

**Effect of Some Plant Materials on Progeny Development in *Callosobruchus maculatus* F. in Established Infestation on Cowpea Grain at Samaru, Nigeria.**

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**ABSTRACT**

In tests of efficacy of various plant materials for control of the bruchid, *Callosobruchus maculatus* Fabricius, on cowpea at Samaru, it was found that groundnut and palm oils but not chilli pepper powder or ash of pawpaw stem adequately protected previously uninfested cowpea from attack by the bruchid. The oils applied at 10 ml/kg seed controlled fresh bruchid infestations of up to three days old but five days or more. Adult progeny emergence was suppressed by 99.1 and 97.8% with groundnut oil and 99.6 and 98.6% with palm oil when applied at five and seven days after introducing the insects on grain, respectively. Cowpea seed germination was impaired over the control by 51.3 - 59.7% and 12.1 - 13.6% with groundnut and palm oils, respectively.

**INTRODUCTION**

Unprotected cowpea (*Vigna unguiculata* L. (Walp) grain stored over a six-month period may become so riddled with emergence holes made by *Callosobruchus maculatus* Fabricius (Coleoptera: Bruchidae) as to be unusable as human food. Most cowpea in Nigeria is produced by peasant farmers who rarely use synthetic storage chemicals to protect the grain (Caswell, 1977) because of cost constraint and sometimes non-availa-

bility of the chemicals. These synthetics are also often associated with hazards from toxic residues and insect resistance following widespread use over many years (Nalanda and Wink, 1981; Uvah et al., 1990).

Peasant farmers the world over often claim successful use of materials of plant origin in insect pest control including ash (Pruthi and Singh, 1950); Bernard, 1950; Khare and Agrawal, 1972; Ajayi et al. (1987), ground pepper (Su, 1977; Neza, 1983), vegetable oils (Bernard, 1950;

Schoonhoven, 1978; Pereira, 1983) and plant parts (Don-Pedro, 1985; Ajayi *et al.*, 1987). Ivbijaro and Agbaje (1986) found that the peppers, *Piper guineense* Schum and Thorn and to a lesser extent *Capsicum frutescens* L and *C. annuum* (Miller), significantly reduced numbers of *C. maculatus* on cowpea in southwestern Nigeria. However, work in northern Nigeri by Ajayi *et al.* (1987) indicated that palm oil but not ash from leaves and twigs of *Tamarindus indicus* L. nor ground chilli pepper, effectively controlled *C. maculatus* on cowpea. All these studies determined efficacy of the plant materials for suppression of infestations imposed after the clean grain had been treated with the test materials. Often, however, *C. maculatus* infestations commence in the field and hence freshly harvested cowpea grain may already be infested by the weevil. The present study sought to determine the efficacy of some plant materials for control of *C. maculatus* infestations at various levels of establishment on cowpea grain.

## MATERIALS AND METHODS

### *General Methods*

#### *C. maculatus* Culture

*C. maculatus* adults obtained from naturally infested cowpea were identified at the insect museum of the Department of Crop Protection, Institute for Agricultural Research, Samaru. These were then introduced onto uninfested cowpea in two insect-proof 0.51 Kilner jars at room tem-

perature ( $27 \pm 2^{\circ}\text{C}$ ). Each jar was capped with a piece of muslin, 10 mesh/cm, which allowed ventilation but precluded entry or exit of insects. Adults emerging over a 38h period were used in each experiment.

#### *Source and Application of Plant Materials*

Traditionally processed palm (*Elaeis guineensis* L.) and groundnut *Arachis hypogea* L.) oils and ground bird's eye chillies (*Capsicum frutescens* L.) were obtained from the Samaru market. Ash was obtained by burning dry pawpaw (*Carica papaya* L.) stem. Ash, especially that from pawpaw, is traditionally used in eastern Benue State of Nigeria to dust stored grain and vegetable seedlings against insect pests.

One hundred grams of prefumigated clean cowpea seed were weighed into each jar for the experiment. Aluminium phosphide was used in the fumigation. Test materials were thoroughly mixed with cowpea seed by shaking the mixture gently for five minutes. Treated seed was left to settle overnight to allow better coverage of grain surface by the oils before introduction of *C. maculatus* adults.

#### *Design and Sampling*

The randomised complete block design was used. Blocks were arranged parallel to the only side of the room bearing windows to ensure uniform lighting for treatments in each block. *C. maculatus* adults were separated from grain using a 2.5 mesh/cm sieve.

Numbers of dead weevils were recorded whilst test materials and living weevils were returned to the jars. When sampling for adult emergence, however, all weevils found were discarded.

#### Data Analysis

Data from replicated trials were analysed by the two-way anova and differences between treatment means were determined by the least significant difference test at 5% level of probability.

#### EXPERIMENT 1 - Effect of Plant Materials Applied to Cowpea Grain before Infestation on Progeny Development by *C. maculatus*

It was aimed to test the effect of application of the plant materials to clean cowpea before infestation with *C. maculatus* on adult progeny emergence so as to ascertain activity of the specific lot of plant materials procured by the authors. The seven treatments were: pawpaw ash and chilli pepper each at 50g seed, groundnut oil and palm oil each at 10 and 15 ml/kg seed and the untreated control. These treatments were replicated three times. Plant materials were applied to the 100g seed lots at 24h before introducing the insects. Seven pairs of male and female *C. maculatus* adults were introduced onto the cowpea in each jar. Fourteen days after artificial infestation, all parent weevils were recovered from the jars and discarded. Numbers of dead and live *C. maculatus* were recorded weekly from four to seven weeks after introducing the parent

bruchids. It is relevant that *C. maculatus* adults live for a mean of eight days and development from egg to adult takes four to five weeks at room temperature (Hil 1975).

Cowpea seed for the four most effective treatments i.e., groundnut and palm oils at 10 and 15 ml/kg seed as well as the untreated control were tested for germination and seedling vigour. Five weeks after application of the treatments to uninfested grain, a total of 50 seeds from the three replicates of each treatment were sown at 2 cm depth in separate clay pots (29cm lip diameter, 15cm diameter base and 27cm deep which had been three-quarters filled with heat-sterilised soil. Seed from the poorly performed ash and chilli pepper treatments were not potted. Pots were lightly watered daily. Numbers of emerged seedlings and height of ten seedlings per pot were recorded at three weeks after sowing.

#### EXPERIMENT 2 - Effect of Palm and Groundnut Oils Applied at Different Days after Infesting Cowpea Grain on *C. maculatus* Adult Emergence

The objective was to determine the efficacy of palm or groundnut oil for control of the cowpea weevil after three to seven days of infestation. Seven pairs of male and female *C. maculatus* were introduced into each jar containing 100g of pre-fumigated grain. The seven treatments, replicated three times, were: palm and groundnut oils each applied separately at 10 ml/kg seed at

3, 5 and 7 days after introduction of weevils (DAIW) and the untreated control. Numbers of dead and live weevils were recorded once at seven weeks after introduction of the parent insects.

### **Experiment 3 - Effect of Palm and Groundnut Oils Applied to cowpea Grain an Established Infestation on Progeny Emergence of *C. maculatus***

It was aimed to test the efficacy of the plant materials for control of an established infestation through monitoring progeny emergence. Each jar was supplied with 50g of heavily infested grain (from which adults had been removed) which was thoroughly mixed with 50g of prefumigated cowpea grain. Infested grain, being from the same stock, was assumed to have a uniform infestation. The clean beans were to ensure continued supply of food for immature derived from emerged weevils during the experiment. The following three treatments were replicated three times: groundnut oil at 10ml/kg seed, palm oil at 10 ml/kg seed and the untreated control. Treatments were applied 48h after seeds had been mixed. Numbers of dead and live weevils were recorded weekly from one to 10 weeks after introducing the weevily grains.

### **RESULTS**

Table 1 shows that similar numbers of adult *C. maculatus* emerged from cowpea treated with pawpaw ash, pepper powder and nothing ( $P>0.05$ ). There was no weevil emergence from the groundnut oil and 15 ml/kg seed palm oil treatments. Palm oil at 10 ml/kg seed had 99.4% fewer emerged wee-

vils ( $P<0.05$ ) than the untreated control. Table 1 also indicates that untreated cowpea seed resulted in 78% seedling emergence. Cowpea from the palm oil treatment and the untreated control had similar germination. Cowpea treated with groundnut oil, however, had about 50% lower germination ( $P<0.05$ ) than the untreated control. These results were reflected in the height of seedlings which closely followed a similar trend.

Results of Experiment 2 (Table 2) show no adult emergence from cowpea grain treated with either palm or groundnut oils at three days after introduction of the weevils (DAIW). Although some adults emerged from cowpea treated with the oils at five and seven DAIW, the difference from zero emergence was not significant ( $P>0.05$ ). All oil treatments, however, led to lower emergence of adult *C. maculatus* ( $P>0.05$ ) than the untreated control.

In Experiment 3, a trend towards similar numbers of emerged adults was evident for up to four weeks after application of the treatments (Table 3). Later, however, numbers fell off sharply in the oil treatments but generally increased in the untreated control. Total numbers of weevils emerging from the untreated cowpea were higher ( $P<0.05$ ) than those emerging from cowpea treated with the oils. Although numbers of surviving adults in the control were three-fold those in the oil treatments, percentage survival of emerged adults over the sampling period was similar in all the treatments.

Table 1. Experiment 1, 1988. Effect of some plant materials on *C. maculatus* adult emergence, germination of cowpea seed and height of seedlings.

Treatments	Total Emergence/ 100g seed	No. of seedlings/ 50 seeds sown	Height of seedlings, cm
Groundnut oil at 10ml/kg seed	0a	15.7a	15.06a
Groundnut oil at 15ml/kg seed	0a	19.0a	14.79a
Palm oil at 10ml/kg seed	4a	33.7b	18.37b
Palm oil at 15ml/kg seed	0a	34.3b	19.08b
Ash at 50g/kg seed	540b	-	-
Pepper at 50g/kg seed	660b	-	-
Untreated Control	642b	39.0b	19.30
LSD	190.3*	6.31**	1.691**

\*F value is significant at P=0.05

\*\*F value is significant at P=0.01

Table 2. Experiment 2, 1988. Effect of time of application of palm and groundnut oils following infestation on adult emergence from cowpea grain, 1988.

Treatments, Oil at 10 ml/kg seed	Emerged adult <i>C. maculatus</i>
Palm oil at 3 days	0.0a
Palm oil at 5 days	5.3a
Palm oil at 7 days	12.3a
Groundnut oil at 3 days	0.0a
Groundnut oil at 5 days	2.0a
Groundnut oil at 7 days	8.0a
Untreated control	567.92b
LSD	55.92***

\*\*\* = F value is significant at P=0.001

**Table 3. Experiment 3, 1988. Effect of palm and groundnut oils on *C. maculatus* adult emergence from previously infested cowpea grain, 1988.**

Treatments	No. of emerged adults/100g seed										Total		
	Weeks after treatment										Live & Dead	Live	% Survival
	1	2	3	4	5	6	7	8	9 & 10				
Oil at 10 ml/kg seed													
Groundnut oil	83	120	88	55	39	16	7	3	5		416a	157a	38
Palm oil	55	121	66	51	29	12	5	1	3		343a	138a	40
Control	43	135	98	78	103	302	174	93	185		1211b	404b	33
LSD	-	-	-	-	-	-	-	-	-	-	246.2*	110.8*	11.9NS

\* = F value is significant at P=0.05

NS = F value is not significant at P=0.05

## DISCUSSION

The experiments have shown that traditionally prepared palm and groundnut oils at 10-15 ml/kg seed but not chilli pepper powder and pawpaw ash adequately protected previously uninfested cowpea from *C. maculatus* attack. This result is consistent with previous work by Schoonhoven (1978), IITA (1975) and Pereira (1983) using industrially refined palm and groundnut oils and Ajayi et al. (1987) using chilli pepper, but contradicts work by Ivbijaro and Agbaje (1986) who obtained considerable reductions in *C. maculatus* infestations with chilli pepper. Efficacy of vegetable oil against *C. maculatus* on cowpea has been attributed

to ovicidal effects of the oils (Singh et al., 1978), reduced oviposition (Schoonhoven, 1978) and reduced adult longevity. Although groundnut oil considerably lowered cowpea seed germination, palm oil did not. It would appear that the thinner groundnut oil could spread more readily over the entire surface of the seed and could therefore more severely impede their breathing process. Thus whereas both oils may be used to protect uninfested cowpea from attack by *C. maculatus*, only palm oil may be used to protect cowpea stored for seed.

It is clear in the present study that the palm and groundnut oils failed to control an established infestation. At first, emergence from all treatments was similar indicating that the larvae developing within the grains

before application of oils may have been unaffected by the oils. However, adult emergence from the oil-treated cowpea declined considerably starting from five weeks after application of treatments. This was possibly because of adverse effects of the oils leading to early mortality of the emerged adults and ovicidal effects on their eggs. It is also evident from the experiments that both palm and groundnut oils were able to give complete control of a fresh infestation of three days old but not five days or more. Cowpea grain treated with the oils at 5 and 7 days after introduction of the weevils, however, had considerably lower progeny emergence (99.1 and 98.8% for groundnut oil and 99.6 and 98.6% for palm oil, respectively) than the untreated grain. It would appear that larvae from eggs laid early were able to escape the adverse effects of the oils once they tunnelled into the cowpea seed but eggs laid later would have been affected by the oils. It is therefore clear that palm and groundnut oils may be used to protect cowpea grain from a fresh but not a properly established infestation of *C. maculatus*. These results indicate a need to institute preventive or preemptive measures against the weevil soon after harvest.

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