



## *Sesamum indicum* and *Trichilia heudelotii* N-hexane and Ethanol Extracts: Effective Remedy Against *Callosobruchus maculatus* F. (Coleoptera: Chrysomelidae) Infesting Cowpea Grains

Temitope Olawale ILESANMI<sup>1</sup>, Victoria Gbonjubola AWOLOLA<sup>2</sup>, Omotayo Robert UDDIN II<sup>1</sup>,

Suleiman MUSTAPHA<sup>1\*</sup>, Temidayo Mujidat LAWAL<sup>1</sup>

<sup>1</sup>Department of Crop Protection, University of Ilorin, Ilorin, Nigeria

<sup>2</sup>Department of Industrial Chemistry, University of Ilorin, Ilorin, Nigeria

### ARTICLE INFO

#### Article history:

Received date: 07.06.2020

Accepted date: 10.11.2020

#### Edited by:

Murat KARACA; *Selcuk University, Turkey*

#### Keywords:

Pest Control

*Callosobruchus Maculatus*

Cowpea Grains

Plant Extracts

Phytochemical

Botanicals

### ABSTRACT

The use of synthetic pesticides usage to prevent cowpea weevils have been reported to be harmful, sometimes leading to the demise of consumers by ingestion of contaminated grains. To save lives, efforts are intensely made to seek after safer alternatives one in particular, is the use of plant based biopesticides. A study was conducted to investigate the effectiveness of N-hexane and ethanol extracts of both sesame (*Sesamum indicum*) leaf and seed and *Trichilia heudelotii* leaf to control *Callosobruchus maculatus* infesting grains of cowpea. The methods employed involved dressing cowpea seeds (100 g) with the botanical crude extracts at 0 (control), 0.5, 1.0 and 1.5 ml respectively. Next, six pairs of newly emerged adult *C. maculatus* were introduced into glass vials containing treated seeds in three replicates and observation was conducted for; adult mortality; emergence of larvae, pupae, and new adults of the insect; weight loss of cowpea grains; and qualitative phytochemical screening. The results presented in this paper revealed that the N-hexane and ethanol extracts of both sesame and *T. heudelotii* were significantly ( $p < 0.05$ ) effective mostly at 1.5 ml in controlling the weevil when compared to the control. The phytochemical analysis indicated the presence of some useful bioactive compounds in the extracts. The observation on weight loss of cowpea revealed that all the various treatment especially at 1.5 ml sustained a significant ( $p < 0.05$ ) weight compared to the control (mean = 40.00) which was lower. A plausible usage of homemade biopesticide using sesame and *T. heudelotii* could be suggested as additives to cowpea grains in the control of *C. maculatus*.

### 1. Introduction

Cowpea (*Vigna unguiculata* L. Walp) is cultivated for its nutritious grains, leaves, and green pods, which plays an important part in the protein requirement for both rural and urban settlers and also a source of quality fodder for livestock and provide cash inflow to the buyers and sellers of the crop (Wakili, 2013; Langyintuo & Lowenberg, 2006). The protein content of cowpea has been classed to be about 23% making it a desirable source of plant based protein (FAO, 2005). It is also rich in starch with seeds containing about 63.6% carbohydrate in them as reported by Akyaw et al. (2014). The production practices of growing cowpea

has been estimated to support over 850 million people worldwide showing that the importance of the crop should not be underestimated especially in supplying the nutrition requirements of the undernourished in sub-Saharan Africa (FAO, 2005). Up to 70% of the world's cowpea supplies come from the dry Savanna and Sahel Zones of West and Central Africa because the crop is relatively well adapted to the agricultural ecosystem of these areas (Timko et al., 2007; Coulibaly et al., 2009).

Despite the afore mentioned benefits and importance of cowpea, the production yield is still considered to be very low at 100 to 500 kg ha<sup>-1</sup> in farming conditions compared to the potential yield of 1.5 to 3 tons ha<sup>-1</sup> (Rachie, 1985; Karungi et al., 2000; Asante et al. 2001; Asiwe et al., 2009; Boukar & Fatokun, 2009; Oyewale & Bamaiyi, 2013;

\* Corresponding author email: [juniorsuleiman78@gmail.com](mailto:juniorsuleiman78@gmail.com)

Singh, 2014). This low yield has been attributed to a combination of both abiotic and biotic stress factors most especially insect pests' infestations and damage having the most negative influence on the production of cowpea, sometimes depleting the average grain yields to up to 90 to 80% under intense infestations (Togola et al., 2017; Singh, 2014; Jackai & Daoust, 1986; Singh & Jackai, 1985).

One of the known most prominent and important insect pest of this crop is the field-to-store cowpea weevil- *Callosobruchus maculatus* (Fabricius) which belong to the Order Coleoptera and Family Chrysomelidae (Brisibeet al., 2011). When cowpea are allowed to wait in the field for longer periods before harvest, the greater the damage to cowpea grains in storage that will be incurred by the insect pest sometimes reaching a 50% damage level within the space of few months in storage (Dugie et al., 2009). The larvae of the bruchid weevil depends on the grains for its nutrition, feeding and developing exclusively on it. Adult weevils emerge from cowpea grains leaving exit holes. Substantial infestation rates causes loss of quality and the growth of mould invariably reducing market quality and loss of farmers income (Mulatu & Gebremedhin, 2000). Enormous losses of about 50 to 100% have been recorded on stored cowpea due to attack by *C. maculatus* (Udo & Harry, 2013).

The use of chemical insecticides remains the commonest measure used so far to control of the insect pest. However, the practice is extremely hazardous to users and consumers (Togola et al., 2017) sometimes leading to death of consumers as in the case of people who died in Nigeria after consuming beans containing high levels of pesticides used in preventing the bruchid weevils from attacking cowpea grains. This event was later known as the killer beans spree (Shiabu, 2008; Gwary et al., 2012) thereby prompting both farmers and consumers with the urgent need to search for safer alternatives to chemical insecticides. Efforts are being made to seek eco-friendly alternative including the use of biopesticides (Togola et al., 2017) hence the reason for conducting this investigation. The current study's objective is to investigate the use of plant materials namely *Sesamum indicum* L (Pedaliaceae: Lamiales) and *Trichilia heudelotii* Planch (Meliaceae: Sapindales) as a biopesticide alternative to the use of chemical insecticides in the control of *Callosobruchus maculatus* affecting cowpea grains. These plants are easily sourced within sub-Saharan Africa where major cowpea production yield have been reported and have also been observed to grow as part of natural vegetation in the region, thereby the above mentioned

plants as biopesticides was investigated to study their effectiveness against the bruchid beetle.

## 2. Materials and Methods

### 2.1. Culture of *Callosobruchus maculatus*

Mass culture of *C. maculatus* was maintained using the procedure described by Strong et al. (1968). The variety of cowpea used for this experiment was the variety IT96D-610 provided by the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Seeds were described to be susceptible to attacks and infestation by the insect pest *Callosobruchus maculatus*. The insects were acquired from stock cultures from the Nigerian Stored Products Research Institute (NISPRI), Ilorin, Nigeria. Six pairs of 0-1 day-old adults (male and female) of *C. maculatus* were isolated and introduced into small glass vials (7.5 × 2.5 cm) containing untreated cowpea seeds (Khalequzzaman et al., 2007). The insects were given 7 days to mate and oviposit in the cowpea. Glass vials were covered with muslin cloth and secured firmly with rubber bands to prevent escape of the insect. After one week, when oviposition had been noticed, the parent stocks of *C. maculatus* were removed and vials were left under laboratory conditions (temperature 24-28°C, relative humidity of 70%) till the emergence of new filial progenies which were used for the experiment.

### 2.2. Sample preparations and extraction

Sample preparation and extraction was done according to the methods described by Uddin II et al (2020). The plant materials, *Sesamum indicum* seeds and leaves and *Trichilia heudelotii* leaves were air-dried at room temperature, turning regularly to ensure even and thorough drying to avoid moulding of the samples. The dried plant materials were ground using an electric grinder and sieved using a 90-micron mesh sieve to obtain fine powder of the samples. The powdered leaves (650 g for *Trichilia heudelotii* and 700 g for *Sesamum indicum*) and seeds (1.1 kg) were extracted twice by maceration, sequentially with a non-polar and polar organic solvents, hexane (Hex) and ethanol (EtOH) respectively. Yields of 14.26 g (Hex) and 10.24 g (EtOH) of *Trichilia heudelotii* leaves and 12.24 g (Hex) and 13.04 g (EtOH) of *Sesamum indicum* was obtained after evaporation of the organic solvents. For the sesame seeds, 8.6g (Hex) and 12.8 g (EtOH) was obtained. The crude extracts obtained used for the experiment were then prepared using an aqueous solution of 1% v/v of acetic acid in distilled water and concentrated at 0.5 g per ml.

### 2.3. Phytochemical screening (qualitative)

Chemical tests were carried out on both the ethanolic and N-Hexane extracts for the qualitative determination of phytochemical constituents as described by Harborne (1973), Trease and Evans (1989) and Sofowora (1993).

**Test for Tannins:** Few drops of 1% lead acetate was added to 0.2 g of the extract and observed for the formation of yellow precipitate

**Test for Alkaloids:** Exactly 0.2 g of the extract was stirred with 5 ml of 1% aqueous HCl on water bath and then filtered. One ml of the filtrate was taken individually into two separate test tubes. To the first portion, Mayer's reagent was added and appearance of buff-coloured precipitate was an indication for the presence of alkaloids. To the second portion, few drops of Dragendorff's reagent was added to the filtrate and observed for the formation of an orange-red precipitate.

**Test for Terpenoids:** Exactly 2 ml of chloroform was added to 0.2 g of the extract, 3 ml of concentrated sulphuric acid was added carefully to form a layer. Formation of a reddish-brown colouration at the interface indicates the presence of terpenoids.

**Test for Phenolic Compounds:** The extract (0.5 g) was dissolved in 5 ml of distilled water. To this, few drops of neutral 5% ferric chloride solution was added. A dark green colour indicates the presence of phenolic compounds.

**Test for Flavonoids:** Exactly 4 ml of dilute ammonia solution was added to a portion of the extract followed by addition of concentrated sulphuric acid. A yellow colouration indicates the presence of flavonoids.

**Test for Saponins:** Exactly 1 g of the extract was boiled with 5 ml of distilled water and filtered. To the filtrate, about 3 ml of distilled water was further added and shaken vigorously for about 5 minutes. Frothing which persists on warming shows the presence of saponins.

**Test for Steroids:** Acetic anhydride (2ml) was added to a portion of the extract with 2ml H<sub>2</sub>SO<sub>4</sub>. Colour change from violet to blue or green indicates the presence of steroids.

### 2.4. Experimental procedure

The experiment was carried out under ambient laboratory conditions. One hundred gram (100 g) of undamaged cowpea were placed in glass vials (7.5 × 2.5 cm). The seeds were properly mixed with the various levels of the botanical treatment extracts at 0.5, 1.0, and 1.5 ml respectively using a wooden spatula to ensure uniform coating of the seeds. The control (0.0

ml) had no treatment applied to it. Six pairs of newly emerged male and female adult *C. maculatus* were introduced after drying coated seeds for five minutes and glass vials were ensured covered with muslin cloth fastened with rubber bands to permit ventilation and prevent escape of the insect. The experiment was a Completely Randomized Design (CRD) with three replications. Dead beetles were removed from vials every 24 hours interval when beetles were noticed to be inactive and unresponsive to probing of the abdomen using an entomological needle (Uddin et al., 2020).

Oviposition rate was recorded at day 7 after treatment (DAT) and ten seeds were randomly selected from each treatment vials to view eggs laid using a × 100 magnifying lens. Larval and pupae emergence was recorded at 15 and 23 DAT respectively by also selecting 10 seeds at random from the various treatments and control and dissecting seeds gently with a sharp razor blade to check for the presence of *C. maculatus* larvae and pupae in cowpea seeds. Emergence of adult progeny was recorded from 33 days after treatment and the adults removed every 24 hours to avoid the next generation. The percentage loss in cowpea grain weight was recorded at day 38 after release of beetles that have completely emerged (Khalequzzaman et al., 2007). Data collected were subjected to a two-way analysis of variance and T-test and significant mean differences were separated using New Duncan Multiple Range Test set at a P-value of 0.05.

## 3. Results and Discussion

### 3.1. Effects of the selected extracts on adult mortality of *Callosobruchus maculatus* after treatment

The experiment showed significant results between the various botanical extracts and the control. Post hoc analysis revealed that at 1 DAT, both the N-Hexane extract and the ethanol extract of sesame leaf were the most effective treatment, significantly ( $p < 0.05$ ) able to suppress the population of *C. maculatus* by the mean number of 6.00 in both treatment at the concentration rate of 1.5 ml when compared to the other treatment and the control (Table 1). Further observation also indicated that the next effective botanical treatment were the N-Hexane and Ethanol extract of *T. heudelotii* leaf which were also significantly ( $p < 0.05$ ) able to suppress the insect pest adult population to a mean number of 5.33 at the increasing concentration rate of 1.5 ml when compared to the control (0.0 ml) which had a mortality rate of 2.33 as shown in Table 1. The highest mortality was recorded to occur within 24 hour period after treatment (Table 1).

Table 1

Comparative effect of the botanical treatment extracts on adult mortality of *Callosobruchus maculatus*

Treatments	Conc.(ml)	Adult Mortality Days after treatment (DAT)				
		1	2	3	4	5
NHTL	0.5	4.00 <sup>abcd</sup> ±1.00	1.67 <sup>abc</sup> ±0.58	1.67 <sup>ab</sup> ±0.58	0.67 <sup>abc</sup> ±0.58	0.00 <sup>a</sup> ±0.00
	1.0	5.00 <sup>bcd</sup> ±0.00	1.33 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±0.00	0.67 <sup>abc</sup> ±0.58	0.00 <sup>a</sup> ±0.00
	1.5	5.33 <sup>cd</sup> ±1.53	1.67 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±0.00	0.00±0.00 <sup>a</sup>	0.00 <sup>a</sup> ±0.00
NHSS	0.5	4.00 <sup>abcd</sup> ±1.00	1.33 <sup>abc</sup> ±0.58	1.33 <sup>ab</sup> ±0.58	1.33 <sup>bc</sup> ±0.58	0.00 <sup>a</sup> ±0.00
	1.0	4.67 <sup>abcd</sup> ±0.58	1.33 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±0.00	0.67 <sup>abc</sup> ±0.58	0.33 <sup>a</sup> ±0.58
	1.5	5.00 <sup>bcd</sup> ±0.00	2.00 <sup>abc</sup> ±1.00	0.67 <sup>a</sup> ±1.16	0.33 <sup>ab</sup> ±0.58	0.00 <sup>a</sup> ±0.00
NHSL	0.5	4.33 <sup>abcd</sup> ±1.52	1.33 <sup>abc</sup> ±1.16	1.00 <sup>ab</sup> ±0.00	1.00 <sup>abc</sup> ±0.00	0.33 <sup>a</sup> ±0.58
	1.0	5.00 <sup>bcd</sup> ±0.00	1.67 <sup>abc</sup> ±0.58	0.67 <sup>a</sup> ±1.16	0.67 <sup>abc</sup> ±0.58	0.00 <sup>a</sup> ±0.00
	1.5	6.00 <sup>d</sup> ±1.00	1.00 <sup>ab</sup> ±0.00	1.00 <sup>ab</sup> ±0.00	0.00 <sup>a</sup> ±0.00	0.00 <sup>a</sup> ±0.00
ETHTL	0.5	4.67 <sup>abcd</sup> ±1.16	1.67 <sup>abc</sup> ±0.58	0.67 <sup>a</sup> ±1.16	0.67 <sup>abc</sup> ±0.58	0.33 <sup>a</sup> ±0.58
	1.0	5.33 <sup>cd</sup> ±1.53	1.00 <sup>ab</sup> ±1.00	0.67 <sup>a</sup> ±1.16	0.33 <sup>ab</sup> ±0.58	0.67 <sup>a</sup> ±0.58
	1.5	5.33 <sup>cd</sup> ±1.53	0.67 <sup>a</sup> ±0.578	1.33 <sup>ab</sup> ±0.58	0.67 <sup>abc</sup> ±0.58	0.00 <sup>a</sup> ±0.00
ETHSS	0.5	4.00 <sup>abcd</sup> ±1.00	1.00 <sup>ab</sup> ±0.00	1.33 <sup>ab</sup> ±0.58	1.00 <sup>abc</sup> ±0.00	0.67 <sup>a</sup> ±0.58
	1.0	3.67 <sup>abcd</sup> ±1.53	1.33 <sup>abc</sup> ±1.16	2.00 <sup>ab</sup> ±1.00	0.67 <sup>abc</sup> ±0.58	0.33 <sup>a</sup> ±0.58
	1.5	3.33 <sup>abc</sup> ±0.58	1.67 <sup>abc</sup> ±0.58	2.33 <sup>b</sup> ±1.155	0.67 <sup>abc</sup> ±0.58	0.00 <sup>a</sup> ±0.00
ETHSL	0.5	4.00 <sup>abcd</sup> ±1.00	1.67 <sup>abc</sup> ±0.58	1.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	0.33 <sup>a</sup> ±0.58
	1.0	4.67 <sup>abcd</sup> ±1.53	1.67 <sup>abc</sup> ±1.16	1.33 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	0.00 <sup>a</sup> ±0.00
	1.5	6.00 <sup>d</sup> ±1.00	0.67 <sup>a</sup> ±0.58	1.33 <sup>ab</sup> ±0.58	0.00 <sup>a</sup> ±0.00	0.00 <sup>a</sup> ±0.00
Control	0.0	2.33 <sup>a</sup> ±1.53	1.00 <sup>ab</sup> ±0.00	1.00 <sup>ab</sup> ±0.00	1.67 <sup>c</sup> ±0.58	2.00 <sup>b</sup> ±1.73

Means followed by the same letter (s) in a column are not significantly different from each other at  $P < 0.05$  according to New Duncan's Multiple Range Test

Keys: Conc. =Concentration, NHTL = N-Hexane extract of *T. heudelotii* leaf, NHSS = N-Hexane extract of sesame seed, NHSL = N-Hexane extract of sesame leaf, ETHTL = Ethanol extract of *T. heudelotii* leaf, ETHSS = Ethanol extract of sesame seed, ETHSL = Ethanol extract of sesame leaf

### 3.2 Effects of the selected extracts on the mean number of eggs, larvae emergence and pupae of *C. maculatus* after treatment

There were significant ( $p < 0.05$ ) differences between the treatments and the control. Table 2 showed that all the various treatments were effective in restricting the amount of eggs laid by *C. maculatus* although, the N-Hexane extract of sesame leaf was observed to have the least mean number of eggs laid by the insect pest (1.33) at the concentration level of 1.5 ml when compared to the others (Table 2). The control did not show any reduction in the egg laying activities of the insect and as such had the highest rate of oviposition (8.33) as shown in Table 2.

Table 2 also showed that all the various treatments were significantly effective in restricting the larvae emergence of *C. maculatus* at different concentration levels, although the concentration rate of the botanical extracts: N-Hexane *T. heudelotii* leaf, N-Hexane sesame seed, N-Hexane sesame leaf, Ethanol *T. heudelotii* leaf and Ethanol sesame seed at 1.5 ml was

observed to have the lowest mean number (1.00) of emerged larvae of the insect pest (Table 2). The control had the highest mean number (6.00) of larvae that emerged and thus was significantly ( $p < 0.05$ ) higher when compared to the botanical treatments which were able to suppress the numbers of emerging larvae of the weevil as seen in Table 2.

On the amount of *C. maculatus* pupae recorded after treatment, the experiment showed significant results between the various treatment extracts and the control. It was observed that the botanical extracts used were effective in suppressing the numbers of *C. maculatus* pupating (Table 2). Close observation of the mean numbers of pupae seen further indicated that the ethanol extract of *T. heudelotii* leaf at the concentration rates of 1.0 and 1.5 ml had the least amount of pupae at the mean number of 0.67(±0.58) each. This was also the same for the ethanol extract of sesame seed at 1.5 ml (0.67±0.58). The control (4.67±0.58) had the most amount of pupae seen in the experiment when compared to the treated ones shown in Table 2.

Table 2  
Effect of the different treatments on the mean numbers of eggs, larvae emergence and pupae of *C. maculatus*

Treatments	Conc.(ml)	7 DAT	15 DAT	23 DAT
		Eggs laid	Larvae emergence	Pupae
NHTL	0.5	4.00 <sup>abcd</sup> ±1.00	2.00 <sup>abc</sup> ±1.00	1.67 <sup>abc</sup> ±0.58
	1.0	3.67 <sup>abcd</sup> ±1.53	1.33 <sup>ab</sup> ±0.58	1.00 <sup>ab</sup> ±0.00
	1.5	3.33 <sup>abcd</sup> ±1.53	1.00 <sup>a</sup> ±0.00	1.00 <sup>ab</sup> ±0.00
NHSS	0.5	3.67 <sup>abcd</sup> ±1.53	1.67 <sup>abc</sup> ±0.58	1.67 <sup>abc</sup> ±0.58
	1.0	3.33 <sup>abcd</sup> ±1.16	1.67 <sup>abc</sup> ±0.58	1.33 <sup>abc</sup> ±0.58
	1.5	2.00 <sup>abc</sup> ±0.00	1.00 <sup>a</sup> ±0.00	1.00 <sup>ab</sup> ±0.00
NHSL	0.5	2.67 <sup>abcd</sup> ±1.53	1.33 <sup>ab</sup> ±0.58	1.33 <sup>abc</sup> ±0.58
	1.0	1.67 <sup>ab</sup> ±1.16	1.33 <sup>ab</sup> ±0.58	1.00 <sup>ab</sup> ±0.00
	1.5	1.33 <sup>a</sup> ±0.58	1.00 <sup>a</sup> ±0.00	1.00 <sup>ab</sup> ±0.00
ETHTL	0.5	4.00 <sup>abcd</sup> ±1.00	1.67 <sup>abc</sup> ±0.58	1.33 <sup>abc</sup> ±0.58
	1.0	3.33 <sup>abcd</sup> ±1.16	1.33 <sup>ab</sup> ±0.58	0.67 <sup>a</sup> ±0.58
	1.5	3.00 <sup>abcd</sup> ±1.00	1.00 <sup>a</sup> ±0.00	0.67 <sup>a</sup> ±0.58
ETHSS	0.5	4.33 <sup>bcd</sup> ±0.58	1.67 <sup>abc</sup> ±0.58	2.00 <sup>abc</sup> ±0.00
	1.0	2.67 <sup>abcd</sup> ±1.16	1.67 <sup>abc</sup> ±0.58	1.67 <sup>abc</sup> ±1.16
	1.5	2.67 <sup>abcd</sup> ±0.58	1.00 <sup>a</sup> ±0.00	0.67 <sup>a</sup> ±0.58
ETHSL	0.5	3.33 <sup>abcd</sup> ±0.58	1.67 <sup>abc</sup> ±1.16	1.33 <sup>abc</sup> ±0.58
	1.0	1.67 <sup>ab</sup> ±1.16	2.00 <sup>abc</sup> ±1.00	1.00 <sup>ab</sup> ±0.00
	1.5	1.67 <sup>ab</sup> ±0.58	1.33 <sup>ab</sup> ±0.58	1.00 <sup>ab</sup> ±0.00
Control	0.0	8.33 <sup>e</sup> ±1.53	6.00 <sup>d</sup> ±1.00	4.67 <sup>d</sup> ±0.58

Means followed by the same letter (s) in a column are not significantly different from each other at  $P < 0.05$  according to New Duncan's Multiple Range Test,

Keys:DAT= day after treatment, Conc. =Concentration, NHTL = N-Hexane extract of *T. heudelotii* leaf, NHSS = N-Hexane extract of sesame seed, NHSL = N-Hexane extract of sesame leaf, ETHTL = Ethanol extract of *T heudelotii* leaf, ETHSS = Ethanol extract of sesame seed, ETHSL = Ethanol extract of sesame leaf

### 3.3. Effects of the selected extracts on the mean number of newly emerged *C. maculatus* adults

Table 3 showed the effects of the different botanical treatments against the emergences of *C. maculatus* adults. All of the treatment extracts were effective in restricting the emergence of the adults and were thus significantly ( $p < 0.05$ ) potent when compared to the

control which had the highest population of newly emerged *C. maculatus* adults from 33 to 37 DAT with the mean numbers of 2.67(±1.16), 3.00(±1.73), 2.67(±1.16), 3.00(±1.00) and 2.33(±0.58) respectively. Consideration of the mean numbers of the treatments indicated that N-Hexane sesame leaf (0.0±0.00) and Ethanol sesame leaf extract (0.0±0.00) at 1.5 ml had no emergence of *C. maculatus* adults recorded at 33 DAT (Table3).

Table 3  
Effect of treatments on the number of newly emerged *C. maculatus* adults

Treatment	Conc.(ml)	Days after treatment (DAT)				
		33	34	35	36	37
NHTL	0.5	0.67 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	1.67 <sup>abc</sup> ±0.58	1.33 <sup>ab</sup> ±1.16	1.33 <sup>bcd</sup> ±0.58
	1.0	1.33 <sup>abcd</sup> ±0.58	1.33 <sup>ab</sup> ±0.58	1.00 <sup>ab</sup> ±0.00	1.00 <sup>ab</sup> ±1.00	0.67 <sup>abc</sup> ±0.58
	1.5	1.00 <sup>abc</sup> ±1.00	0.67 <sup>ab</sup> ±0.58	1.33 <sup>abc</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58
NHSS	0.5	0.67 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	1.00 <sup>abcd</sup> ±0.00
	1.0	0.67 <sup>abc</sup> ±0.58	0.67 <sup>ab</sup> ±1.16	1.00 <sup>ab</sup> ±0.00	0.33 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58
	1.5	0.33 <sup>ab</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	0.33 <sup>a</sup> ±0.577	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58
NHSL	0.5	0.33 <sup>ab</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	1.33 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	0.33 <sup>ab</sup> ±0.58
	1.0	0.67 <sup>abc</sup> ±0.58	0.33 <sup>a</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	0.00 <sup>a</sup> ±0.00	0.33 <sup>ab</sup> ±0.58
	1.5	0.00 <sup>a</sup> ±0.00	0.33 <sup>a</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	0.00 <sup>a</sup> ±0.00
ETHTL	0.5	0.67 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	1.33 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	1.00 <sup>abcd</sup> ±1.00
	1.0	1.00 <sup>abc</sup> ±1.00	1.00 <sup>ab</sup> ±1.00	1.00 <sup>ab</sup> ±0.00	1.00 <sup>ab</sup> ±1.00	0.33 <sup>ab</sup> ±0.58
	1.5	0.67 <sup>abc</sup> ±1.16	0.67 <sup>ab</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	0.67 <sup>ab</sup> ±1.16	0.33 <sup>ab</sup> ±0.58

Table 3  
Effect of treatments on the number of newly emerged *C. maculatus* adults

Treatment	Conc.	0.5	1.0	1.5	0.5	1.0	1.5
ETHSS	0.5	0.67 <sup>abc</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	0.67 <sup>abc</sup> ±1.16	
	1.0	0.33 <sup>ab</sup> ±0.58	0.67 <sup>ab</sup> ±1.16	0.67 <sup>ab</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	
	1.5	0.33 <sup>ab</sup> ±0.58	0.67 <sup>ab</sup> ±0.58	0.33 <sup>a</sup> ±0.577	0.67 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	
ETHSL	0.5	0.67 <sup>abc</sup> ±1.16	1.67 <sup>abc</sup> ±1.53	1.00 <sup>ab</sup> ±0.00	1.00 <sup>ab</sup> ±1.00	0.67 <sup>abc</sup> ±0.58	
	1.0	0.33 <sup>ab</sup> ±0.58	1.00 <sup>ab</sup> ±1.00	0.67 <sup>ab</sup> ±1.16	1.00 <sup>ab</sup> ±1.00	0.67 <sup>abc</sup> ±0.58	
	1.5	0.00 <sup>a</sup> ±0.00	0.33 <sup>a</sup> ±0.58	0.67 <sup>ab</sup> ±1.16	0.33 <sup>ab</sup> ±0.58	0.33 <sup>ab</sup> ±0.58	
Control	0.0	2.67 <sup>d</sup> ±1.16	3.00 <sup>d</sup> ±1.73	2.67 <sup>c</sup> ±1.16	3.00 <sup>c</sup> ±1.00	2.33 <sup>e</sup> ±0.58	

Means followed by the same letter (s) in a column are not significantly different from each other at  $P < 0.05$  according to New Duncan's Multiple Range Test

Keys: Conc. = Concentration, NHTL = N-Hexane extract of *T. heudelotii* leaf, NHSS = N-Hexane extract of sesame seed, NHSL = N-Hexane extract of sesame leaf, ETHTL = Ethanol extract of *T. heudelotii* leaf, ETHSS = Ethanol extract of sesame seed, ETHSL = Ethanol extract of sesame leaf

### 3.4. Effects of the treatment extracts on the percentage weight of cowpea

The experiment revealed that the various treatment sustained a significant amount of cowpea weight (g) when compared to the control. However, the ethanol extract of sesame leaf retained the highest percentage weight of 93.33% of the cowpea at 1.5 ml concentration followed by the ethanol extract of sesame seed (86.67%), N-Hexane extract of sesame leaf (86.66%) and N-Hexane extract of sesame seed (86.66%) at 1.5 ml concentration when compared to the other botanical treatments and the control in Table 4. The control had a drastic loss of weight (40.00%) significantly ( $p < 0.05$ ) lower than the botanical treatments used as shown in Table 4.

Table 4

Effects of the treatment extracts on the percentage weight of cowpea

Treatment	Conc.(ml)	% weight (g)
NHTL	0.5	66.67 <sup>bc</sup> ±6.67
	1.0	73.33 <sup>cd</sup> ±6.67
	1.5	73.33 <sup>cd</sup> ±6.67
NHSS	0.5	66.67 <sup>bc</sup> ±6.67
	1.0	80.00 <sup>de</sup> ±6.67
	1.5	86.66 <sup>ef</sup> ±6.67
NHSL	0.5	73.33 <sup>cd</sup> ±0.00
	1.0	80.00 <sup>de</sup> ±6.67
	1.5	86.66 <sup>ef</sup> ±6.67
ETHTL	0.5	73.33 <sup>cd</sup> ±6.67
	1.0	73.33 <sup>cd</sup> ±6.67
	1.5	73.33 <sup>cd</sup> ±6.67
ETHSS	0.5	73.33 <sup>cd</sup> ±6.67
	1.0	86.66 <sup>ef</sup> ±6.67
	1.5	86.67 <sup>ef</sup> ±6.65
ETHSL	0.5	73.33 <sup>cd</sup> ±6.67
	1.0	80.00 <sup>de</sup> ±6.67
	1.5	93.33 <sup>f</sup> ±6.67
Control	0.0	40.00 <sup>a</sup> ±6.67

Means followed by the same letter (s) in a column are not significantly different from each other at  $P < 0.05$  according to New Duncan's Multiple Range Test

Keys: Conc. = Concentration, NHTL = N-Hexane extract of *T. heudelotii* leaf, NHSS = N-Hexane extract of sesame seed, NHSL = N-Hexane extract of sesame leaf, ETHTL = Ethanol extract of *T. heudelotii* leaf, ETHSS = Ethanol extract of sesame seed, ETHSL = Ethanol extract of sesame leaf

### 3.5. Qualitative Phytochemical screening of the different botanical treatment extracts

The qualitative phytochemical screening (Table 5) indicated that there was relatively moderate amount of alkaloid present in the N-hexane and ethanol sesame seed and in the N-hexane *T. heudelotii* extracts. Flavonoids were detected to be in trace amount in all the treatment extracts. Saponin was indicated to be moderately available in the ethanol sesame seed, and in the N-Hexane and ethanol *T. heudelotii* leaf. Tannin was mostly present in the ethanol sesame leaf extract with the other extracts having tannin in trace amount. Steroid was abundantly present in all the treatment extracts except in the ethanol sesame leaf and seed which were in moderate amount as shown in Table 5.

Table 5

Qualitative phytochemical analysis of the various treatment extracts

Phyto-chemicals	NH SL	ETH SL	NH SS	ETH SS	NH TL	ETH TL
Alkaloids	+	-	++	++	++	+
Flavonoids	+	+	+	+	+	+
Terpenoids	-	+	-	++	++	+
Saponin	+	+	+	++	++	++
Tannin	+	++	+	+	+	+
Steroid	+++	++	+++	++	+++	++

Keys: NHTL = N-Hexane extract of *T. heudelotii* leaf, NHSS = N-Hexane extract of sesame seed, NHSL = N-Hexane extract of sesame leaf, ETHTL = Ethanol extract of *T. heudelotii* leaf, ETHSS = Ethanol extract of sesame seed, ETHSL = Ethanol extract of sesame leaf, - = Absence of the Secondary metabolites, + = Trace presence of Secondary metabolites, ++ = Presence of Secondary metabolites, +++ = Abundance of Secondary metabolites

Extracts from different plants have been studied to possess insecticidal properties against a wide range of insect pests (Abdullah & Muhammad, 2004). The study conducted showed promising bio-pesticidal potentials of two plant botanical extracts namely sesame and *Trichilia heudelotii* against various life stages of the ruthless insect pest *Callosobruchus maculatus* infesting cowpea grains.

The current study investigated the use of N-hexane and Ethanol extracts of *Trichilia heudelotii* leaf, sesame leaf and seed. The extracts of the treatment used were mostly effective at an increased rate of 1.5 ml invariably resulting to the control of *C. maculatus* in cowpea. Sesame and *T. heudelotii* extracts increased adult mortality, reduced oviposition and larvae emergence rate, constricted the population of the next generation of *C. maculatus* adults from emerging and also had the lowest cowpea weight loss when compared to untreated ones. Several reports have suggested the bio-insecticidal action of the selected plant extracts. Ahmed et al. (2003) made use of sesame oil and discovered that sesame oil controlled the larvae of *Callosobruchus chinensis* inside the cotyledons of azuki beans. There was no evaluation of the use of sesame leaves in his study hence the present study showed that N-hexane and ethanol leaf extracts of sesame could be considered a plausible control against *C. maculatus* when used as additives on cowpea grains. In another study, Wheeler and Isman (2001) and López-Olguín (1998) investigated the use of different plant parts of the genus *Trichilia* and discovered that it has insecticidal and antifeeding effects against some field insects. This, too, was without consideration of the *Trichilia* species-*heudelotii* as indicated in this research that the leaf extracts of the plant could possibly be used to restrict the life cycle of the bean weevil from further development in grains.

The insecticidal properties of the extracts of *Trichilia heudelotii* leaf, Sesame leaf and Sesame seed might be connected to the phytochemical constituents such as alkaloids, flavonoids, steroids, terpenoids and tannin. Anilakumaret al (2010) stated that sesame plants contain many phytochemically important compounds like flavonoids, phenolic acids, alkaloids, tannins, saponins, steroids and terpenoids that could restrict the activities of various insect pests. Similarly, it was reported that the genus *Trichilia* is a good source of different classes of phytochemical compounds with bio-insecticidal potentials in the control of insect pests (Garcia-Gomez et al., 2019; Sengottayan, 2013; Curcino-Vieira et al., 2014). These components may be having the role of biochemical defenses or protectant against *C. maculatus* in cowpea grains.

The antagonistic action of the treatment extracts may be partially attributed to interference in the normal respiration of the insect pest, leading to suffocation

(Schoonhoven, 1978). Other factors other than shortages of oxygen supply may also play its unique role in their mode of action (Shaaya & Ikan, 1978). Egg mortality has been previously connected to toxic components of plant materials and also to their physical properties which could cause changes in surface tension and also oxygen tension within the insect eggs (Singh et al., 1978).

Al-lawati et al (2002a,b) stated that materials gotten from plants have been traditionally used and accepted by farmers due to their relatively safe usage in protecting and preserving grains from pest attacks. The study relatively showed that there was better maintenance and very low loss of the grain weight of cowpea after having been treated with the botanicals

is advisable for short grain storage because of high degradability and volatility of the plant material (Salako et al., 2008) this is comparatively safer in preserving cowpea grains for a short period as it is intended to be eaten soon thereby leaving off no toxic chemical residues. Plant materials with insecticidal and preservative potentials could be easily sourced and acquired from local environment and also suggested as a cheaper, quick and eco-friendly option in preserving food grains such as cowpea for home usage due to the developing fears of using chemical pesticides (Mukanga et al., 2010).

#### 4. Conclusion

The use of plant materials as insecticides is increasingly gaining prominence as a sustainable means of pest management in cowpea grains. Previous studies have revealed the negative impacts of chemical insecticides, even the reports of deaths of consumers of cowpea who ingested grains containing lethal dosage of the substance after 24 hours. Biopesticides, on the other hand, poses no deleterious risk to human health, the environment and non-target organisms. The use of sesame (seed and leaf) and *Trichilia heudelotii* (leaf) N-hexane and ethanol extracts indicated active insecticidal potentials against the notorious insect pest-*Callosobruchus maculatus* whose reputation is known to be extremely destructive, drastically reducing cowpea yield and its market values. The plant extracts added to cowpea grains as alternatives to synthetic insecticides effectively reduced the population of the weevil further disorienting the various life cycle of the insect pest from development in cowpea. The solution presented here could be easily adopted by household users in preventing their grain stock from degradation by the insect pest therefore a recommendation of subsequent research to improve the longevity and persistence of the bioactive compounds of these plant extracts on cowpea is suggested.

## 5. References

- Abdullahi YM, Muhammad S (2004). Assessment of the toxic potentials of some plant powders on survival and development of *Callosobruchus maculatus*. *Afr. J. Biotech*3:60-64.
- Ahmed KS, Itino T, Ichikawa T (2003). Duration of developmental stages of *Callosobruchus chinensis* L.(Coleoptera:Bruchidae) on azuki bean and the effects of neem and sesame oils at different stages of their development. *Pak. J. Biol. Sci.* 6: 932-935.
- Akyaw MO, Baidoo PK, Mochiah MB. (2014). The effect of time harvest on the damage caused to cowpea by storage beetle, *Callosobruchus maculatus* (FAB.) (Coleoptera: Bruchidae). *Global advanced research journal of agricultural science* 3(11): 351-355.
- Al-Lawati HT, Azam KM, Deadman ML. (2002a). Insecticidal and Repellent Properties of Subtropical Plant Extracts Against Pulse Beetle, *Callosobruchus chinensis*. *Agric. Sci.* 7: 37-45.
- Al-Lawati HT, Azam KM, Deadman ML (2002b). Potential of Omani Flora as Source of Natural Products for Control of Pulse Beetle, *Callosobruchus chinensis*. *Agric. Sci.* 7: 59-63.
- Anilakumar KR, Pal A, Khanum F, Bawa AS (2010). "Nutritional, medicinal and industrial uses of sesame (*Sesamum indicum* L.) seeds - An overview." *Agriculturae Conspectus Scientificus*, 75(4): 159-168.
- Asante SK, Tamo M, Jackai LEN (2001). Integrated management of cowpea pest using elite cultivars, date of planting and minimum insecticide application. *Afr Crops Sci J*9(4):655-665
- Asiwe JAN, Belane D, Dakora FD (2009). Evaluation of cowpea breeding lines for nitrogen fixation at ARC-Grain Crops Institute, Potchefstroom, South Africa. Abstract, the 16th International Congress on Biological Nitrogen Fixation, Montana, USA, pp 14-19
- Boukar O, Fatokun C (2009). Strategies in cowpea breeding. In Zerihun T (ed) New approaches to plant breeding of orphan crops in Africa: proceedings of an international conference, 19-21 September 2007, Bern, Switzerland, pp 69-92
- Brisibe EA, Adugbo SE, Ekanem U, Brisibe F, Figueira GM (2011). Controlling Bruchid Pests of Stored Cowpea Seeds with Dried leaves of *Artemisia annua* and Two Other Common Botanicals. *Africa Journal of Biotechnology*10(47): 9586-9592.
- Coulibaly O, Alene AD, Manyong V, Sanogo D, Abdoulaye T, Chianu J, Fatokun C, et al. (2009). Situation and outlook for cowpea and soybean in sub-Saharan Africa. II Project in West and East Africa.
- Curcino-Viera IJ, Silva-Terra W, Dos Santos GM, Braz-Filho R (2014). Secondary metabolites of the genus *Trichilia*: contribution to the chemistry of Meliaceae family. *American Journal of Analytical-Chemistry* 5: 91-121.
- Dugje IY, Omoigui LO, Ekeleme F, Kamara AY, Ajeigbe H (2009). Farmers' Guide to Cowpea Production in West Africa. IITA, Ibadan, Nigeria. p20.
- FAO (Food and Agriculture Organisation of the United Nations)(2005). The state of food and agriculture. Document prepared for the International Conference on Worlds' state of food. FAO, Rome, Italy.
- Garcia-Gomez A, Figueroa-Brito R, Garcia-Serrano LA, Jimenez-Perez A(2019). *Trichilia* (Meliaceae) plants: an important source of biomolecules with insecticidal properties. *Florida Entomologist*101 (3):470-479.
- Gwary OM, Hati SS, Dimari GA, Ogugbuaja VO (2012). Pesticide residues in bean samples from North-Eastern Nigeria. *J Sci Technol*2(2): 97-84.
- Harborne JB (1973). *Phytochemical Methods: A Guide to Modern Technique of Plant Analysis*. Chapman and Hall Ltd
- Jackai LEN, Daoust RA (1986). Insect pests of cowpeas. *Annu Rev Entomol* 31:95-119
- Karungi J, Adipala E, Ogenga-Latigo, MW et al (2000). Pest management in cowpea. Part I. Influence of planting time and plant density on cowpea field pest infestation in eastern Uganda. *Crop Prot* 19:231-36.
- Khalequzzaman M, Hussain SMA, Osman GS (2007). Efficacy of edible oils in the control of pulse beetle, *Callosobruchus chinensis* L. in stored pigeonpea. *Univ. j. zool. Rajshahi Univ.* 26: 89-92.
- Langyintuo AS, Lowenberg DJ (2006). Potential regional trade implication of adopting Bt cowpea in West and Central Africa. *Back Issues Index* 9(2): 38-42.
- López-Olguín JF (1998). Actividad y modo de acción de productos de *Trichilia havanensis* Jacq. y *Scutellaria alpina* subsp. *Javalambrensis* (Pau), sobre *Leptinotarsa decemlineata* (Say) y *Spodoptera exigua* (Hübner). Tesis de Doctorado. Escuela Técnica Superior de Ingenieros Agrónomos. Universidad-Politécnica de Madrid. Madrid, España.
- Mukanga M., Deedat Y, Mwangata, FS(2010). Toxic effects of five plant extracts against the larger grain borer, *Prostephanus truncatus*. *Afr. J. Agric. Res.* 5(24): 3369- 3378.
- Mulatu B, Gebremedhin T. (2000). Oviposition-deterrent and toxic effects of various botanicals on the Adzukibean beetle, *Callosobruchus chinensis* L. *Insect Sci Applicata*, 20(1):33-38.



- Oyewale RO, Bamaiyi LJ (2013). Management of cowpea insect pests. *Sch Acad J Biosci (SAJB)* 1(5):217–226.
- Rachie KO (1985). Introduction. In: Singh SR, Rachie KO (eds) Cowpea research production and utilization. Wiley, London
- Salako EA, Anjorin ST, Garba, CD, Omolohunnu EB. (2008). A review of neem biopesticide utilization and challenges in Central Northern Nigeria. *African Journal of Biotechnology* 7(25): 4758-4764.
- Schoonhoven AV (1978). The use of vegetable oils to protect stored beans from bruchid attack. *J. Econ. Entomol.* 71, 254-256.
- Sengottayan, S. N. (2013). Physiological and biochemical effect of neem and other Meliaceae plants secondary metabolites against Lepidopteran insects. *Frontiers in Physiology* 4: 359.
- Shaaya E, Ikan R. (1978). The effectiveness of vegetable oils in the control of *Callosobruchus maculatus*. Institute for Technology and Storage of Agricultural Products, Department of Scientific Publications, Special Publication 216, Bet-Dagan, Israel pp 39.
- Shaibu I. (2008). 30 agrochemical products banned in Nigeria after deaths. Vanguard [Internet]. Available from: <https://www.organicconsumers.org/news/30-agrochemical-products-banned-nigeria-after-deaths> Assessed May 17, 2020
- Singh BB (2014). Cowpea: the food legume of the 21st century. Crop Sci Soc Am, Madison
- Singh SR, Jackai LEN (1985). Insect pests of cowpeas in Africa: their life cycle, economic importance and potential for control. *Cowpea Res. Prod Util* 217–231
- Singh SR, Luse RA, Leuschner LK, Nangju D. (1978). Groundnut oil treatment for the control of *Callosobruchus maculatus* (F.) during cowpea storage. *J. stored Prod. Res.* 14: 77-80.
- Sofowora LA (1993). *Medicinal plants and traditional medicine in Africa spectrum*. Books Ltd. Ibadan, pp 191-289
- Strong RG, Partida GJ, Warner DN (1968). Rearing stored product insects for laboratory studies, bean and cowpea weevil. *J. Econ. Entomol.* 61: 747-751.
- Timko MP, Ehlers JD, Roberts PA (2007). Cowpea: *In Genome Mapping and traditional vegetables in Tanzania*. Technical Bulletin No. 40. AVRDC—The World Vegetable Center, Shanhua, Taiwan, pp 53.
- Togola A, Boukar O, Belko N, Chamathi SK, Fatokun C, Tamo M, Oigiangbe N (2017). Host plant resistance to insect pest of cowpea (*Vigna unguiculata* L. Walp): achievements and future prospects. *Euphytica*, 213(239): 1-16.
- Trease, G. E. & Evans, W. C. (1989). *Pharmacognosy*. 11 Edition, Bailliere Tindall, London, pp 45-50
- Uddin II RO, Awolola GV, Mustapha S, Abdulazeez OH, Ilesanmi OT, Aliyu SA (2020). Novel application of *Trichilia heudelotii* Planch: effectiveness of different polarity of organic solvents of leaf and stem bark extracts on the control of cowpea beetle. *Cercetări Agronomice în Moldova* 53(3): 278-296
- Udo IO, Harry GI. (2013). Effect of groundnut oil in protecting stored cowpea; *Vigna unguiculata* from attack by cowpea weevil, *Callosobruchus maculatus*. *J Biol Agric Health Care* 3(1):89-92.
- Wakili AM (2013). Economic analysis of cow-pea production in Nigeria. *Russian J. of Agric. and Socio-Economic Sci* 1(13): 60 – 63.
- Wheeler D, Isman M (2001). Antifeedant and toxic activity of *Trichilia Americana* extract against the larvae of *Spodoptera litura*. *Entomologia Experimentalis et Applicata*, 98: 9–16.