and the petri dishes were arranged in a Completely Randomized Design (CRD) with three replications and kept in incubator under the constant conditions of 28 ± 2°C and 70 ± 5% R. H. In each treatment, observations were made and recorded for toxicity effect on mortality rates after 24, 48, 72 and 96 hours. Data collected was analyzed as percentage mortality of the number of insects used for the experiments.

Fecundity/Number of Eggs Laid

After 14 days of infestation and exposing the beetles to the treatments, samples of 10 seeds of cowpea from each of the treated and control petri dishes were randomly taken and the number of eggs deposited on them were counted and recorded.

Grain Damage

After 28 days of treatment, the percentage weight loss of the seeds was evaluated by weighing the cowpea seeds in petri dish and the difference from the initial weight of 20 g was transformed into percentage weight loss as follows:

$$\% \text{ Damage} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

The weevil perforation index (WPI) will be evaluated as follows:

$$\text{WPI} = \frac{\% \text{ Treated grains perforated}}{\% \text{ Control grains perforated} + \text{Treated grains perforated}} \times 100$$

Statistical Analysis

The data collected was subjected to Analysis of Variance ANOVA and means were separated using least significant difference (LSD).

RESULTS

The effect of *E. balsamifera* and *L. inermis* leaf powders on adult *C. maculatus* after 14 days of treatment is shown in Table 1. The Table shows that the *E. balsamifera* leaf powder resulted in higher (90.00%) mortality of adult *C. maculatus* than in the treatments of *L. inermis* (83.30%) when applied at the rate of 1.00/ 20 g of cowpea seeds, while there was 56.70% mortality in the control. The adult mortality was observed to be significantly ($P \leq 0.05$) different between the leaf powders used and control. The adult mortality of *C. maculatus* was generally directly proportional to the amount of leaf powders of *E. balsamifera* and *L. inermis* applied.

The effect of leaf powders of *E. balsamifera* and *L. inermis* on fecundity of *C. maculatus* is shown in Table 2. The Table shows that the highest (15.00) egg produced by the adult *C. maculatus* in cowpea was obtained from the control, while the fecundity observed from the *C. maculatus* treated with 0.25g of *L. inermis* was found to be higher (8.33) than what was observed from the treatment of 1.00 g of *E. balsamifera*. The results show that increase in the amount of the plant powders used decreased the number of eggs laid by the adult *C. maculatus*.

The effect of the leaf powders of *E. balsamifera* and *L. inermis* on cowpea seed damage caused by *C. maculatus* is shown in Table 3. The highest (18.33) cowpea seed damage was observed from the control. Both the leaf powders resulted in 1.67% cowpea seed damage when applied at 1.00 g/ 20 g, while the damage was observed to be higher (5.00) in *L. inermis* than that from treatments with *E.* balsamifera at the dose of 0.25 / 20 g.

Table 1: Effect of Leaf Powders of *E. balsamifera* and *L. inermis* on Adult Mortality of *C. maculatus*

Plant Powder	Amount Used (g/20 g)	Number of Insects Introduced	Mean Mortality (Per cent)
E. balsamifera	0.25	10	76.70
	0.50	10	86.70
	1.00	10	90.00
L. inermis	0.25	10	66.70
	0.50	10	76.70
	1.00	10	83.30
Permethrin	0.12	10	100.00
Control	0.00	10	56.70
LSD ($p \leq 0.05$)	_	_	2.34

Table 2: Effect of Leaf Powders of *E. balsamifera* and *L. inermis* on fecundity of *maculatus*

Plant Powder	Amount Used (g/20 g)	Number of Insects Introduced	Number of Seed Sample	Mean Fecundity (Number)
E. balsamifera	0.25	10	10	6.67
	0.50	10	10	4.00
	1.00	10	10	3.33
L. inermis	0.25	10	10	8.33
	0.50	10	10	7.00
	1.00	10	10	5.33
Permethrin	0.12	10	10	0.00
Control	0.00	10	10	15.00
LSD ($p \leq 0.05$)	_	_	_	3.17

Table 3: Effect of Leaf Powders of *E. balsamifera* and *L. inermis* on Cowpea Seed Damage Caused by *C. maculatus*

Plant Powder	Amount Used (g/20 g)	Number of Insects Introduced	Cowpea seed Damage (Per cent)
E. balsamifera	0.25	10	4.33
	0.50	10	3.00
	1.00	10	1.67
L. inermis	0.25	10	5.00
	0.50	10	3.33
	1.00	10	1.67
Permethrin	0.12	10	0.00
Control	0.00	10	18.33
LSD ($p \leq 0.05$)	_	_	3.55

DISCUSSION

From the results obtained, it can be seen that the plant powders used in the research showed significant ($P \leq 0.05$) effect on the mortality and fecundity of adult *C. maculatus* as well as damages caused on cowpea seeds by the insect.

Both of the leaf powders used were observed to have effect the mortality of *C. maculatus* at varying amounts applied. This agrees with the results obtained by Khalequzzaman *et al.* (2009) where they showed that the toxic effect of the plant leaves used on *C. maculatus* and recorded 100% mortality in all the doses. In all treatments of both of the leaf powders, there was a significant ($p \leq 0.05$) increase in the mortality of the bruchids with respect to the untreated control. *E. balsamifera* caused higher mortality rate of *C. maculatus* compared to *L. inermis* and this might be as a result of its strong odours which could have toxic effect that caused suffocation of adult bruchids, thereby, preventing physical contact or hindering oviposition success. The findings of this work also revealed that increase in the amount of both of the leaf powders increased the adult mortality of *C. maculatus* and this agrees to the findings of Al-Moajel (2004) which reported an increase in effectiveness of leaves powder of *L. inermis* with increase in concentration.

The results after all the three trials of different concentrations had shown clearly that the tested leaf powders of *E. balsamifera* and *L. inermis* affected the oviposition of *C. maculatus* in the cowpea used. The number of eggs laid was much reduced in treated samples in

comparison with untreated control, and this is in conformity with the findings of Khalequzzaman *et al.* (2009) who reported that the use of leaf powder of *A. indica* reduced the mean numbers of eggs laid by *C. maculatus* from 8.33 to 3.33 when its application was increased from 1.0 g to 3.0 g. Significantly there was higher mean number of bruchid eggs laid on untreated compared to treated cowpea seeds and this indicates that the leaf powder of the two plants used effectively deterred oviposition by *C. maculatus* on cowpea. This effect is however dosage dependent, in which lower number of bruchid eggs were laid on cowpeas treated with higher dosages of the leaf powder. Yahaya (2002) reported that the oil and powder of *P. guinnense* significantly reduced the egg laying capacity of adult *C. maculatus* weevils, as well as their survival on cowpea grains.

Suleiman *et al.* (2012) reported that *J. curcas* and *L. inermis* resulted in 100.00% adult mortality of *S. zeamais* at all doses, while *E. balsamifera* gave similar results only with 2.0 g concentration. A part form the control which gave 15.00% mean mortality. The effect of the test powders on *Sitophilus zeamais* adult mortality in their research was significantly ($p \leq 0.05$) different among the treatments and between them and the control and all the test powders they used were observed to have potentials of reducing adult emergence. There is no enough literature on the use of *E. balsamifera* in the protection of stored products against insect pests. However, Zorloni (2007) reported the effectiveness of *E. balsamifera* in the control of animal ectoparasites. Powder of *E. balsamifera* applied was found effective in protecting the sorghum grains from damage caused by *S. zeamais* Suleiman *et al.* (2012).

Leaf powders of *E. balsamifera* and *L. inermis* have effect on the mortality and fecundity of adult cowpea bruchid in cowpea, thus, must have considerably reduced the damage caused by the bruchid since there was fewer number of the bruchid after treatment. The two leaf powders resulted in similar effect at the higher dose applied by. The cowpea seeds damage was generally reduced with the increase in the amount of the plant powders used. This agrees with findings of Suleiman *et al.* (2013) who reported that increase in the amount of *E. balsamifera* from 0.5 to 2.0 g resulted in reducing sorghum grain damage from 23.00 to 6.00%. This action might be as a result of its effectiveness in killing the adult bruchids introduced within a short period of time. The control caused higher damage of cowpea seeds with respect to the treated ones.

Varying activity by different powders indicate that the pest controlling factors are not uniformly present in every aromatic plant. The leaf powders might thus have inhibited the larval penetration into the seed and thus showed maximum feeding deterrence. The bitter

taste, pungent smell and chemical nature of the plant powders causing quick mortality within five days would not allow the formation of resistant races of the insect which is quite prevalent with most of the synthetic pesticides (Shukla *et al.*, 2007).

CONCLUSION

The findings of this study have shown that the leaf powders of *E. balsamifera* and *L. inermis* have a great potentiality in protecting cowpea seeds from damage that might be caused by *C. maculatus.* Farmers could utilize these locally available plant powders in keeping their cowpea seeds free from *C. maculatus* attack in the store. More research work is hereby recommended to isolate the secondary metabolites present in the leaf powders of *E. balsamifera* and *L. inermis* that have the insecticidal potentials.

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