



STUDIES ON THE EFFICACY OF LEAF EXTRACT OF *BALANITES AEGYPTIACA* ON THE OVIPOSITION AND SURVIVAL OF IMMATURE STAGES (LARVAE AND PUPAE) OF *CALLASOBRUCHUS MACULATUS* (F.) ON TREATED COWPEA SEED

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ABSTRACT

The efficacy of *Balanite aegyptiaca* acetone leaf extract against the survival of Larvae and pupae of *Callosobruchus maculatus* (F.) on cowpea treated seed was evaluated at the Biological Sciences Department, Bayero University, Kano. Leaf extract from *B. aegyptiaca* was obtained by extraction using acetone as the solvent and the extract was diluted prior to the experiment. *C. maculatus* were obtained from IITA in Kano State of Nigeria. The insects were reared in the laboratory. Four different concentrations of the leaf extract (0.5, 1.0, 1.5, and 2.0g) were separately mixed with twenty gram (20g) of cowpea in separate Petri dishes which correspond to (2.5, 5.0, 7.5, and 10.0w/w) respectively. Control treatment was set along. Ten adult pairs of newly emerged *C. maculatus* were introduced into each Petri dish. Oviposition of the female insect was significantly ($p < 0.05$) reduced on seed treated with higher treatment level of the extract, in comparison with the control treatments. Furthermore the survival of larvae and pupae from the seed cotyledon were also found to be significantly reduced ($p < 0.005$) on seed treated with varying doses of *B. aegyptiaca* leaf extract. The lower concentration of the extract (2.5%w/w) recorded 41.43% and higher dose recorded 32.94% survival of larvae and pupae from the seed cotyledon in comparison with the control treatments (90.85% and 91.32 %). None of the seeds treated with *B. aegyptiaca* leaf extract at all level of application recorded similar result with the seeds treated with Actellic dust. *B. aegyptiaca* leaf extracts was effective against oviposition and survival of larvae and pupae when compared with the untreated control treatment the extract therefore has great potential for use as a plant-based biopesticide for controlling pulse beetle *C. maculatus*.

Keywords: *Balanite aegyptiaca*, Acetone leaf Extract, Survival, Immature stages (larvae & pupae), *Callosobruchus maculatus*

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp] is known to be attacked by insect pests both in the field and during storage. *Callosobruchus maculatus* has been the major pest of stored cowpea and the pest can record as much as 50% o damaged to grains after 8 month of storage (Caswell, 1984). Synthetic insecticides had been used and are still being employed for the control of this pest. However, the drawbacks associated with these are well known (Deedant, 1994). Synthetic insecticides are noxious to man and livestock and can be pollutants to the environment (Deedant, 1994). They may not be readily available and are unaffordable by the rural farmers. They may also be persistent in the produce (Deedant, 1994). Application of the synthetic insecticides require a degree of skill to the rural farmers who are the producers of the bulk of the nations' food supply and furthermore each generation of insects becomes more immune to chemical pesticides leading to the problem of resistance (Georgiou, 1991). In addition, non-selective insecticides kill beneficial insects thereby causing an imbalance in the ecosystem (Georgiou, 1991). In recent years, attention has been focused on the use of plant materials for insect pest control. Such

plant materials include powders from parts of the neem tree, (*Azadirachta indica* A. Juss) (Ivbijaro, 1983), vegetable oils from groundnuts, palm kernel and coconut (Hall and Harman, 1991; Lale, 1995). Others are leaf extracts of *Toprosia vogelii* (Mallaya, 1985), oils from fresh garlic (Ho *et al.*, 1997) and basilum (Grainge & Ahmed, 1988).

Balanites aegyptiaca (L.) Del. Zygophyllaceae belongs to the family *Balaniteceae* is also called desert date (English), adua (Hausa, Nigeria), tanni (Fulfulde, Nigeria) and heglig (Arabic). It is widely grown in the Sudano-Sahelian region of Africa, the Middle East, and South Asia and has various uses from ethno botanical to fire wood; it is considered one the most neglected tree species in arid regions. *B. aegyptiaca* leaf extract was used in this study in order to assess its possible effect against the oviposition and the survival of the immature stage of *C. maculatus* on cowpea seed treated with the plant extract. The leaf of *B. aegyptiaca* plant was traditionally used in some rural areas of Kano State for the control of *C. maculatus* infestation in the stores based on that the plant was selected for the present study.

MATERIALS AND METHOD

Study area

The study was conducted in Kano State of Nigeria at the Department of Biological Sciences Bayero University Kano under ambient conditions of temperature and relative humidity. Kano State lies in latitude $11^{\circ}59'N$ and longitude $8^{\circ}34'E$, with altitude of 486.5(159ft)

Plant materials

Fresh plants leaves of *Balanite aegyptiaca* was collected from some rural areas of Kano State (latitude $11^{\circ}59'N$ and longitude $8^{\circ}34'E$,with altitude of 486.5(159ft). These were washed and air dried in the shade (Boateng and Kusi, 2008; Bamaiyi *et al*, 2007).

Test Insect culture

The beetle, *C. maculatus* (F.) were used for the experiment. A small population of *C. maculatus* beetle was obtained from IITA in Kano State of Nigeria, along with infested cowpea. These were identified as described by (Utida, 1972).The beetle *C.maculatus* was reared in the Biological Sciences laboratory and were differentiated into males and females based on their morphological characters (Southgate, 1979).

Maintenance of Cowpea

Cowpea (Danila) was collected from IITA, Kano and mechanically damaged seed were excluded. Checked seeds were placed in plastic bags and kept in the freezer overnight to eliminate any possible beetle infestation coming from field (Marcileyne *et al*, 2004).The seed were removed from the freezer and kept at room temperature and relative humidity for some hours to equilibrate and the moisture content of the seed was measured before the experiment (Jackai and Asante, 2001)

Acetone leaf extracts

Acetone extract were made according to the method of Talukder and Howse(1993).Ten grams of grounded leaves of *B. aegyptiaca* were separately mixed with 50ml acetone and stirred for 30 minute using stirrer and then left to stand for 2 weeks. The mixture was then filtered through whatmann grade 1 filter paper, and the solid were stirred again for 15minutes with 30ml acetone and filtered and the filtrates were then combined. The filtrates were evaporated after complete evaporation the final crude extract from the plant was then weighted, and preserved in sealed bottles in a refrigerator until required for bioassay.

Bioassay

Bioassay were conducted based on the method described by (Talukder and Howse, 1994) Four different diluted concentration of extract from the leaf of *B. aegyptiaca* (0.5,1.0,1.5,and 2.0g) which were design after a trial expirement.These were separately mixed with twenty gram(20g) of Danila cowpea in separate Petri dishes which correspond to 2.5,5.0,7.5, and 10.0% W/W respectively. Danila cowpea seeds which were mixed with different concentrations of the extract were shaken properly to ensure proper coating of the seeds with the extract. The seeds were then air-dried for one hour to evaporate the solvent (Talukder and Howse, 1994). Actellic dust at varying levels was set up as standard chemical insecticides. Control treatment was also set along (which has

neither extract nor actellic dust). Ten pairs of the beetle *C. maculatus* which freshly emerged from the culture were released into each treatment. These were covered with a muslin cloth to facilitate proper aeration and prevent entry and exit of insects. Each treatment were replicated three times and arranged in a completely randomized design (CRD) and left on the laboratory bench for daily observation (Oparaeke, 1996) Mortality of the insect was observed after 24hours interval. The number of eggs laid was counted separately for each treatment. All the eggs laid in different Petri dishes were examined and the viable eggs were identified. Viable eggs were recognized by their morphological aspect (Marcileyne *et al*, 2004), since they become opaque as a function of their residue discharged by the larvae during penetration. The % survival of immature stages was also determined. The results were analyzed using computer statistical software.

RESULTS AND DISCUSSION

The results showed that *B. aegyptiaca* leaf extract at all level of application level significantly($p<0.005$) reduced the oviposition of *C. maculatus* in comparison with the untreated control treatments(Table1).The reduction of the oviposition by the extracts was found to be higher on seed treated with higher doses of the extract(7.5 and10.0% w/w) and lower on seeds treated with lower doses of the extract(2.5 and5.0% w/w) and the differences was found to be significant(Table1). The result therefore indicated the probable presence of a strong oviposition deterrent in the extract. The finding in this study was similar to the finding of Elhag (2000) who tested extracts from nine plant materials as oviposition deterrents against *C.maculatus* and found that pulse treated with *Rhazya stricta* leaves, neem seeds, *Heliotropium bacciferum* aerial parts and citrus peels acted as highest ovipositional deterrents.

Furthermore the viability (%hatching of the eggs), survival of immature stages as well as adult emergences were highly reduced in all the treatments(Table2).The differences observed in all the treatments was found to be significantly different ($p<0.05$) in comparison with the acetone treated and untreated control. However the reduction in adult emergences was found to be higher on seed treated with higher doses of the extract (7.5 and10.0% w/w). The eggs mortality and failure to hatch on the seed treated with the extract has been probably attributed to the toxic component of the extract and also to the physical properties, which cause changes in surface tension and oxygen tension within the eggs (Singh *et al*, 1978) the ovicidal effect of the extract on the bruchid may also be explained in terms of asphyxiation by occluding a funnel which is probably the major route of gas exchange between a thin area of the chorion and the outside (Credland, 1992). The reduction of the survival of larvae and pupae as well as adult emergence from the cowpea seeds treated with the extract may be due to decreased in the hatching rate of the eggs (Table2).

The finding from this study was similar to these of Raja *et al.* (2001) who reported that when pulses were stored in gunny bags treated with aqueous extract from leaves of *Melia azadirachta*, *Hyptis suaveolens* and tubers of *Cyperus rotundus*, they effectively protected stored pulses from bruchids and damage for up to 6 months.

The extracts coating the seed may have a possible contact of the insect during oviposition since eggs are laid on the seeds and thus the extracts can acts as contacts pesticide to the insect which can penetrate the body and possibly interfering with the normal development of the adult *C. maculatus* by suppressing hormonal and biochemical processes. The extract of *B. aegyptiaca* at all level of application were not found to record similar effects to the insect with Actellic dust, indicating that the bioactive agents present in the extract was not effective as the chemical constituent of Actellic dust. Similar physiological interferences was observed by Ofuya *et al.*, 1992, Chiranjeevi and Sudhakar, (1996) and

Kumar *et al.* (2003). Earlier report have shown that product of plants materials have been used in the control of Stored product pest (Lale, 1992). The effectiveness of *B. aegyptiaca* leaf extract may be attributed to the presence of different bioactive agent in different plants formulations. The plant extract may impair respiration of the insect as suggested by (Hall and Harmann, 1991) as it blocks the spiracle thereby leading to suffocation. Other insecticidal effect could be attributed to toxicity and repellency by the constituent of the extract. The extract could also modify the micro-environment there by discouraging and probably killing the insect which consequently reduced the number of eggs laid by the insects on treated seed. The finding from this study was comparable with that of Bhaduri *et al.* (1985), who found out that the leaf extract of bankalmi had insecticidal properties against pulse beetle and that of Kim *et al.*, (2003) who showed the potent insecticidal activity of extract from cinnamon (*Cinnamomum cassia*) bark against the pulse beetle.

Table 1: Oviposition of female *Callasobruchus maculatus* reared on seed treated with *Balanite aegyptiaca* plant leaf extract

Treatments.	Amount applied/20g (Conc in %)	Mean number of eggs laid
<i>Balanites aegyptiaca</i> extract	0.5(2.5)	203.66±5.99d
	1.0(5.0)	154.33±5.36c
	1.5(7.5)	150.00±1.15c
	2.0(10.0)	88.66±4.66b
Control		794.33±15.01e
Acetone treated control.		798.66±27.38e
Seed treated with actellic dust	0.5(2.5)	0±0.00a
	1.0(5.0)	0±0.00a
	1.5(7.5)	0±0.00a
	2.0(10.0)	0±0.00a

Mean (±s.e) bearing same letters in a column are not significant different by LSD 0.05

Table 2: Survival of immature stages (*larvae & pupae*) of *Callasobruchus maculatus* reared on seed treated with *Balanite aegyptiaca* plant leaf extract

Treatments	Amount applied/20g (Conc in %)	Mean number of eggs laid	Mean number of hatched eggs	Mean number of adults emerged ±s.e	Mean number of larvae and pupae died ±s.e	Survival of larvae and pupae (%)
<i>Balanites aegyptiaca</i>	0.5(2.5)	203.66±5.99d	97.33±7.53d	40.33±7.88c	57.00±4.61d	41.43
	1.0(5.0)	154.33±5.36c	54.66±6.43c	20.66±6.17b	34.00±5.03c	37.79
	1.5(7.5)	150.00±1.15c	52.30±17.15c	19.33±3.17b	15.00±2.08b	37.17
	2.0(10.0)	88.66±4.66b	28.33±4.09b	09.33±1.20b	19.00±3.78b	32.94
Control		794.33±15.01e	740.00±24.58e	672.33±19.61d	67.67±6.64d	90.85
Acetone treated control.		798.66±27.38e	764.33±30.86e	698±24.37d	66.33±8.95d	91.32
Seeds treated with actellic dust	0.5(2.5)	0±0.00a	0±0.00a	0±0.00a	0±0.00a	0
	1.0(5.0)	0±0.00a	0±0.00a	0±0.00a	0±0.00a	0
	1.5(7.5)	0±0.00a	0±0.00a	0±0.00a	0±0.00a	0
	2.0(10.0)	0±0.00a	0±0.00a	0±0.00a	0±0.00a	0

Mean (±s.e) bearing same letters in a column are not significant different by LSD 0.05

Conclusion and Recommendations

B. aegyptiaca leaf extract has demonstrated a potent activity against the oviposition, survival of immature stages as well as emergence of cowpea bruchid (*C. maculatus*) which is similar to the synthetic chemical

pesticide and significantly different from the acetone treated and untreated controls. It is therefore recommended to further identify the bioactive agents in the plants responsible for this activity.

REFERENCES

- Bamaiyi L.J., Ndams I.S., Toro W.A. and Odekina S. (2007): Effects of Mahogany *Khaya senegalensis* seed oil in the control of *Callosobruchus maculatus* on stored cowpea. *Plant Protection Science*, 42: 130–134.
- Bhaduri N, Ram S, and Patil BD (1985). Evaluation of some plant extracts as protectants against pulse beetle, *Callosobruchus maculatus* F. infesting cowpea seeds. *Journal of Entomological Research*: 9(2):183–187.
- Boateng.B.A and Kusi, F. (2008) Toxicity of *Jatropha* seed oil to *Callasobruchus maculatus*(F)(Coleoptera:Bruchidae) and its parasitoid, *Dinarmus basalis* (Hymenoptera :Pteromalidae) *Journal of applied Sciences Research* 4(8):945-951
- Caswell, G.H., (1984). The value of the pod in protecting cowpea seeds from attack by bruchid beetles. *Samaru Journal Agricultural Research*, 2: 49–55
- Chiranjeevi, C. and T.R. Sudhakar.(1996) Effect of indigenous plant materials on the fecundity, adult emergence and development of pulse beetle *Callosobruchus chinensis* (L.) in black gram. *Journal of Research APAU* 24:57-61.
- Credland, P.F., (1992). The structure of Bruchid eggs may explain the ovicidal effects of oils. *Journal Stored Product Research*. 28: 1-9
- Deedant, Y.O. (1994). Problems associated with the use of pesticides: an overview. *J. Agric. Sci.*, 93: 735–47
- Elhag,EA (2000).Deterrent effects of some botanical products on oviposition of the cowpea bruchid *Callasobruchus maculatus*(F)(Coleopteran:Bruchidae). *International Journal of Pest Management* 46(2):109-113.
- Georgiou, G.P. (1991). The Occurrence of Resistance to Pesticides in Arthropods, p: 318. FAO, AGPP/MISC
- Grainge, M. and S. Ahmed,(1988). Handbook of Plants with Pest- Controlling Properties New York, USA, Wiley and Sons
- Hall, J.S. and G.E. Harman, (1991). Protection of stored legume seeds against attack by storage fungi and weevils: mechanism of action of oil seed treatment. *Crop Prot.*, 10: 375–80
- Ho, S.H.Y., H.T. Maand and W. Tan,(1997). Repellency of some plant extracts to the stored products beetles, *Tribolium castaneum* (Herbst) and *Sitophilus zeamais* Mostch. *Pest Manage. Stored Food Feed*, 59: 209–15
- Ivbijaro, M.F., (1983). Toxicity of neem seed, *Azadirachta indica* A. Juss to *Sitophilus oryzae* (L.) in stored maize. *Production. Ecology.*, 5: 353–7
- Jackai, L.S. and Asante, S.K. (2001). A case for the standardization of protocol used in screening cowpeas, *Vigna unguiculata* for resistance to *Callasobruchus maculatus* (Coleoptera :Bruchidae). IITA, Ibadan, Nigeria. 25:210-285
- Jaya, M. Elumalai K, Jaya Sankar A, and Raja N (2003) Efficacy of crude extract of *Hyptis Sua veolens* and *Melochia Charcori folia* on pulse beetle *Callasobruchus maculatus*(F.)(Coleoptera:Bruchidae). *Proceedings in Biological control of insect pest*. 219-223
- Kim SI, Roh JY, Kim DH, Lee HS, and Ahn YJ(2003). Insecticidal activities of aromatic plant extracts and essential oils against *Sitophilus oryzae* and *Callosobruchus chinensis*. *Journal of Stored Products Research*: 39(3):293–303.
- Lale, NES (1992). A laboratory study of the comparative toxicity of products from three spices to the maize weevil. *Postharvest Biology and Technology* 2: 61-64.
- Lale, N.E.S., (1995) An overview of the use of plant products in the management of stored product coleopteran in the tropics. *Post Harvest News Inform.* 6: 69N–75N
- Mallaya, G.A., (1985). Maize Entomology In: Moshi, A.J. (ed.), National Maize Research Programme 1984-1985, *Progress Report National Maize Research Co-ordinating Comm.*, 4 Nov., 1985, pp: 521–525
- Marcileyne, P.L.D., Jose, V.D.O and Reginaldo, B.(2004). Alternation of cowpea genotype affect the Biology of *Callasobruchus maculatus* SCI/Agric(Piracicaba, Brazil) Vol 61: 1
- Ofuya, T.I., Okoye, B.C and A.S.Olola,(1992). Efficacy of crude extracts from seeds of *Monodora myristica* (Gaertn) Dunal as surface protectant against *Callosobruchus maculatus* (F) attacking legume seeds in storage. *Journal Plant Disease Protection*. 99; 528-532.
- Opakaraeke, A.M (1996): Comparative evaluation of some local plant materials for the control of *C. Maculatus* (L) (Coleoptera:Bruchidae) on stored cowpea . Msc. Thesis. Department of crop protection, Faculty of Agriculture, Ahmadu Bello University, Zaria.
- Raja N, Babu A, Dorn S, and Ignacimuthu S.(2001) Potential of plants for protecting stored pulses from *Callosobruchus maculatus* (Coleoptera: Bruchidae) infestation. *Biological Agriculture and Horticulture*: 19(1):19–27.
- Singh, S.R., R.A. Luse, K. Leuschner, and D. Nangju, (1978) Groundnut oil treatment for the control of *Callosobruchus maculatus* (F.) during cowpea storage. *Journal Stored Product Research*, 14: 77–80
- Southgate. B.J. (1979) Biology of Bruchidae. *Annual Review of Entomology* 24, pp449-473.
- Talukder FA, and Howse PE.(1993) Deterrent and insecticidal effects of extract of Pithraj, *Aphanamixis polystachya* against *Tribolium castaneum* in storage. *Journal of Chemical Ecology* 19 (11):2463–2471.
- Talukder, FA, Howse PE.(1994) Repellent, toxic and food protectant effects of pithraj, *Aphanamixis polystachya* extracts against the pulse beetle, *Callosobruchus chinensis* in storage. *Journal of Chemical Ecology* 20(4)
- Utida, S.(1972). Density dependant polymorphism in the adult of *Callasobruchus maculatus* (Coleoptera:Bruchidae) *Journal of Stored Product Research* .8:111-126.