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PROTECTANT EFFECT OF PLANT OILS AGAINST COWPEA WEEVIL (*Callosobruchus maculatus*) ON STORED COWPEA (*Vigna Unguiculata*)

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ABSTRACT

Groundnut oil and palm oil were evaluated in the laboratory against *Callosobruchus maculatus* by admixing 5ml, 10ml and 20ml with 50g of grains to assess progeny development, damage caused, insect mortality and effect on grain germination. The experiment was laid out in a complete randomized design and data generated were subjected to analysis of variance while means were separated using least significant difference. Results obtained showed groundnut oil significantly ($P<0.05$) reducing damage caused and inhibiting progeny emergence at 20ml treatment level while adult mortality was significant at 10ml treatment level. A significant effect was observed from palm oil on progeny development while insect mortality was only affected after seventy two hours after treatment. The oils did not affect the germinating ability of the seeds and the potential of plant oils as stored cowpea protectant against *C. maculatus* infestation is discussed.

Keywords: plant oils, stored cowpea, *Callosobruchus maculatus*, progeny development, mortality.

INTRODUCTION

Storage of agricultural products is carried out for several reasons and there are many factors militating against safe storage which may include arthropod pests like insects. As in field crops, a wide range of insect pests attacks stored products, the commonest being beetles and moths (Udo, 2011). Storage pest has become an increasing threat to food security in Africa and losses of over 30% or more have been recorded (Lale and Ofuya, 2001). *Callosobruchus maculatus* is known to cause up to 100% loss of stored cowpea and estimates have shown that over 30 million U.S. dollar is lost as a result of cowpea damage in Nigeria (Jackai and Daoust, 1986; Udo and Epidi, 2009). *C. maculatus* infestation of cowpea could start from the field where adult insects lay eggs on maturing cowpea pods or may penetrate the pods and lay eggs on the seed grains in storage. Approaches aimed at controlling attack by insect pests have relied heavily on the use of synthetic insecticides. Although various synthetic insecticides have been developed over the years for the control of *C. maculatus*, the cost of purchase, residual effect, health hazard to grain handlers and the widespread development of resistance in insect pests are still issues of great concern (Udo, 2011; Abulude *et al*., 2007). It is in the light of the above problems that the need to develop alternative control strategies that will be affordable and eco-friendly becomes expedient. The use of plant oils in stored product protection has been researched upon (Obeng-Ofori, 1995; Mohiuddin *et al*., 1987; Lale, 1991; Kumar and Okoronkwo, 1991) but more study needs to be done in this direction. The present work therefore was designed to investigate the protectant properties of two plant oils; groundnut oil and palm oil against the cowpea seed bruchid, *Callosobruchus maculatus* on cowpea in storage.

MATERIALS AND METHODS

Culturing of insects

Adult *Callosobruchus maculatus* were obtained from an infested stock of cowpea grains from Uyo main market, Nigeria. They were introduced into 2kg of cowpea grains and kept for seven days in the laboratory to allow for oviposition. The parent insects were sieved out after seven days using an impact test sieve and the culture bottle was covered with white muslin cloth held in place with rubber bands. After twenty eight days of adult removal, the progeny that emerged were used for re-culturing. Subsequently, insects that emerged were used for the different experiments.

Grains and plant oils

A total of seven kilograms of cowpea grains were purchased from the Uyo main market, Nigeria. The grains were sterilized by freezing in a refrigerator for fourteen days to eliminate possible hidden infestation and developing stages of insect (Obeng-Ofori, 1995; Udo, 2008). Four litres each of groundnut oil and palm oil respectively, were purchased from Etaha Itam market within Uyo metropolis, Nigeria. They oils were stored under laboratory conditions and then used for the experiment.

Progeny development

Fifty adult *C. maculatus* obtained from the stock culture were introduced into 1kg of cowpea grains in a glass jar covered with white muslin cloth and held in place with rubber bands. The glass jar was kept in the laboratory under ambient conditions for seven days to allow for oviposition after which the parent insects were removed by sieving and discarded by freezing. One, seven and fourteen days after removal of adult insects, palm oil and groundnut oil, respectively was applied at the rate of 5, 10

and 20 ml to 50 g of grains in plastic cups while the mouth was covered with white muslin cloth and held in place with rubber bands. The control treatment had no plant oil added and the experiment was replicated four times while observation was made after every seven days for up to twenty eight days.

Damage assessment

One hundred grams of cowpea grains was measured into plastic cups and 5ml as well as 10ml of groundnut oil and palm oil respectively, were admixed thoroughly. Four hours later, twenty adult *C. maculatus* were introduced into the cups and covered with white muslin cloth held in place with rubber bands. Each treatment was replicated four times and left to stand undisturbed for four weeks while the control treatment had no plant oils added. Samples of 100 grains were taken from each cup and the number of damaged grains (grains with characteristic holes) and undamaged grains were counted and weighed. Percent weight loss was calculated after the method of FAO (1985).

Adult mortality

The effect of groundnut oil and palm oil on adult insects was evaluated by applying 5ml and 10ml of each oil to 40g of grains in plastic cups and covered with white muslin cloth held in place with rubber bands. Four hours after applying the plant oils, twenty adult *C. maculatus* from the stock culture were introduced into each treatment. The control experiment had no plant oil added and the experiment was replicated four times. Mortality was scored after twenty four hours and up to ninety six hours after treatment and insects was assumed dead on failure to respond to three probes from a blunt dissecting probe.

Effect on germination

Twenty five grams of cowpea grains were treated with 5ml and 10ml of groundnut oil and palm oil respectively, and allowed to stand for four weeks in the laboratory. Thereafter, 10 healthy grains were selected from each treatment and soaked in one litre of distilled water for six hours (Udo, 2008). The grains were removed and placed on moist cotton wool in a Petri dish in the laboratory. Germination was observed from the first day and up to the tenth day. Each treatment was replicated four times and the control experiment had no plant oil added.

RESULTS

Progeny emergence

The result showing the mean emergence of *C. maculatus* from treated and untreated cowpea grains is shown in Table-1. Groundnut oil applied at 20 ml per 50 kg of grains completely inhibited progeny development at one day and 14 days after adult removal from grains. Palm oil applied at the same concentration significantly brought down the number of progeny compared with the control treatment.

Table-1(a). Progeny emergence of *C. maculatus* from grains treated with palm oil after different periods of oviposition.

Treatment (ml)	Days after oviposition		
	1	7	21
0	31.00	46.00	107.00
5	3.25	2.50	21.00
10	1.50	1.75	9.00
20	1.00	1.50	8.25
LSD	1.77	3.29	6.40

Results are means of four replicates of twenty insects each.

Table-1(b). Progeny emergence of *C. maculatus* from grains treated with groundnut oil after different periods of oviposition.

Treatment (ml)	Days after oviposition		
	1	7	21
0	48.00	115.00	107.00
5	0.00	0.75	1.50
10	0.00	0.00	0.25
20	0.00	0.00	0.00
LSD	0.00	0.74	1.87

Results are means of four replicates of twenty insects each.

Damage assessment

Cowpea grains treated with both plant oils at the two levels of concentration showed significant difference ($P<0.05$) in the reduction of damage caused by *C. maculatus* compared with the control (Table-2). Complete protection was achieved at the 10 ml treatment level with groundnut oil.

Table-2. Effect of groundnut oil and palm oil on damage caused by *C. maculates.*

Treatment (ml)	Mean percent weight loss	
	Groundnut oil	Palm oil
0	6.16 ± 5.49	6.23 ± 2.03
5	0.79 ± 0.61	1.17 ± 0.60
10	0.00 ± 0.00	1.09 ± 1.44
LSD	0.56	1.97

Adult mortality

Results of mortality caused by the two plant oils are presented in Table-3. Mortality was observed in cowpea grains treated with groundnut oil after 24 hours of application. Palm oil was able to induce mortality in

insects after 72 hours of treatment compared with the control.

Table-3(a). Percent mortality of *C. maculatus* from grains treated with palm oil.

Treatment (ml)	Hours after treatment			
	24	**48**	**72**	**96**
0	0.00	0.00	0.00	0.00
5	0.00	5.00	13.00	17.00
10	2.00	10.00	17.00	20.00
LSD	ns	ns	0.48	0.59

Results are means of four replicates of twenty insects each.

Table-3(b). Percent mortality of *C. maculatus* from grains treated with groundnut oil.

Treatment (ml)	Hours after treatment			
	24	**48**	**72**	**96**
0	0.00	0.00	0.00	0.00
5	12.00	17.00	24.00	32.00
10	15.00	26.00	40.00	51.00
LSD	1.46	0.48	0.48	1.57

Results are means of four replicates of twenty insects each.

Seed germination

Cowpea grains treated with groundnut oil and palm oil showed no significant difference in percent germination (Table-4) compared with the control. Even at the 10 ml treatment level, the grains percentage germination compared well with the control.

Table-4. Effect of groundnut oil and palm oil on cowpea seed germination.

Treatment (ml)	**Percent germination**	
	Groundnut oil	**Palm oil**
0	83	78
5	85	75
10	87	80
LSD	ns	ns

ns = non significant

DISCUSSIONS

The plant oils investigated showed sufficient protection of cowpea grains from damage by *C. maculatus* and groundnut oil inhibited progeny development when applied at 20ml per 50kg of grains. However, most of the insects that emerged were found dead from the treatments. This demonstrates the ability of the oils to act as suffocating materials with the possibility of preventing respiration (Obeng-Ofori, 1995). However, the observed progeny emergence from the treatment after 21 days of adult removal could have occurred due to hidden infestation or the insect's developmental period was not affected by the oils. The complete protection of grains from damage by the weevil achieved with groundnut oil suggests the presence oviposition deterrence and repellent principle in the oil. The effect of plant oils on insect development could have been caused by physical properties of coating and blocking of respiration rather than by specific chemical effect (Abulude *et al*., 2007). The non emergence of insects from treatments with groundnut oil could be as a result of the effect of arachidonic acid present in groundnut and could have been responsible for the mortality of insect eggs thus preventing further development (Lale, 2002). Plant oils are generally reported to exert ovicidal action against insect pests of storage products (Don-Pedro, 1989). Application of coconut oil has been found effective against *C. maculatus* and *C. chinensis* for a storage period of up to six months when applied to green gram at 1% and also when applied to rice to protect it against *R. dominica* and *S. cerealella* (Doharey *et al*., 1990). The plant oils were also observed not to affect seed germination which confirms non-adverse effect on grain chemistry.

From the study, plant oils are readily available and poor resource farmers could use plant oils to protect cowpea grains meant for short duration storage and mostly for consumption. This will reduce the use of synthetic insecticides thus curtailing the risks attendant upon their usage.

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