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Investigation into African Mahogany (*Khaya Grandifoliola*) C.D.C. Gum Extracts for the Control of Cowpea Weevil (*Callosobruchus Maculatus*) on Stored Cowpea

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Abstract: *The investigation of the African mahogany (Khayagrandifoliola) c.d.c gum extract was evaluated for the control of beans weevil (Callosobruchusmaculatus) on stored cowpea. 5ml of 20,000; 40,000; 60,000 and 80,000ppm of aqueous were used per 100g of cowpea. The increase in concentration caused increase in mortality which suppressed oviposition and emergence of F1 progeny, it does not inhibit germination and seed coat is not affected. The result is indicative of the potential of Khayagrandifoliola for the control of Callosobruchus maculates on stored cowpea.*

Keywords: *African mahogany, Khayagrandifoliola, Gum, Beans weevil, Callosobruchus maculates, stored cowpea.*

1. INTRODUCTION

In Nigeria, protein which is an important food component in the building and replacement of the body cell is inadequate because animal sources like meat, fish e.t.c. are unaffordable by low income earners. However, food crops like cowpea and soya beans have been found to have high level of protein and less expensive (Steele and Mehra, 1980). Apart from the dry seed, which are made into various products, the young leaves, pods and mature seeds are eaten haulms are fed with livestock in India and Africa (Steele and Mehra, 1980).

As important as cowpea (*Vignaunguiculata*), it has been reported to be prone to heavy damage by *Callosobruchusmaculatus* (F), since it occurs everywhere cowpea is grown (Caswell, 1973). Although, the degree of damage in field is usually as low as 2%, it provides a dangerous nucleus for store infestation during a storage period that may be as long as 9 months in many part of Nigeria (Booker, 1967). The severe damage caused by *Callosobruchusmaculatus* lowers the quality and quantity of the cowpea available for consumption.

In Nigeria and other developing countries of the world, there is a deadline in the use of chemical insecticides not only due to the withdrawal of subsidies on themby the government (Lale, 1995; Lale and Yusuf, 2001), but also due to the resistance of insect to them. Therefore, the need for efficient and less expensive strategies such as the use of natural products to control storage pests becomes pertinent.

African mahogany, *Khayagrandifoliola* is endemic to Africa and it is very common in Nigeria. It is similar to true mahogany, *Khayasenegalensis* in its oleoresin composition, durability and resistance to insects (Kochhar, 1986). The bitter bark is scaly, dark grey, yield gum when wounded and often cut for medicinal use (Keay, 1989).

Although, there is paucity of information on the insecticidal properties of the gum extracts of *Khayagrandifoliola.* However, Yusuf *et al*, (1998) observed that admixture of *Khayasenegalensis* wood ash caused a significantly high mortality in adult *Sitophiluszeamais* within 21 days and a reduction in F1 adult emergence.This study is therefore aimed at investigating the insecticidal properties of gum extracts of *Khayagrandifoliola*.

2. MATERIALS AND METHODS

2.1. Collection and Preparation of the Plant Material

The gum of *Khayagrandifoliola* was collected from Government Reservation Area (GRA), Ilorin, Kwara State. They were immediately transported to the laboratory where the gum exudates were kept into a rubber container with a well-sealed screw cap. They were then stored in deep freezer to prevent drying. Different grains of the gums at 20,40, 60 and 80 were dissolved in 1000ml (1litere) of water for a week to form the extract. The mixture was stirred vigorously and filtered through double folds of muslin cloth to obtain the filtrate containing the extracts.

2.2. Insect Culture

Freshly emerged adult *Callosobruchusmaculatus* were obtained from Nigerian Stored Products Research Institute (NSPRI), Ilorin, Kwara State. They were cultured on insecticide free, whole grains of beans at ambient temperature of 26^{o}C and 27^{o} C and relative humidity ranging from 55% to 75%.

2.3. Cowpea Grains and Measurement

Fresh cowpea grains were harvested from Nigeria Stored Products Research Institute (NSPRI), Ilorin farm. The grains were initially kept in deep freezer for one week to rid them for any incipient infestation. The cowpea grains were then measured into 60 translucent plastic cups at 100g each by electric weighing balance.

2.4. Treatment and Mortality Test

5ml each of four (4) different concentration of 20,000ppm, 40,000ppm, 60,000ppm and 80,000ppm from aqueous *Khayagrandifoliola* gums extract were measured into each translucent plastic cups already containing 100g of cowpea and mixed thoroughly. The treatments were left for two hours to allow drying. There were 12 replicate for each experiment and control respectively. Four males and six females of active adults of *Callosobruchus maculatus* were introduced into each translucent plastic cups and covered with muslin cloth to allow aeration and prevent the escape of insects. The rate of mortality was assessed by counting after 24hrs, 48hrs and 7th days of post treatment.

2.5. Oviposition and Adult Emergence

After 30 days of post treatment oviposition rate was recorded by counting the total number of eggs laid at a random sample of 100 seeds. The adult emergence investigation was carried out after four weeks for F1 generation through counting.

2.6. Viability Test

20 seeds were selected at random for viability test. The seeds placed inside the petri-dish lined with cotton wool, soaked with water and exposed to light. The germination records were evaluated after five days. The percentage grain germination was calculated using the formular below:

$$\text{Mean \% grains germinated} = \frac{\text{Mean No of grains germinated}}{\text{Mean No grains tested}} \times 100$$

2.7. Grain Damage

The number of seeds damaged per 100 grains was determined by counting the number of seeds with emergent holes and the percentage seed damaged calculated using this formula:

$$\text{\% grains germinated} = \frac{\text{No of seeds damaged}}{\text{Total No of seeds}} \times 100$$

This was determined after the emergence of F1 generation (Odeyemi and Daramola, 2000). The data collected were subjected to the Analysis of Variance (ANOVA) and significant treated means were separated at the $P<0.05$ by least significance different.

3. RESULT

3.1. Toxicity Bioassay

The extract of *K. grandifoliola* at 5ml per 100g of cowpea affected the mortality of *C. maculatus* in treatment of 40,000, 60,000, and 80,000ppm applications. These concentration have significance different at P<0.05. Increase in concentration increases mortality.

Table1. *Mean mortality of Callosobruchusmaculatus on cowpea grains stored with Khayagrandifoliolaextracts for seven days.*

Treatment/Concentration (5ml)	No of Insects	Mean Number of Insects Mortality		
		24hrs	48hrs	7th day
Control	10	0.05±0.44a	1.83±1.44a	8.69±6.81b
20,000ppm	10	1.92±1.50a	6.33±3.69b	9.32±4.81a
40,000ppm	10	3.52±2.50c	6.50±2.44a	9.44±4.31a
60,000ppm	10	4.92±3.75d	6.67±1.63a	9.81±3.88a
80,000ppm	10	5.67±4.25d	6.92±1.44a	9.93±3.81a
S.E. ±		0.94	0.61	0.03

P<0.05

Mean followed by the same letters in the same column are not significant different at P<0.05

3.2. Effects of Oviposition and Progeny Emergence

The main number of eggs laid ranging between 79.86 and 115.50 compared with control 151.17 while the number of viable eggs between 24.17 and 38.67, 53.38 in control. The F1 progeny reduce in all applications ranging between 0.08 and 0.01 with 32.75 in control (Table 2). The oviposition was reduced at P<0.05 with all levels of application. The extract suppressed oviposition and reduced progeny emergence at all levels.

Table2. *Effects on oviposition, viable eggs and progeny emergence at four weeks*

Treatment/ Concentration (5ml)	**Mean No eggs laid/ 100g of seeds**	**Mean No of viable eggs**	**Mean No of F1 progeny**
Control	151.17±153.06d	52.75±53.38c	32.75±33.44b
20,000ppm	115.50±121.31c	38.67±41.25b	1.00±6.06a
40,000ppm	99.42±93.94a	29.25±33.88a	0.05±7.94a
60,000ppm	81.58±106.81b	25.92±32.25	0.18±8.00a
80,000ppm	79.86±100.19b	24.17±38.31ab	0.08±8.06a
S.E. ±	11.61	4.92	6.55

Means followed by the same letters in the same column are not significant different at P<0.05.

3.3. Cowpea Protection and Viability

The percentage protection ranging between 99.54 and 99.72 with 57.75 in control. The percentage protection is higher in all application except the control. The percentage grain damage ranging between 0.28 and 0.46 with 42.25 in control. The *K. grandifoliola* extract protect the grains.

Table3. *Percentage cowpea damage*

Treatment/Concentration (5ml)	**Mean No of selected grains**	**Mean No of emergence holes in grains**	**% grains Damaged**	**% grains protection**
Control	100	42.25±37.38b	42.25	57.75
20,000ppm	100	0.46±11.14a	0.46	99.54
40,000ppm	100	0.35±10.50a	0.35	99.65
60,000ppm	100	0.30±9.88a	0.30	99.70
80,000ppm	100	0.28±9.81	0.28	99.72
S.E. ±		7.11		

Means followed by the same letters in the same column are not significant different at P<0.05.

3.4. Effects on Viability of the Cowpea Seed

The mean number of germinated grains ranged between 52.92 and 61.66 in all applications and 5.00 in control. This shows that all levels of application, the cowpea seeds are protected and viable. There is significant difference at P<0.05 in all applications compared to control

Table4. *Effects of extract on cowpea seed viability*

Treatment/Concentration (5ml)	No of grains tested	Mean No of germinated grains
Control	100	5.00±1.06a
20,000ppm	100	52.92±8.06b
40,000ppm	100	54.58±8.63b
60,000ppm	100	57.08±8.81b
80,000ppm	100	61.66±9.50b
S.E. ±		2.07

Means followed by the same letters in the same column are not significant different at P<0.05.

4. DISCUSSION

After 7th day of post-treatment, it was observed that the extract result in mortality of *C. maculatus* as the concentration of *K. grandifoliola* increase due to contact action of the extract on the bean weevils. According to Yusuf *et al.*, (1998) who observed 8g/100g of maize with *K. senegalensis* of wood ash against *Sitophiluszeamais* and had a significance increase in P<0.001 mortality in adult *S. zeamais* within 21 days of post treatment. The ability of the plant extract to cause mortality of *C. maculatus* increased with increase in exposure period and also with the concentration of the extracts. The action of *K. grandifoliola* on *C. maculatus* could be attributed to stomach poisoning, while feeding on whole grain and causing death.

The mean number of eggs laid ranging between 79.86 and 115.50 with the concentration while the control is 151.17. This reduced the mean number of eggs laid and their viability. This could be as a result of mortality rate of *C. maculatus* and thus, disrupting mating and sexual communication as well as deterring females from laying viable eggs which affects partial or complete failure of embryonic development respectively (Agina and Sani, 1995). Therefore, the mean number of viable eggs in different concentration is 36.67, 29.25, 25.92 and 24.17 respectively while the control is 52.75.

The F1 progeny ranging between 0.08 and 1.00 per 100g of seeds and control is 32.75 per 100g of seeds. This indicates that the protected cowpeas are more viable than untreated grains due to the mean number of F1 progeny. The percentage grains protection ranges between 99.54 and 99.72 while the control is 57.75. The mean number of germinating grains range between 52.92 and 61.66 while the control is 5.00. Therefore, the viability test showed that *K. grandifoliola* had no deleterious effects on the germination of the treated seeds.

In Nigeria where this study was conducted, these Mahogany tree products can easily be obtained without any specialized technology. Also, they are easily available with safety and low cost in processing as against the synthetic insecticides. The seed coat of the grains was not affected by the gum extracts and there was no mouldiness on the treated seeds.

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