

Control of *Callosobruchus maculatus* (Fab.) on Stored Cowpea with African Curry (*Ocimum gratissimum* L) and African Bush Tea (*Hyptis suaveolens* Poit) Leaf Powders

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ABSTRACT

Leaf powders of African curry, *Ocimum gratissimum* L and African bush tea, *Hyptis suaveolens* Poit, were evaluated for their efficacy against the cowpea bruchid *Callosobruchus maculatus* (F) on stored cowpea. *O. gratissimum* at 2.5g, 5.0g and 10.0g per 100g cowpea grains effected 46.7%, 46.7% and 65.0% adult bruchid mortality respectively within 24 hours; 73.3%, 75.0% and 80.0% adult bruchid mortality respectively within 48 hours post treatment. Similar application of *Hyptis suaveolens* powder had 1.7%, 3.3% and 8.3% adult beetle mortality respectively in 24 hours, 15.0%, 26.7% and 38.3% mortality respectively in 48 hours. *O. gratissimum* significantly ($P < 0.01$) reduced oviposition and progeny development in all treatment levels and therefore protected cowpea grains better than *H. suaveolens*. The seed coat colour, texture, taste and grain viability were not affected by the treatments after three months of storage with these plant powders.

INTRODUCTION

African curry plant, *Ocimum gratissimum* L. and African bush tea, *Hyptis suaveolens* Poit, are common herbaceous plants found in West Africa. The plants are between 0.2 and 1.0 metres tall and have remarkable odour, which has a repelling effect on insects. Their seeds are tiny and dark brown in colour. In Nigeria, their leaves are dried, and smoked to repel mosquitoes, houseflies and cockroaches in homes. In the Eastern states of Nigeria, African curry leaves are also used as a source of stimulant, condiment in soup and medicinally for the treatment of stomach ache, and sores (Amadi, 1993 Personal communication]. Some farmers in the savanna region of the country dry and grind the leaves and

then sprinkle or mix the powder with cereals before bagging and storing. Others lay fresh leaves in alternate layers with dried cowpea pods or maize cobs. High cost of insecticides at present in most African countries has stimulated interest in alternative approaches to crop protection using plant derived products which are cheap, effective and non-toxic to man and livestock. Some of these botanicals include neem seed, lemon grass stem and leaf, Eucalyptus leaf, orange peels, garlic bulbs, African nut meg seed (Schmutterer, 1980; Dike and Mbah, 1992; Dike and Mshelia, 1996, Ajayi *et al.*, 1987; Pereira, 1982, Mardia *et al.*, 1992; Oparaeke and Dike, 1996; Oparaeke *et.al.*, 1997, Jackai *et al.*; 1992; Watt and Bryer 1962). *O. gratissimum* and *H. suaveolens* are hardly attacked by insect pests throughout their growing season. Little or no information is available in literature on the use of the two plant products as bioagents for the control of stored cowpea pests. This manuscript presents a laboratory evaluation of the insecticidal efficacy of *O. gratissimum* and *H. suaveolens* products for *C. maculatus* control on stored cowpea.

MATERIALS AND METHODS

Preparation of plant materials

Fresh leaves of *H. suaveolens* were obtained from around Samaru Zaria, while that of *O. gratissimum* were purchased from markets around Zaria. These leaves were sun dried for three days and ground into fine powder using a high power electric mill. The powders were separately placed in transparent cellophane bags and stored in a refrigerator at 4°C for three days.

Preparation of cowpea

Cowpea variety (SAMPEA-7) was used for the study. The grains were screened to remove contaminants and infested seeds. Screened seeds were fumigated with phostoxin in an air-tight container for 24 hours to kill any insect present. The seeds were later spread on a laboratory bench for three days to allow for dissipation of fumigant effect. One hundred grams of these seeds were weighed into kilner jars covered with fine wire mesh for aeration for about 15 minutes.

Maintenance of *C. maculatus* culture.

Two hundred grams of already fumigated cowpea seeds were placed in each of two kilner jars and infested with adult bruchid from the insect culture. From this culture, newly emerged (24 hr.) adult bruchid were used for infestation.

Bioassay

Each of the powders of *O. gratissimum* and *H. suaveolens* was applied at three different levels (2.5, 5.0 and 10.0) in kilner jars containing 100g cowpea seeds and replicated three times. Each treatment was shaken vigorously for proper mixing and allowed to stand for an hour before introducing 10 pairs of newly emerged adult bruchid into each jar. There was a control without treatment, which was replicated three times. The kilner jars were arranged in a randomized complete block design on laboratory bench.

Adult bruchid mortality records were taken from each jar at 24 and 48 hr. (the latter being regarded as the peak of oviposition in *C. maculatus*). Data on oviposition rates were taken after two weeks post treatment by counting the number of eggs layed per random sample of 20 seeds. Progeny development (F_1 , F_2 and F_3) were recorded at 4, 8 and 12 weeks respectively. Cowpea damage was assessed at the end of 12 weeks by randomly selecting 100 seeds from each treatment jar and counting the number of emergent holes on each. Viability test was also conducted by picking randomly 20 seeds from each jar, which were moistened in petri dishes, lined with Whatman's No.44 filter paper and allowed to stand on laboratory bench for seven days. Quality assessments (organoleptic studies) on the seed coat colour and texture as well as taste were made to observe any visible changes. Ten respondents were asked to rate the seed coat colour (for mouldiness or taints), texture (for peatness or softness) and taste after cooking the seeds from each bulked treatments, using such indices as shown in Table 5.

RESULTS**Treatment effects on mortality:**

O. gratissimum powder at 2.5, 5.0 and 10.0g per 100g cowpea effected 46.7%, 46.7% and 65.0% adult bruchid mortality respectively within 24 hr; 73.3%, 75.0% and 80.0% mortality respectively within 48 hours post treatment (Table1). Similar application of *H. suaveolens* powder had 1.7%, 3.3% and 8.3% bruchid mortality respectively in 24 hours; 15.0 %, 26.7% and 18.3% mortality in 48 hours. *O. gratissimum* powder showed significantly higher adult bruchid mortality than *H. suaveolens* powder and the control at 24 and 48 hours after treatment. The study showed increase in mortality as the concentration of the powders increased in both treatments.

Table 1 Percentage mortality of *Callosobruchus maculatus* on stored cowpea grains at 24 and 48 hr post treatment with *Ocimum gratissimum* L. and *Hyptis suaveolens* Poit

Treatment levels (g)	Mean number of insects used	Mean number of insects killed		% mortality of insects	
		24 hr	48hr	24hr	48hr
<i>Ocimum gratissimum</i> powder					
20	20	9.1	14.7	46.7	73.3
10	20	9.1	15.0	46.15	75.0
5	20	13.0	16.0	65.0	80.0
<i>Hyptis suaveolens</i> powder					
20	20	0.31	3.0	1.7	15.0
10	20	0.71	5.31	3.31	26.6
5	20	1.71	7.71	8.31	38.0
(control)	20	0.0	0.0	0.0	0.0
SD (P<0.01)		7.9	4.8		

Treatment effects on oviposition and progeny emergence.

Oviposition was reduced significantly ($P<0.05$) with the powder of *O. gratissimum* at all levels as against the powder of *H. suaveolens* and the control in that order. The lowest number of eggs layed (13.7 and 48.3) was at 10.0g treatment level for both *O. gratissimum* and *H. suaveolens* respectively as against the 250.8 eggs for the control (Table 2). On progeny emergence, *O. gratissimum* recorded the lowest mean number, 5.7, 13.0, and 16.67 for F_1 , F_2 , and F_3 respectively at 10g compared with 28.3, 36.0 and 64.7 respectively for *H. suaveolens* and the control 225.8, 300.0 and 404.3 at similar generations respectively. The powder of *O. gratissimum* exhibited two or three times more efficiency in suppressing oviposition and reducing progeny emergence than *H. suaveolens* at all levels.

TABLE 2: Effect of *Ocimum gratissimum* and *Hyptis suaveolens* leaf powders on oviposition and progeny development of *C. maculatus* on cowpea grains at 2 and 4 weeks respectively.

Treatment Levels (g)	Means no. of eggs laid (20 seeds)	Mean no of progeny generation			% F ₁ generation
		F ₁	F ₂	F ₃	
<i>Ocimum gratissimum</i>					
2.5	22.3	12.3	12.3	31.0	55.2
5.0	17.3	9.3	22.0	18.0	53.8
10.0	13.7	5.7	13.0	16.6	41.4
<i>Hyptis suaveolens</i>					
2.5	60.3	45.3	62.0	93.3	75.1
5.0	57.3	41.3	51.0	75.3	72.1
10.0	48.3	28.3	36.0	64.7	58.6
0.0(control)	250.8	225.8	300.0	404.3	84.7
LSD (P<0.01)	67.82	27.8	240.6	158.8	

Cowpea Protection and Viability

O. gratissimum at 10.0g gave significantly higher (P<0.01) protection to cowpea grains (83.3%) from *C. maculatus* attack and performed better than those of *H. suaveolens* at all levels and the control in that order after 12 weeks storage (Table 3). Grain damage was least on seeds treated with 10.0g powder of *O. gratissimum* and highest on 2.5g level (w/w.). On grain viability, both *O. gratissimum* and *H. suaveolens* had no inhibitory effect on germinability of seeds after 12 weeks post treatment (Table 4). The difference between the treatment and the control was highly significant (P<0.01).

TABLE 3. Percentage damage of cowpea seeds by *C. maculatus* after 12 weeks of treatment with *Ocimum gratissimum* and *Hyptis suaveolens* products

Treatment Levels (g)	Mean number of grains Selected	Mean number of holed grains	% grain damage	% grain protection
<i>Ocimum gratissimum powder</i>				
2.5	100	33.0	33.0	67.0
5.0	100	20.7	20.7	79.3
10.0	100	16.7	16.7	83.3
<i>Hyptis suaveolens powder</i>				
2.5	100	66.3	66.3	33.7
5.0	100	55.3	55.3	44.7
10.0	100	54.0	54.0	46.0
0.0(control)	100	75.7	75.7	24.3
LSD (P<0.01)		52.1		

TABLE 4. Effect of *Ocimum gratissimum* and *Hyptis suaveolens* powder on cowpea seed viability after 12 weeks post treatment

Treatment Levels (g)	Mean number of grains tested	Mean number of grains germinated	Mean % grains germinated
<i>Ocimum gratissimum powder</i>			
2.5	20	17.3	86.7
5.0	20	17.7	88.3
10.0	20	18.7	93.3
<i>Hyptis suaveolens powder</i>			
2.5	20	18.0	90.0
5.0	20	18.3	91.7
10.0	20	18.7	93.3
0.0 (Control)	20	5.7	28.4
LSD [P<0.01]		8.8	

Grain Quality

The seed coat colour and texture as well as taste of the grain (Table 5) were not affected by the leaf powders of *O. gratissimum* and *H. suaveolens*. However, because the latter had the highest proportion of emergent holes (> 54.0%) on its seeds at all levels, it may have low market value. There was no mouldiness or peatiness on the seeds treated with leaf powders of both plants.

TABLE 5. Effect of *Ocimum gratissimum* and *Hyptis suaveolens* leaf powders on quality of cowpea after cooking

Treatment Levels (g)	Number of Respondents	Grain Colour		Overall Assessment	Grain Taste/Flavour			Overall Assessment		
		V	P		P	F	G			
<i>Ocimum gratissimum</i> powder										
2.5	10	-	-	7	3	Good	-	9	1	Fair
5.0	10	-	-	2	8	V. Good	-	2	8	Good
10.0	10	-	-	2	8	V. Good	-	1	9	Good
<i>Hyptis suaveolens</i> powder										
2.5	10	6	4	-	-	V. Poor	8	2	-	Poor
5.0	10	1	2	7	-	Fair	4	5	1	Fair
10.0	10	-	4	6	-	Fair	1	6	3	Fair
0.0 (Control)	10	9	-	1	-	V. Poor	9	1	-	Poor

Key: V.P Very, Poor; P = Poor; F = Fair; G = Good; V.G. = Very Good
Quantity of cowpea grains used = 300g each.

DISCUSSION

After 12 weeks, it was observed that the powder of *O. gratissimum* protected cowpea grains from *C. maculatus* attack irrespective of its concentration. At 10.0g per 100g seed, cowpea grains had 83.3% protection as against 46.6% and 24.3% at similar levels for *H. suaveolens* and the control respectively. The mode of action of *O. gratissimum* as a fast knock down botanical, in reduction of oviposition and suppression of progeny emergence is not fully understood. However, it may be due to contact action resulting in high mortality rates, partial or complete failure of embryonic development respectively. Agina and Sani (1995)

have reported that smoke from ground dried *O. gratissimum* and "queen of the night" leaves produced 82% and 52% mortality respectively on the weevils (*Sitophilus zeamais* Motsch) and *Tribolium castaneum* (Herbst) and on mosquitoes. *O. gratissimum* contains alkaloids, which could be responsible for its insecticidal action. From this study, the powder of *H. suaveolens* seemed to be less effective in its repellent action, though, it performed better than the control. The reason for its ineffectiveness could be due to low concentrations of the powder applied.

Dike and Mbah (1992) have reported that lemon grass powdery products were effective, at 20.0g per 100g cowpea seeds, in protecting cowpea grains from bruchid attack up to eight weeks post treatment. However, because of the bulkiness of materials required (at 20kg/100kg seed), *H. suaveolens* may suffer an added disadvantage if used as a grain protectant.

Viability test showed that the powdery products of *O. gratissimum* and *H. suaveolens* had no deleterious effects on the germination of treated seeds. This result corroborates earlier work by Oparaeke and Diko (1996), Oparaeke *et al*, (1997) and Ivbijaro (1983). Reports on the use of powdery products of *O. gratissimum* and *H. suaveolens* to protect stored cowpea are scanty. However, considering their ease of availability, safety, low cost and low-technological requirement in processing as against the synthetic insecticides, *O. gratissimum* has a lot of potential for adoption by the resource poor farmers for use in cowpea grain storage.

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