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INSECTICIDAL EFFECTS OF *CASSIA TORA* AND *CASSIA ALATA* AGAINST COWPEA WEEVIL (*CALLOSOBRUCHUS MACULATUS*)

*Deme, G. G.[1], Malann, Y. D.[1], Chundusu, E. S[2]. And Chup, J. A[3].

[1]Department of Biological Sciences, University Of Abuja
[2]Department of Science, Plateau State Polytechnic, Barkin Ladi.
[3]Department of Pre-ND Science, Plateau State Polytechnic, Barkin Ladi.

*Corresponding Author Email Address: demejnr@gmail.com

ABSTRACT
A study on the effects of *Cassia tora* and *Cassia alata* against cowpea weevil (*Callosobruchus maculatus*) was conducted from April to July, 2016 and aimed at evaluating the effects of *Cassia tora* and *Cassia alata* in the control of cowpea weevil (*Callosobruchus maculatus*). The percentage mortality of *Callosobruchus maculatus* in white variety seeds of cowpea treated with concentrations 2g, 3g, 4g and 5g powder of *Cassia alata* are 40%, 50%, 70% and 90% respectively and *Cassia tora* of the same concentrations gave mortality percentage of 30%, 40%, 60% and 70% respectively. The mortality of adult *C. maculatus* was higher in both varieties treated with powdered mixture of both plant materials in ratio of Ca80%:Ct20% showed (90%) mortality followed by Ca50%:Ct50% with 80%. *C. maculatus* mortality according to variety was higher in the white variety than the brown variety with Ca20%:Ct80% mixture as (3.00±1.00) and (2.50±0.50) respectively. The weevil perforation index (WPI), increase as the concentration of the plant increased with *Cassia alata* having the highest weevil perforation index when compared to *Cassia tora*. There was significant difference ($P<0.05$) between combination of the two plants (*Cassia alata* and *Cassia tora*) and weevil perforation index for both varieties of cowpea seeds. Since the plant species showed efficacy and are cheap and readily available, it therefore be recommended, that the leaf powders of these two plants can be used in the control of adult *C. maculates* in storage of cowpea.

Keywords: Insecticidal Effect, *Cassia tora*, *Cassia alata,* Against, Cowpea Weevil (*Callosobrunchus Maculatus*)

INTRODUCTION
Cowpea (*Vigna unguiculata* L. Walp.) is a major staple food crop and essential source of protein in sub-Saharan Africa, especially in the dry savanna regions of West Africa where animal protein is rarely available. The production and storage of cowpea have faced so many constraints, throughout West Africa such as diseases and the limited use of fertilizers and irrigation inputs (Brisibe *et al*., 2011; Raguraman and Singh, 2000) but the major constraints is the insect pest known as *Callosobruchus maculatus* (Musa, Oyerinde and Owolabi, 2009), which infests it before and after harvest consequently leading to loss of economic value (Baidoo *et al.,* 2010). Insect pests are considered to be largely responsible for attack which can result in 90 - 100% yield reduction (Fatokun *et al*., 2002).
Infestations on stored grains may reach 50% within 3-4 months of storage (Oparaeke and Dike, 2005). In storage, the bruchid, *Callosobruchus maculatus* (Coleoptera: Chrysomelidae: Bruchinae), causes the major losses. They are field – to - store agricultural insect pests of Africa and Asia that presently range throughout the tropical and subtropical world (Beck and Blumer, 2011). In the bid to control the storage insects of cowpea, chemical insecticides are widely used (Lowenberg-Deboer & Ibro, 2008).
Nigeria cultivates 4.5million hectares annually representing over 60% of total production. The crop can be harvested in three stages; while the pods are young and green, mature and green and dry. The grain yield of cowpea in Nigeria is 700kg/ ha (Fatokun *et al*., 2002). The highest production of cowpea comes from the northern states of Nigeria (about 1.7 million tonnes from 4 million hectares). The sale of cowpea seeds and fodder earns income to farmers. In Nigeria, farmers who cut and store cowpea fodder for sale at the peak of the dry season have been found to obtain as much as 25% of their annual income by this means. Cowpea also plays an important role in providing soil nitrogen to cereal crops (such as maize, millet and sorghum) grown after cowpea cropping (Fatokun *et al*., 2002). Therefore there is need to improving the storage condition of cowpea in Nigeria by the use of plants.

MATERIALS AND METHODS

Experimental set up
Fifty grams (50 g) of well preserved and air-dried cowpea seeds were placed in a total of 52 (50 ml) plastic tubes with, 44 experimental set up and 8 controls. The experiment was in two Groups A and B. Thirty-six of these plastic containers were for the Group A while the remaining sixteen (16) plastic containers were used for the Group B (Fatope *et al.,* 1995).

Location of Cowpea Collection.
The cowpea seeds for the experiment which include white variety (IT82 (e-18) and the red variety (Ife Brown) were collected from Agricultural Development Programme (ADP) Abuja, Gwagwalada. The cowpea were sealed in cellophane bags and disinfested by deep-freezing for 2 weeks. The seeds were air-dried in the laboratory for 24 hours prior to use.

Insect culture
The laboratory culture of the cowpea weevil *Collosobruchus maculatus* were reared at ambient temperature (25 ± 2^{o}C) and relative humidity of 56±4 mmHg. The adult insects were collected from infested cowpea seeds at Gwagwalada market FCT-Abuja, Nigeria. The insects were introduced into two breeding containers containing susceptible cowpea seeds.

Collection and preparation of test plant powders

Fresh leaves of *Cassia alata* and *Cassia tora* were obtained from Giri Gwagwalada area of Federal Capital Territory Abuja, Nigeria. The collected plant materials were dried in the Biology Laboratory, University of Abuja, Nigeria and processing done within one week of collection to prevent rotting or other problems that may lead to loss of active principles (Sharma, 1982). The plant materials were pulverized into fine powder using an electric blender, passed through 10- micron sieve and sealed in cellophane bags until needed for use.

Bioactivity test of *Cassia alata* and *Cassia tora* against *Collosobruchus maculatus*

In Group A, four rates (2.0, 3.0, 4.0 and 5.0 g/50.0 g cowpea seed) of each of the two (2) plants products (*Cassia alata* and *Cassia tora*) were added randomly to each variety of cowpea, the white variety (IT82 (e-18) and the red variety (Ife Brown) and replicated twice (that is 2 plant products x 4 rates x 2 replications). The controls (that is 2 plant products x 2 replications) were stored without the treatment (Fatope *et al.,* 1995).

In Group B, about 5 g of the experimental leaf powders in the proportions of *Cassia alata* 20% ratio *Cassia tora* 80% (Ca20%:Ct80%), Ct80%:Ca20% and Ca50%:Ct50% were added separately into the containers containing each variety of the cowpea, the white variety (IT82 (e-18) and the red variety (Ife Brown) and vigorously shaken to mix thoroughly. The control was also set up without the treatments. All Treatments were arranged in completely randomized design (C.R.D).

Five pairs of adult *C. maculatus* aged between 24 - 48 hours were introduced into each of the plastic tubes. The tubes were firmly covered with baft cloth to allow for respiration of the insects and preclude entry or exit of insects. The experiment was left for 10 weeks after the introduction of the insects and the emergence of the F1 generation (first filial generation). All the insects (dead and living) were removed from each of the plastic tubes (Fatope *et al.,* 1995).

The following parameters were measured.

- Effect of the plant materials on adult emergence and mortality: The numbers of dead and living insects were recorded weekly from one to sixth weeks after the introduction of the treatment materials. Both the living and dead insects were discarded after each week's recordings.
- Damage assessment was done through the counting of the total number and distribution of holes per seed of cowpea. The number of holes per sub-sample of ten randomly selected seeds and the number of these seeds with holes were recorded. This assessment was done at the sixth week.

The Weevil Perforation Index (WPI) (Fatope *et al.,* 1995) was then calculated thus:

$$\text{WPI} = \frac{\text{\% Treated cowpea grains perforated}}{\text{\% Control cowpea grains perforated}} \times \frac{100}{1}$$

Weevil Perforation Index value exceeding 50 % was regarded as enhancement of infestation by the weevil or negative ability of the plant material or insecticides tested.

Statistical analysis

Data generated were subjected to analysis of variance (ANOVA) using Microsoft Excel Statistical Software package (window 10) at 0.05 significant levels.

RESULTS

Mortality of *Callosobruchus maculatus* in White variety treated with *Cassia tora* and *Cassia alata*

The percentage mortality of *Callosobruchus maculatus* in white variety treated with concentrations 2g, 3g, 4g and 5g are as follows; for *Cassia alata* 40%, 50%, 70% and 90% respectively while for *Cassia tora* 30%, 40%, 60% and 70% respectively when compared to the control 20% (Table 1).

Table 1: Mortality of *Callosobruchus maculatus* in White variety treated with *Cassia tora* and *Cassia alata*

	Cassia alata		*Cassia tora*	
Treatments (g)	Mean value	Percentages (%)	Mean value	Percentages (%)
2	2.00±0.00	40	1.50±0.50	30
3	2.50±0.00	50	2.00±1.00	40
4	3.50±0.50	70	3.00±1.00	60
5	4.50±0.50	90	3.50±0.00	70
Controls	1.00±0.00	20	1.00±0.00	20

Each value represents Mean ± Standard deviations from two replicate values

Mortality of *Callosobruchus maculatus* in Brown variety treated with *Cassia tora* and *Cassia alata*

The percentage mortality of *Callosobruchus maculatus* in brown variety treated with concentrations 2g, 3g, 4g and 5g are as follows; for *Cassia alata* 40%, 50%, 60% and 70% respectively while for *Cassia tora* 30%, 40%, 50% and 60% respectively when compared to the control 20%.

Table 2: Mortality of *Callosobruchus maculatus* in Brown variety treated with *Cassia tora* and *Cassia alata*

	Cassia alata		*Cassia tora*	
Treatments (g)	Mean value	Percentages (%)	Mean value	Percentages (%)
2	2.00±0.00	40	1.50±0.50	30
3	2.50±0.00	50	2.00±1.00	40
4	3.00±0.00	60	2.50±0.00	50
5	3.50±1.00	70	3.00±0.00	60
Controls	1.00±0.00	20	1.00±0.00	20

Each value represents Mean ± Standard deviations from two replicate value

Mortality of *Callosobruchus maculatus* treated with the combination of *Cassia tora* and *Cassia alata*

Table 3 showed that the powdered mixture of Ca80%:Ct20% with percentage mortality of (90%) performed more in mortality of adult *C. maculatus* in both brown and white varieties followed by

Ca50%:Ct50% powder mixtures with percentage mortality of 80% in both brown and white varieties while the least was observed in the powder mixture of Ca20%:Ct80% with percentage mortality of 50% and 60% in white and brown variety of beans when compared with the control with percentage mortality of 10% and 30% in white and brown variety respectively.

Table 3: Mortality of *Callosobruchus maculatus* in Brown and White variety treated with the combination of *Cassia tora* and *Cassia alata*

Treatments (%)	Brown variety		White variety	
	Mean	Percentages (%)	Mean	Percentages (%)
Ca80:Ct20	4.50±0.50	90	4.50±0.00	90
Ca50:Ct50	4.00±0.00	80	4.00±0.50	80
Ca20:Ct80	2.50±0.50	50	3.00±1.00	60
Control	1.00±0.00	10	1.50±0.50	30

Keys: Ca80= 80 % *Cassia alata*, Ct20= 20 % *Cassia tora*, Ca20= 20 % *Cassia alata*, Ct 80= 80 % *Cassia tora*, Ca50= 50 % *Cassia alata* and Ct50= 50 % *Cassia tora*. Each value represents Mean ± Standard deviations from two replicate values.

Numbers of holes in white cowpea variety

Tables 4 showed the weevil perforation index for the white variety treated with was higher in white variety treated with *Cassia tora* with Weevil Perforation Index of 67.31 %, 57.69 %, 46.15 % and 39.42 % than white variety treated with *Cassia alata* at 2g, 3g, 4g and 5g with Weevil Perforation Index of 46.15 %, 42.31 %, 35.58 % and 26.92%.

Table 4: Number of holes in White cowpea seeds variety treated with *Cassia tora* and *Cassia alata*

	Cassia alata		*Cassia tora*	
Treatments (g)	**Mean value**	**WPI (%)**	**Mean value**	**WPI (%)**
2	24.00±2.00	46.15	35.00±1.00	67.31
3	22.00±1.00	42.31	30.00±0.50	57.69
4	18.50±1.00	35.58	24.00±2.00	46.15
5	14.00±1.00	26.92	20.50±2.50	39.42
Controls	52.00±0.00	100	52.00±0.00	100

Key: WPI= Weevil Perforation Index. Each value represents Mean ± Standard deviations from two replicate values

Numbers of holes in white and brown cowpea variety

Tables 5 shows the weevil perforation index for the brown variety treated with was higher in white variety treated *Cassia tora* with Weevil Perforation Index of 63.85 %, 66.92 %, 43.85 % and 35.38 % than brown variety treated with *Cassia alata* at 2g, 3g, 4g and 5g with Weevil Perforation Index of 53.85 %, 49.23 %, 46.92 % and 36.92% and 26.92%.

Table 5: Number of holes in Brown cowpea seeds variety treated with *Cassia tora* and *Cassia alata*

	Cassia alata		*Cassia tora*	
Treatments (g)	**Mean value**	**WPI (%)**	**Mean value**	**WPI (%)**
2	35.00±1.00	53.85	41.50±0.50	63.85
3	32.00±2.00	49.23	43.50±1.50	66.92
4	30.50±0.50	46.92	28.50±2.00	43.85
5	24.00±2.00	36.92	23.00±0.00	35.38
Controls	65.00±0.00	100	65.00±0.00	100

Key: WPI= Weevil Perforation Index. Each value represents Mean ± Standard deviations from two replicate values

Numbers of holes in white and brown cowpea variety treated with mixtures of *Cassia tora* and *Cassia alata*

Table 6 showed the highest weevil perforation index (WPI) was observed in the white variety with combination Ca80%:Ct20% which had Weevil Perforation Index of 32.26 %, and followed with combination of Ca50%:Ct50% with Weevil Perforation Index of 34.68 % while Ca20%:Ct80% had the least weevil perforation index of 37.10 %. For the brown variety, the highest weevil perforation index (WPI) was observed with Ca80%:Ct20% combination which had weevil perforation index of 39 %, followed by Ca50%:Ct50% with 40 % and Ca20%:Ct80% showed the weevil perforation index of 43% being the least.

Table 6: Number of holes in Brown and White cowpea seeds variety treated with combination of *Cassia tora* and *Cassia alata*

Treatments (%)	**Brown variety**		**White variety**	
	Mean	**(%)**	**Mean**	**(%)**
Ca80%:Ct20%	19.50±0.50	39	20.00±0.00	32.26
Ca50%:Ct50%	20.00±0.00	40	21.50±0.50	34.68
Ca20%:Ct80%	21.50±0.50	43	23.00±1.00	37.10
Control	50.00±0.00	100	62.00±0.00	100

Key: WPI= Weevil Perforation Index. Each value represents Mean ± Standard deviations from two replicate values

DISCUSSIONS

The present study showed that leaf powders plants of *Cassia alata* and *Cassia tora* showed efficacy against adults of stored cowpea seeds pest *Callosobruchus maculatus*. This result agrees with previous studies carried out by Raguraman and Singh (2000); Musa *et al.* (2009) and Moses and Dorathy (2011) who all reported various plants with efficacy against cowpea weevil. The mortality of *C. maculatus* is an indication that *Cassia alata* and *Cassia tora* leaf powder has some insecticide properties capable of controlling pests of stored cowpea.

In the present study, the treatment with the highest concentration of 5g of the leaf powders of *Cassia alata* and *Cassia tora* when used differently on 150g of cowpea seeds showed a significant difference ($P<0.05$) with the mortality of *C. maculatus*. Although, the leaf powders of the two plant species (*Cassia alata* and *Cassia tora*) showed actions as botanical pesticides, *Cassia alata* leaf powder showed more efficacy than the *Cassia tora* leaf powder. This finding agrees with the findings of Brisibe *et al*.

(2011) who reported that, of the three botanical pesticides tested, the highest adult insect mortality rate was recorded in the treatment with the highest concentration (5g/150g cowpea seeds) of dried and pulverized leaves respectively.

Furthermore, the moderate mean mortality count of adult *Cassia maculatus* was obtained from the cowpea seeds mixed with leaf powders of *Cassia alata* and *Cassia tora* at Ca80%:Ct20% and equal proportions (Va50%:Az50%). However, there was no significant difference (P>0.05) between the mortality rates of adult *C. maculatus* when compared to the various powder mixtures. This may be an indication of the low percentage concentration (Ca20%: Ct80%; Ca80%:Ct20%; Ca50%:Ct50%) of leaf powders and also the volume of the containers used during the treatments. This supports the findings of Musa *et al*. (2009) who reported that adult mortality of *C. maculatus* was found to increase with increase in concentration levels of bio-insecticide leaf powders.

The weevil perforation index (WPI) is the measures of the protection ability of the treatment materials, *Cassia alata* and *Cassia tora* gave the best WPI at the highest rates of application. The weevil perforation index (WPI), increased as the concentration of the plant increase with *Cassia alata* having the highest weevil perforation index, as compared to *Cassia tora*. The combination of the two plants *Cassia alata* and *Cassia tora* gave a good weevil perforation index for both White and Brown varieties. The best weevil perforation index (WPI), was seen in the white variety which agree with Frank and Adeyinka (2013) who reported similar performance in their assessment of the curative potency of some plant materials on cowpea seeds with established infestation of *Callosobruchus maculatus*.
The effects of leaf powders of *Cassia tora* and *Cassia alata* in the control of adult *Callosobruchus maculatus* was observed in this study. Since the plant species are cheap and readily available, it is recommended that the leaf powders of these two plants be used in the control of adult *C. maculatus*.

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