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Insecticidal efficcay of oil extracts of *Balanites aegyptiaca* seeds and cashew nuts against *Callosobruchus maculatus* Fabr. (Coleoptera: Bruchidae)

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The insecticidal efficacy of oils extracted from *Balanites aegyptiaca* seeds and Cashew nut on survival and development of cowpea weevil *Callosobruchus maculatus* in cowpea seeds during storage was investigated. Fifty grams of sterilized cowpea *(Vigna unguiculata)* seeds in each Petri dish were treated with 0.5, 1 and 1.5 ml concentrations. Each dish was then infested with 10 newly emerged adult bruchids of both sexes. In each case the treated and untreated samples (control) were replicated three times. In all trials 100% mortality rate was recorded within 48 h post infestation. The oils also affected egg laying capacity of the females and have a high larvicidal effect with very low productivity results. Thus, the oils have a significant effect on survival and development of the weevil.

Key words: Oil extract, cowpea weevil, mortality, infestation, development, insecticidal.

INTRODUCTION

Cowpea, a protein rich food is a staple food in many societies. It is used not only as human food but, as a fodder for livestock feeds. It is subject to attack by a variety of insect pests (Ibrahim and Magaji, 1998). However, *C. maculatus* appeared to be the most common and damaging pest of stored cowpea in Nigeria, the world highest producer which accounts for over 70% of world's production (Ajayi and Wintola, 2006).

Several measures have been adopted to curtail the problem of insect infestation. These include the use of chemical agents or synthetic insecticides, biological, physical, genetic, and legislative control methods etc (Srivastava, 1988). While physical and or traditional methods are often, too expensive as they require sophisticated technology; the chemical methods (use of synthetic insecticides) require expensive equipments and training, are directly or indirectly dangerous to the user (man) and non target organisms, destruction of beneficial organisms, residual toxicity, wide spread environmental hazards, development of resistance by insect species etc (Yusuf et al., 2006; Oni and Ileke, 2008; Oni, 2011). This necessitated the need for a safer alternative control strategy. It is in this regard that extracts of plant origin have been receiving attention from different parts of the world. The method has been described as cheaper and eco-friendly safer means of controlling insect pests of stored cowpea (Adedire et al., 2011).

Plants products are believed to contain some natural toxins that can serves as botanical insecticides. Extract from these plants have natural tendency break rapidly

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and are environmentally safe as they produce no toxic residue (Alan et al., 2009; Ismam, 2006). Singh and Saratchandra (2005) reported that most of these plant species exhibit an insect deterrent rather than insecticidal effect indicative of the fact that the extracts inhibit normal development in insects. Also, most of these plants can be sourced locally and are easy to handles by small holder farmers with no toxic residue. Several plant products have been shown to possess insecticidal properties against a wide range of insects, particularly agricultural pests (Yahaya and Abubakar, 2004; Abdullahi and Muhammad, 2004; Swella and Mushobozy, 2007; Bishnu, 2005; Ajayi, 2007; Raja and Williams, 2008; Aly and Sahar, 2010; Chris et al., 2011). For instance Adedire et al. (2011) and Ileke and Olotuah (2012) reported that both powder and oil extracts of *Anacardium occidentale* possess strong insecticidal activity against storage insect pests. Also extract of *Balanites aegyptiaca* have been shown to be effective in reducing the proliferation of the snail flukes in irrigation canals; infestation of cowpea by *C. maculatus* and possess antifeedants, anti mollucidal, antihelminthes, and contraceptive activities etc (Jain and Tripathi, 1991; Ibrahim, 1992; Rao et al., 1997).

In view of the economic importance of cowpea, the severity of damage caused due to insect infestation an attempt was made to provide a safer method for the control of C. *maculatus* during storage.

MATERIALS AND METHODS

Plant materials used

The plant materials used were the dried seeds of desert date *Balanites aegyptiaca* and Cashew nut *Anacardium occidentale*. Fresh and ripe seeds of *B. aegyptiaca* were obtained within the Usmanu Danfodiyo University, Sokoto Main Campus while Cashew nut was purchase from Marina market in Sokoto town. Both seeds were air dried for two weeks and ground separately into powder.

Oil extraction

Oils from seeds of different plants were obtained by extraction with N-hexane using Soxhlet apparatus. Thirty grammes (30 g) of each ground samples were placed separately, into the porous thimble. The mouth of the thimble was then covered with cotton wool. Then 200 ml of N-hexane was carefully added into the dry 250 ml extraction flask. The covered porous thimble, was then placed, into the condenser and boiled gently for about 5 to 6 h to extract oil. After heating, the condenser was detached and porous thimble carefully removed and the N-Hexane collected for reuse. The extraction flask containing the oil, was then removed, from the water bath and oven dried, at 105 to 110°C for an hour. The oil was allowed to cool and stored for use.

The cowpea variety used

Local variety of cowpea *Vigna unguiculata* (Farin wake in Hausa) was used. Seeds with emergence holes or egg debris were considered infested and removed. The un-infested seeds were then sterilized by freezing for 14 days to kill any prior infestation and conditioned for two weeks at a controlled temperature 25 to 28°C and 100% relative humidity. These set of seeds were used for experimentation and insect culture.

Insect culture

Adult weevils used in the experiments were reared on previously sterilized *V. unguiculata* seeds. Two (2) separate plastic containers, containing two hundred and fifty grams (250 g) of the previously sterilized cowpea, were infested with 10 pairs of adult weevils, collected from the same variety of seeds. The containers were then covered with muslin cloth tied with a rubber band, and kept under laboratory conditions where temperature ranges between 25 and 28°C and the relative humidity between 50 and 60%. After 4 days, the seeds were carefully examined and the dead and surviving weevils were removed. The eggs laid on these seeds were allowed to develop to adults. The new generation of adult weevils (F_1), that emerged from these stocks were allowed to multiply to produce another generation. The second generation adults that emerged were used in all the trials. The stock culture was maintained throughout the duration of the study.

Experiments conducted

To start with 3 sterilized Petri dishes containing 50 g of sterilized cowpea were treated separately with 0.5 ml of the *B. aegyptiaca* seeds oil. The 4th Petri dish contained untreated cowpea serving as control. The Petri dishes were labeled accordingly. Both the treatment and control were then infested with 5 pairs of newly emerged adult bruchids obtained from the stock culture. Temperature and relative humidity ranges between 25 and 28ºC and 50 and 60% respectively.

The same procedure was repeated using the same quantity of the grains treated with 1 and 1.5 ml of the oils in second and third trials respectively.

In another setting, same procedure was repeated using same quantity of the seed treated with same amount of the oil from Cashew nut. Observations were made on mortality of the adults, fecundity rate and emergence of the adult weevils. Dead weevils were removed and eggs laid on 30 seeds selected randomly from each of the Petri dishes were counted. These seeds were then carefully returned into the dishes and observations made on emergence of adult weevils. The data obtained was subjected to ANOVA and where significant differences were observed between treatments and or levels, such differences were ranked using the New Duncan's multiple range test (NDMTR).

RESULTS AND DISCUSSION

Results obtained have shown clearly that the materials tested provided adequate protection to cowpea seeds against *C. maculatus*. The oils significantly affected the longevity or survival of the cowpea weevils. Hundred percent (100%) mortality rates were recorded 48 h (2 days) after infestation in all the trials (Table 1). The mortality rates in the untreated control ranges between 15.3 and 20% on the 4th day (96 h) post infestation. A significant difference existed between treatments and control (P>0.05). The high mortality rate recorded in the treated samples indicates that the oils have a high

Table 1. Mortality among adults of *C. maculatus* reared on cowpea treated with varying amount of different plant oils.

Treatment	Mortality ± SE / Amount of Oil (ml)		
	0.5 ml	l.0 ml	1.5 ml
B. aegyptiaca	100 ± 0.0[a]	100 ± 0.0[a]	100 ± 0.0[a]
Cashew nut	100 ± 0.0[a]	100 ± 0.1[a]	100 ± 0.2[a]
Control	15.3 ± 0.5[b]	20.7 ± 1.0[b]	16.3 ± 0.7[b]
LSD	3.02	2.82	3.15

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan multiple range test.

Table 2. Fecundity (Oviposition) of adults of *C. maculatus* on cowpea treated with varying amount of different plant oils.

Treatment	Fecundity ± SE / Amount of oil (ml)		
	0.5 ml	1 ml	1.5 ml
B. aegyptiaca	12 ± 0.2[a]	13[a] ± 0.1[a]	09 ± 0.2[a]
Cashew nut	14 ± 0.3[a]	13.3 ± 0.5	14 ± 0.6[b]
Control	52 ± 2.3[b]	48 ± 1.2[b]	46.6 ± 2.5[C]
LSD	2.75	3.15	3.26

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan multiple range test.

significant effect on survival period of the weevils. The mortality effects recorded agreed with the findings of Ileke and Olutuah (2012) who reported 63.3 to 100% mortality of *C. maculatus* due treatment with cashew seed powder and oil. The findings also confirmed the earlier report of Oparaeke and Bunmi (2006) and Chris et al. (2011). The effects on mortality recorded due to *B. aegyptiaca* seeds oil tallies with the findings of Bishnu and Weisman (2005) also reported high insecticidal activity of this plant extract against mosquito *Culex pipen.* Lekhu and Singhvi (2004) also recorded high repellency effects of *B. aegyptiaca* extract against *C. maculatus*.

Table 2 shows the mean number of eggs laid in both treated and untreated cowpea. Oviposition was very much reduced in treated samples as compared with the control. Very few eggs were laid in oil treated cowpeas with a mean fecundity of 9 to 12 eggs on *B. aegyptiaca* treated cowpea. A slightly high value was recorded for cashew nut with a mean of 13.3 to 14 eggs. Significant difference (P>0.05) existed when compared with control cowpea which had a mean fecundity ranging from 46 to 52 eggs per female. The high ovicidal effects or reduced oviposition rates observed indicated the possible potentials of the oils as protectants of the cowpea. Ileke and Olutuah (2012) also reported significant reduction in oviposition of *C. maculatus* due to oil extract of *A. occidentale*. The higher fecundity effects on *B. aegyptiaca* treated samples could be attributed to its antifeedants which significantly affects egg laying capacity of the adults (Jain and Tripathy, 1991). The effects could also be due to the saponins contents of the oils (Liang et al., 2002).

The effects of the oils on egg development and subsequent emergence of adults of C. *maculatus* is shown in Table 3. Productivity result in treated cowpeas is very low ranging between 30 and 46.6% while control has a mean emergence of 82.5 to 85%. This means that in all the trials more than 50% of the total eggs laid in treated samples died at various stages of development. It is evident from this that the oil from the plant used has a high larvicidal effect and significantly affected the development of immature stages of the weevil. Analysis of variance indicates a significant difference between treatment and control (P > 0.05).

The significant difference in the mortality, oviposition and productivity results obtained in the treated samples indicated the possible potentials of these oils as an alternative agent for the control of C. *maculatus.* The striking effects could be due to oils coating the surfaces of the seeds making it impossible for the eggs to get glued to seeds. This will affects the viability and subsequent development of eggs as larvae must penetrate the eggs to develop. The oils also affects movement of the adult weevils and this might have made mating impossible thus very few eggs deposited and eventually very low productivity results. Extracts from several parts of *B. aegyptiaca* were shown to exhibit antifeedants and mollucidal activities against variety of pests and steroidal saponin is believed to be the main caused behind these activities (Ibrahim, 1992; Rao et al.,

Table 3. Total number of adults that emerged on cowpea treated with varying amount of plant oils.

Treatment	Mean emergence/productivity results ±SE		
	0.5 ml	1 ml	1.5 ml
B. aegyptiaca	42 ± 2.1[a]	40.6 ± 0.5[a]	36 ± 2.3[a]
Cashew nut	46.6 ± 1.6[a]	42.3 ± 1.3[a]	41.6 ± 1.0[a]
Control	83.2 ± 2.5[b]	85 ± 0.57[b]	81. 5 ± 0.72[b]
LSD	2.85	2.57	3.10

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan multiple range test.

1997). Thus more extensive study might provides useful information on the active principle and possible toxic effects on non target organism especially human.

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