***Original Research Article***

# Protectant Effect of Vegetable Oils Against Cowpea Weevil (*Callosobruchus maculatus*) on Stored Cowpea [*Vigna Unguiculata* (L.) Walp.]


## ABSTRACT

Cowpea is one of the common edible annual herbaceous legume. *Callosobruchus maculatus* is one of the common post-harvest pest of cowpea. This work was aimed at determining the protectant effect of five vegetable oils; coconut oil, cotton seed oil, groundnut oil, palm oil and sesame oil for the protection of stored cowpea against cowpea weevil (*Callosobruchus maculatus*). The study was conducted in Gombe State University between October, 2018 and April, 2019. Black eye seeds were used for the experiment. A completely randomized design with five replicates per treatment was used**.** Black eyed seeds (susceptible variety) used for the experiment were subjected to different oil treatments namely: coconut, cotton, groundnut, palm and sesame oils applied at 0.4, 0.8 and 1.2ml/100g of cowpea equivalent to 4, 8 and 12kg. Effect of the oils on weight lost and seed germination was also tested. Percentage adult mortality at 12 ml/Kg revealed that all the five oils killed 100% of the insects. Among the different edible oils evaluated, cotton seed oil was more effective killing 95% of the insect at 4ml/kg and 100% at 8ml/kg. The lowest mortality was recorded in the treatment with palm oil with 60 and 91.67% mortality at 4 and 8ml/kg dose treatment respectively. Minimum percentage weight loss after 90 days of storage was observed in grains treated with cotton seed oil (1.95%) followed by sesame oil (2.00%) and groundnut oil (2.38%) at 12 ml/kg grains. Cotton seed oil, groundnut oil and sesame oil at doses between 8 and 12 ml/kg could be effective for protecting cowpea in storage against cowpea weevil for 90 days of storage. All the treatments indicated minimal effect on the germination of cowpea. The 8ml/kg of cotton seed, groundnut and sesame oils investigated are promising bio friendly preservatives that could serve as an alternative formulations to synthetic chemical based insecticides for storage of cowpea.



*Keywords: coconut, cotton seed, groundnut, palm, and sesame oil, protectant*


## 1.0 INTRODUCTION

The primary insect pest responsible for causing losses to stored cowpea is the cowpea weevil, *Callosobruchus maculatus*. Infestation mostly begins at low level while in the field. After the crop is placed in store; the insect population continues to thrive until it becomes obvious and severe [1-3]. The larval stage of *C. maculatus* has been reported to be most destructive as the adult do not feed. It was noted that farm storage of cowpea for six months is repeatedly accompanied by about 30% loss in weight, with up to 70% of the seeds being damaged, rendering them virtually unfit for consumption [4,5].

The bulk of food consumed in Northern Nigeria is produced by small-scale farmers using traditional methods and there is widespread misuse of insecticides with serious consequences. However, storage losses are substantial despite the use of storage insecticides by many merchants. Consequently, most farmers sell cowpea shortly after harvest, in part because they do not want to deal with the storage problems [6].

The steady escalation in the cost of synthetic pesticides, the health hazards as well as the development of insecticides resistance by the insects posed a great threat in the management of the storage pest [7]. Other findings noted that the use of conventional pesticides lead to the reduction in crop yield by up to one-third through impaired nitrogen fixation. Hence, the suggestion to have an alternative control measure that can enhance yield in an adequately managed organic farming system [8]. Vegetable oils are reported as one of such viable alternatives to control some insect pests of stored products, including *C. maculatus*. It has been reported that they have the potentiality of having bioactive compounds against several species of insect pest and vectors and have been proven to be environmentally friendly less hazardous to human health [9-13].

Dennis [14] reported that coating legume seeds with oils extracted from plant is effective in bruchid damage control. Also, the findings of [15] compared the effectiveness of groundnut oil, steam treatment and pirimiphosmethyl for the control of *Callosobruchus maculatus* and reported that groundnut oil was nearly as effective as pirimiphosmethyl. Pacheco *et al.* [16] reported that refined soybean oil and castor-oil inhibited the population growth of *C. maculatus* and *Callosobruchus*. *phaseoli* (Gyllenhal) as compared to the untreated seeds. Several other studies have demonstrated the effectiveness of different vegetable oils in protecting grains against major stored product insect pests [17-20]. Oil induced reduction or complete inhibition of oviposition of female bruchids and mortality of the developmental stages has been reported by a number of workers [21].

The work is aimed at determining the protectant effect of some vegetable oils for protection of stored cowpea against *C. maculatus* infestation with the specific objectives of determining the adult mortality, seed weight loss and germination.

## 2.0 MATERIALS AND METHODS

The experiment was conducted under laboratory conditions at the Insectary, Department of Biological Sciences, Gombe State University. Black-eyed cowpea variety used for this experiment was obtained from Gombe main market ("Tudun Hatsi"). The coconut oil, cotton seed oil, groundnut oil, palm oil and sesame oil were obtained from Gombe Old market.

### 2.1 *Experimental Design*

Five treatments each consisting of coconut oil, cotton seed oil, groundnut oil, palm oil and sesame oil applied at different concentrations of 0.4, 0.8, and 1.2 ml/100g grains of cowpea equivalent to 4, 8, and 12 ml/Kg grains of cowpea and a control were laid out in a Completely Randomized Design in three (3) replicates according to the methods prescribed in [22-25] with minor modifications.

### 2.2 *Culturing of Experimental Insects*

Culturing of experimental insects was done using the procedure described by [26-27]. Cowpea grains were sterilised for 2 hours in an oven at $60^0$C. 5kg of the sterilized cowpea grain were put in separate clean jars. Adult cowpea weevils (*C. maculatus*) obtained from heavily infested cowpea were introduced into the jars and then covered with muslin cloth held in place by rubber bands. This ensured that aeration was maintained in the jars and also prevented the escape of introduced insects. The jars were placed in plastic trays and the culture maintained in the laboratory at 25±$2^0$C and 65-70% relative humidity. After 20 days of setting up the experiment, the cultures were set up; the jars were emptied and all the insects (both the living and the dead) were removed and the jars refilled with the same grains. From the 30th day of each culture, the first adult began to emerge and these were used for the experiment. Forceps and camel hair brushe were used for transfering the grains and insects respectively. Hand lense and microscope were used to view laid eggs, hatched eggs as well as adults' sex separation.

### 2.3 *Sample Preparation of Test Oils*

The three oils were thoroughly mixed with 100g grains in a plastic container (capacity 250g). The quantity of oil (0.4, 0.8, and 1.2 ml/100g grains) for all the treatments were measured with the help of micro-pipette and discharged on the grains.

### 2.4 *Effect of Grain Protectant Oils*

In each plastic container, 100g of treated/untreated cowpea grains and 10 pairs of freshly emerged cowpea weevil adults were released. The containers were covered with muslin cloth held in position with the help of rubber band kept at a temperature of 28 ± $1^0$C and 70 ± 5% relative humidity. The adults released were removed after 10 days. Effect on adult mortality, F1 Progeny emergence, grain weight loss and seed germination were evaluated [22,24].
Mortality of adult *C. maculatus* was assessed after 3 days of introduction into various treatments. Numbers of dead adults in each container were counted after 72 hours. To determine the effect of tested oils on the adult emergence, total number of adults (F1 Progeny) emerged from each treatment were counted 35 days after oviposition. The percentage of grain weight loss caused by *C. maculatus* at 45 and 90 days after treatment were calculated as follows:

$$\text{Percentage weight loss} = \frac{\text{initial weight} - \text{weight of sound and damaged grains}}{\text{initial weight}} \text{ x } 100$$

To examine the effect of test materials on viability of the treated grains, the germination of untreated and treated grains were observed. For this, 20 grains from each treatment in three replications were taken at random and placed in petri dishes lined with moistened blotting/filter paper. These petri dishes were kept at room temperature for 6 days which allow the grains sufficient time to germinate. Numbers of sprouted/unsprouted grains were counted and germination percentage determined. The germination percentage of seed was calculated according to [9] thus:

$$\text{G. P.} = \frac{(\text{TG} - \text{UG})}{2\text{TG}} \text{ x } 100$$

Where G.P. = Germination percentage; T.G. = Number of total grains; U.G. = Number of ungerminated grains

### 2.5 *Data Analysis*

The data was analyzed using 2-Way Analysis of Variance (ANOVA) at $P \leq 0.05$ with SPSS version 16.0 and results presented in a Standard Error bar chart.

## 3.0 RESULTS AND DISCUSSION

### 3.1 *Effect of Oils on Adult Mortality*

The result showed that with increase in dose of edible oils, mortality of insects also increased. All the oils showed the maximum (100%) mortality at 12ml/kg grain. At 8ml/kg, cotton and groundnut oils showed the maximum adult mortality of 100% followed by sesame oil (96.67%), palm oil (91.67%) and coconut oil (85.00%). At 4ml/kg cotton oil recorded highest adult mortality (95.00%) followed by groundnut oil (85.00) and coconut oil (75.00). The least, 60.00% was

observed in palm oil “Fig. 1”. These findings revealed that the adult mortality gradually increased with the increase in dose of each treatment. This concur with the findings of [27-28] who reported that groundnut oil at 0.3ml/100g gave complete protection of green gram against *C. maculatus*. Udo [29] reported mortality in cowpea grains treated with groundnut oil after 24 hours of application.

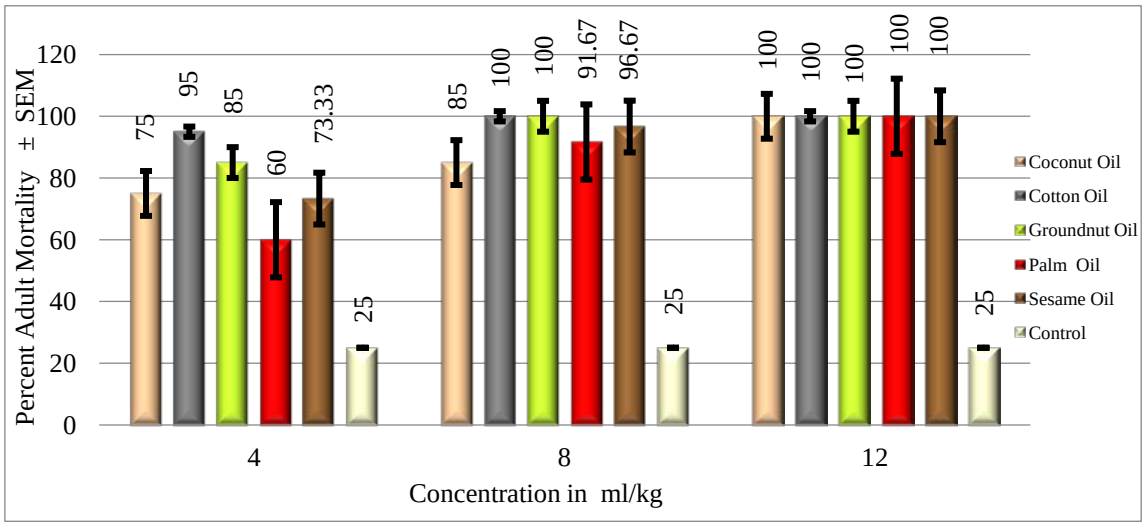


**Fig. 1.** Effect of Vegetable Oils against Cowpea Weevil (*Callosobruchus maculatus*)

### 3.2 Effect of vegetable oils on Grain Weight Loss after 45 and 90 Days

The effect of the vegetable oils on the weight of the Cowpea were assessed. At 45 days the percentage weight loss of the grain generally in the whole treatment were between 1.17 and 10.37% while the control showed 19.73% weight loss. The highest weight loss for the treated grains (10.37%) were observed in treatment with 4 ml/kg palm oil treatment while the lowest (1.17) was noted in the treatment with cotton seed oil at 12 ml/kg. (Fig. 2). Generally, there is a negative correlation between dose of oils and weight loss as reported by [30]. After 90 days, the weight of the grains were evaluated again. Figure 3 showed that at 4ml/kg, the maximum (20.88%) percent weight loss was recorded in grains treated with coconut oil while the lowest was recorded in cowpea treated with cotton seed oil (8.32%). At the dosage level of 8ml/kg the maximum (12.59%) weight loss was recorded in palm oil treated grains while the least weight loss of 4.43% was recorded in groundnut and cotton seed oils. Then, at 12ml/kg the maximum (8.77%) weight loss was also in palm oil treated grains whereas the least were noted in groundnut oil treated grains (1.95%). The effect of different edible oils on grain weight loss caused by *C. maculatus* as shown in *Fig*. 2 and 3 revealed that the edible oils at all concentrations significantly reduced the loss of weight of Cowpea attributed to *C. maculatus* especially when compared to the control. These findings is in agreement with [27,31-34] who reported that grains treated with vegetable oils ranging from 5 - 20ml/kg significantly reduced loss in weight of pulses as compared to untreated grains. Udo [29]; [35-36] also reported similar findings in their work using palm oil, groundnut oil, custard and mustard grain extract at varying dosage levels ranging from 0.1 - 1.4ml/100g grains.

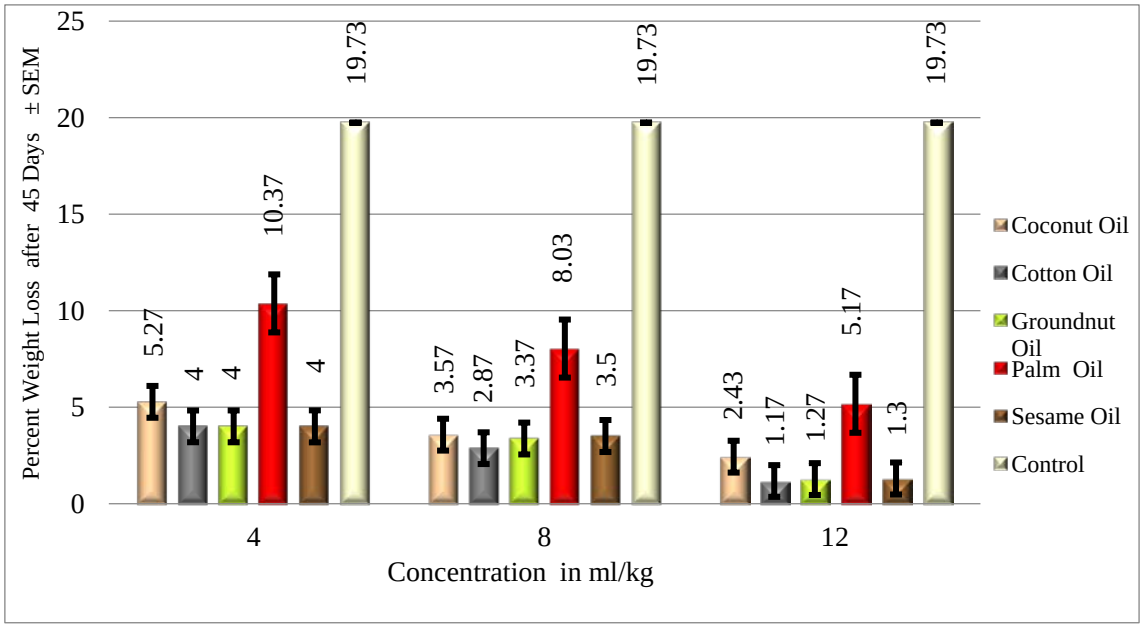


**Fig. 2.** Effect of Vegetable Oils on Cowpea Weight after 45 Days

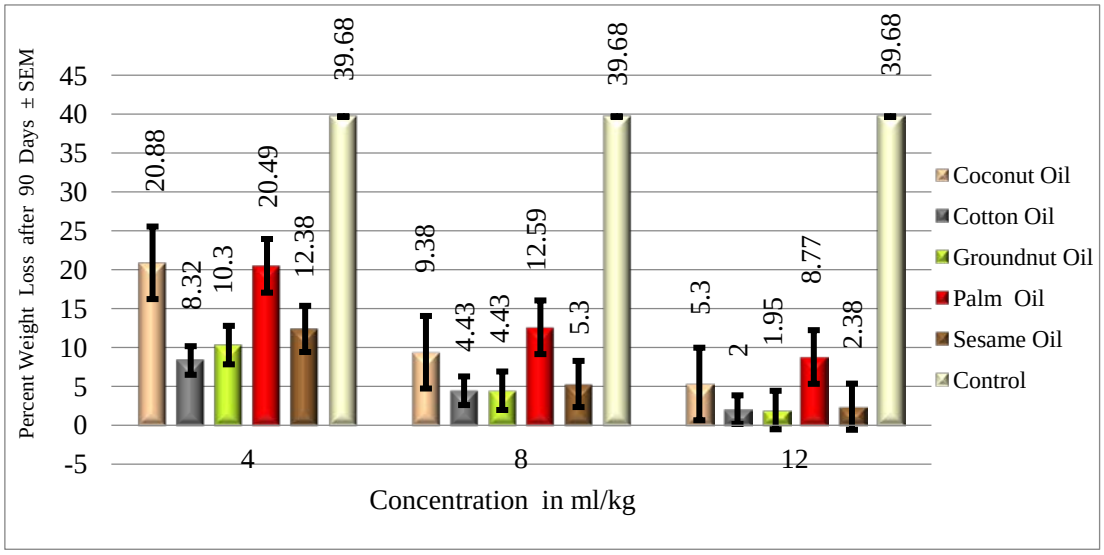


**Fig. 3.** Effect of Vegetable Oils on Cowpea Weight after 90 Days

### 3.3 Effect of Oils on Seed Germination

It was observed that all the grains treated with 12ml/kg of the five different oils including the control showed a germination rate between 81.67 and 88.35. For the dose of 8 and 4 ml/kg the percentage germination range between 83.33 and 88.35% including the control (Figure 4). All the treatments indicated minimal effect on the germination of cowpea with each other as well as with control. This implies that these oils could be safe for seed storage purposes. Several reports also concur with this finding [37-40]. Similarly, [41,42] reported that seed viability was not affected by the oils treatment.

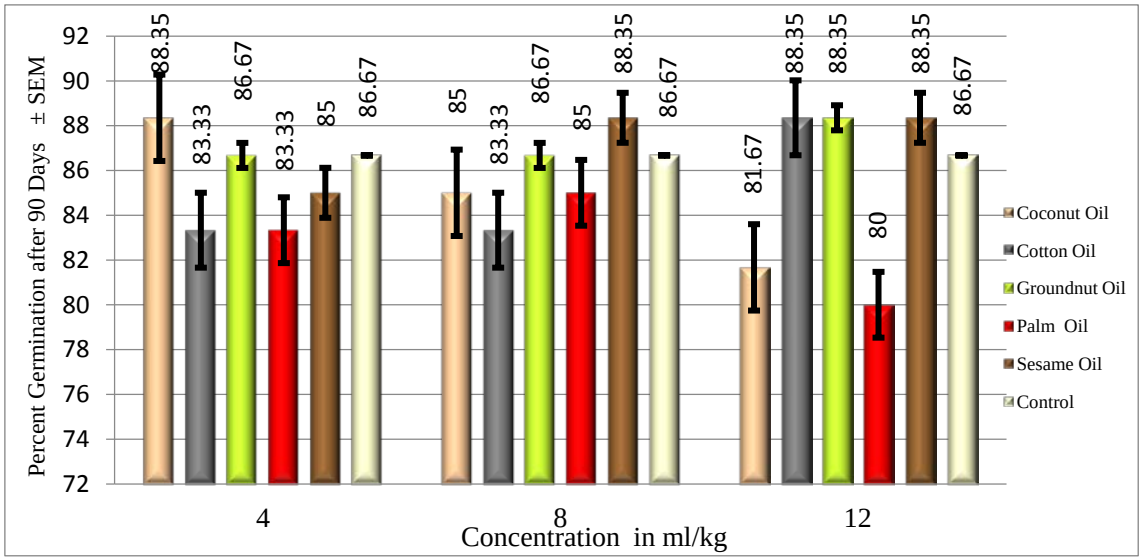


**Fig. 4:** Effect of Vegetable Oils on Seed Germination after 90 Days

## 4.0 CONCLUSION

This work reported the efficacy of five different vegetable oils in protecting cowpea against cowpea weevil. The oils also show insignificant impact both in the weight of the cowpea and the germination rate after 45 and 90 days. This is a promising bio friendly preservative that could serve as an alternative formulation to synthetic chemical based insecticides for storage of cowpea. Further analysis of the oils is necessary to ascertain its potency for usage for storage of cowpea.

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