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EFFICACY OF OLIVE OIL, GROUNDNUT OIL, SOYBEAN OIL AND PALM KERNEL OIL IN THE CONTROL OF *CALLOSOBRUCHUS MACULATUS* (F.) IN STORED COWPEA (*VIGNA UNGUICULATA* L. WALP).

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ABSTRACT

Laboratory experiments were conducted to investigate the potentials of four different vegetable oils (olive oil, groundnut oil, soybean oil and palm kernel oil) for the protection of stored cowpea against Callosobruchus maculatus. Ife-brown seeds (a susceptible variety) used for the experiment were subjected to the different oil treatments applied at 0.2 ml per 50 g of seeds. The experiment was laid out in a completely randomised design with three replicates per treatment.
All the oils tested suppressed the development of C. maculatus to some extent with groundnut oil and palm kernel oil exhibiting similar results in the control of the pest. There was no significant difference between palm kernel oil and groundnut oil for adult mortality, larvae and pupae emergence at P< 0.05 but it was significantly different for the F_1 progeny emergence. Palm kernel oil was more effective against the F_1 progeny emergence. These two oils could be used in the storage of cowpea against C. maculatus.

Keywords: Olive oil, Soybean oil, groundnut oil, palm kernel oil and *Callosobruchus maculatus*

INTRODUCTION

Insect pests are the most common among storage pests. Apart from their direct damage, they create conditions that allow secondary infection by rot organisms mainly fungi (Oke and Maniru, 2001). The huge range of such pests, together with poor storage facilities in tough climatic conditions can cause losses of 50 % or more unless preventive measures are taken (Mabbett, 2003). Although food grains are commonly protected by insecticidal application and fumigation, the use of chemical pesticide in the protection of both field and stored crops is becoming more expensive to the average farmer (Agboola, 1992). Apart from the high cost, they also constitute a health hazard to the farmer and his livestock if proper care is not taken in the handling and usage of these chemicals. In addition there have been reported cases of resistance, pest resurgence and secondary pest out breaks when pesticides are used (Agboola, 1992).

Mixing with plant oils is an ancient Indian and African method of protecting grains against insect attack (Pereira, 1983). Several plant oils have been screened for preventing post harvest losses due to insects (Golob and Webley, 1980) with varying degrees of success. Varma and Pandey (1978) showed that groundnut and other oils applied at 0.3% w/w gave complete protection of green gram *Vigna aureus* (Roxb.) against *C. maculatus* in laboratory bioassays. However Singh et al. (1978) reported that groundnut oil applied to cowpeas has no effect on mortality or longevity of adult *C. maculatus*. Tikku *et al.* (1981) similarly showed that topical application of several vegetable oils, including groundnut and coconut oils, had no effect on mortality of adult *C.*

chinensis. In contrast, Hill and van Schoonhoven (1981) found that palm oil killed adult *C. maculatus*.

Dennis (1990) reported that coating legume seeds with oils extracted from plant is effective in bruchid damage control. Cockfield (1992) compared the effectiveness of groundnut oil, steam treatment and pirimiphosmethyl for the control of *Callosobruchus maculatus* and reported that groundnut oil was nearly as effective as pirimiphosmethyl. Pacheco *et al.* (1995) reported that refined soybean oil and castor-oil inhibited the population growth of *C. maculatus* and *Callosobruchus. phaseoli* (Gyllenhal) as
compared to the untreated seeds. Several other studies have demonstrated the effectiveness of different vegetable oils in protecting grains against major stored product insect pests (Obeng-ofori, 1995). Oil induced reduction or complete inhibition of oviposition of female bruchids and mortality of the developmental stages has been reported by a number of workers (Iale and Abdulrahman, 1999). Although the mode of action of vegetable oils is not clearly understood, it has been suggested by Don-Pedro (1989) that insect death caused by oils is due to anoxia or interference in normal respiration resulting in suffocation
This study aims at investigating the efficacy of some vegetable oils in the protection of stored cowpea against *C. maculatus* in the hope of finding a cheap alternative to the expensive chemicals in current use.

MATERIALS AND METHODS

The experiment was carried out in the laboratory of the Department of Crop Protection, University of Ilorin. Ife-brown seeds (a susceptible variety) obtained from the National Seed Council were used, while olive oil, groundnut oil, soybean oil and palm kernel oil (which are readily available) were sourced from a local market and used for the experiment. Prior to the experiment, the cowpea seeds were refrigerated at 25^0C for three weeks to inhibit any insect development in the seeds. *Callosobruchus maculatus* culture maintained in the laboratory was used for the experiment.
0.2 ml of each oil treatment was applied to 50 g of seed which were placed in a plastic container measuring 7.5 cm X 3.5 cm (15 plastic containers in total). The experiment was conducted using a completely randomised design. Contact method of application was used, i.e. the oil was rubbed onto the seeds before been placed in the plastic container. Ten newly emerged adults of *C. maculatus* (5 males and 5 females) were taken from the culture and introduced into the plastic containers.
There were three replicates per treatment. Mortality was assessed by daily counting the number of dead insects 24 hours to 7 days after introduction of the insects. 10 seeds randomly selected from each replicate were cracked open by hand to view the developmental stages of the insects on the 11^{th}, 15^{th} and 19^{th} day for larvae development and on the 24^{th} to the 30^{th} day for pupae development. The F_1 progeny emergence was also counted from the 27^{th} to the 32^{rd} day after the start of the experiment.

The data contained zero values and were first transformed using the square root transformation, then analyzed using the analysis of variance (ANOVA) in the GENSTAT statistical package. The means were separated using the Least Significant Difference (LSD).

RESULTS

Effect of Oil Treatments on Mortality

Cowpea seeds treated with palm kernel oil had the highest mortality (5.00, 0.70 and 3.00) for the first three days. This was not significantly different from groundnut oil except on the 2nd and 6th day. There was a significant difference between palm kernel oil and the other treatments at $P < 0.05$, with the control having the least adult mortality (Table 1).

Effect of Oil Treatments on Larval Emergence

Seeds treated with groundnut oil and palm kernel oil had no larval emergence for the duration of the experiment. . All treatments were not significantly different at $P < 0.05$ on the 19th day after treatment (Table 2).

Effect of Oil Treatments on Pupal Emergence

As a result of no larval emergence for Groundnut oil, and palm kernel oil, they had no pupal emergence. There was also no pupal emergence for soybean oil.

Effect of Oil Treatments on F_1 Progeny Emergence

There was a near total suppression of F_1 progeny emergence by palm kernel oil as it had the lowest F_1 progeny emergence (Table 4). Emergence occurred only on the 27th day after treatment. This was significantly different from the control which had the highest number of F_1 progeny emergence.

DISCUSSION

Adult female *C. maculatus* lays half its total number of eggs in the first two days after copulation. It will be most effective to control *C. maculatus* on or before the first 2 days to decrease the oviposition potential of *C. maculatus*. All the vegetable oils evaluated were able to suppress the growth and development of *C. maculatus* on cowpea resulting in an increase of adult mortality.

The results from this study show that the four oils were effective in the control of the bruchid beetle, *C. maculatus*. This supports the work of Shaaya *et al*., (1997) who reported that edible oils are potential control agents against *C. maculatus* and can play an important role in stored grain protection. Palm kernel oil was most effective in lowering the adult population of *C. maculatus* when compared with the other treatments.

The reduction was high enough to prevent emergence of the larval stage. Groundnut oil was also able to prevent emergence of the larval stage when compared to the other treatments. Don Pedro (1989) opined that oils exert some lethal action on developing embryos or first instar larva by reduction in respiration due to barrier effect and/or direct toxicity by penetrated oil fractions. The trend was similar for the pupal stage as there was no pupal emergence for both palm kernel oil and groundnut oil. The insecticidal effect of the vegetable oils agree with the work of Ajayi and Adedire (2003) who reported that sand-box seed oil has contact toxic effect on adult C. maculatus with 40% bruchid mortality at the lowest oil treatment at 0.1% at 1 day after treatment

and 100% mortality at 1.5% and 2% oil treatment at 1-day post treatment period. This mode of action could be as a result of the oil coating of the treated cowpea grains which hinder contact between the grains and weevils leading to suffocation (Emosairue *et al*, 2004). This is similar to the work of Ramzan (1994) who reported that groundnut oil, soybean oil cotton seed, sunflower and mustard oils when mixed with cowpea, completely suppressed adult emergence of *C. maculatus*. Ajayi and Adedire (2003) also reported that sandbox seed oil could be used as protectants on *C. maculatus*.

Palm kernel oil most effectively suppressed the F_1 progeny emergence of *C. maculatus* when compared to the other treatments. Though in this study, palm kernel oil performed better than groundnut oil.

CONCLUSION

All the vegetable oils were effective in the control of adult *C. maculatus* and also interfere with the proper growth of their developmental stages. The study confirms the potential of palm kernel oil as a source of insecticide, providing adequate protection for the stored cowpea seeds when compared to the other vegetable oils tested. It could be incorporated into rural cowpea management for the rural farmers who cannot afford the expensive synthetic insecticides.

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TABLE 1: Effect of four vegetable oils on adult mortality of *C. maculatus*

Treatment	1st DAT	2nd DAT	3rd DAT	4th DAT	5th DAT	6thDAT
Olive oil	2.00	2.33	2.00	1.90	1.67	0.80
Groundnut oil	3.33	2.33	2.33	1.23	1.23	0.70
Soybean oil	1.67	2.67	2.33	1.67	1.00	0.90
Palm kernel oil	5.00	0.70	3.00	0.70	0.90	1.33
Control	0.70	2.00	2.67	1.67	1.67	2.00
S.E.D	1.19	0.54	1.47	0.59	0.42	0.20
L.S.D	2.74	1.24	3.39	1.36	0.97	0.47

DAT= Day after treatment

TABLE 2: Effect of four vegetable oils on larval emergence of *C. maculatus.*

Treatment	11th DAT	15th DAT	19th DAT
Olive oil	2.33	2.33	0.70
Groundnut oil	0.70	0.70	0.70
Soybean oil	1.13	2.67	0.80
Palm kernel oil	0.70	0.70	0.70
Control	3.00	2.00	2.00
S.E.D	0.55	0.54	0.37
L.S.D	1.26	1.24	0.86

DAT= Day after treatment

TABLE 3: Effect of four vegetable oils on pupal emergence of *C. maculatus.*

Treatment	Mean number of upae
Olive oil	0.80
Groundnut oil	0.70
Soybean oil	0.70
Palm kernel oil	0.70
Control	0.90
S.E.D	0.08
L.S.D	0.19

TABLE 4: Effect of four vegetable oils on F_1 progeny of *C. maculatus.*

Treatment	27th DAT	28th DAT	29th DAT	30th DAT	31st DAT	32nd DAT
Olive oil	1.20	1.57	1.00	0.80	0.90	0.90
Groundnut oil	1.60	2.90	1.57	1.90	1.67	1.23
Soybean oil	1.30	1.13	1.23	1.13	1.00	1.23
Palm kernel oil	2.20	0.70	0.70	0.70	0.70	0.70
Control	84.30	5.00	2.33	3.33	2.67	3.67
S.E.D	11.54	1.29	0.36	0.98	0.45	1.20
L.S.D	26.61	2.69	0.84	2.25	1.03	2.77

DAT= Day after treatment