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RESEARCH ARTICLE

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Comparative Effect of *Boswellia dalzielii* Parts on Survival of Adult *Callosobruchus maculatus* (Fabricius) [Coleoptera: Chrysomelidae] Reared on Cowpea Seeds

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ABSTRACT

Studies were conducted to determine the comparative effects of various doses of Boswelliadalzielii Hutch leaf, stem and back powders on the mortalityof adult Callosobrucus maculatus (Fabricius). Thirty air-dried Cowpea, Vigna unguiculata (L.) Walpersgrains, treated with three (10.0%, 5.0%and 2.5%w/w) doses ofB.dalzielii powders were infested with five pairs offreshly emerged adult C. maculatus. Treatments were replicated four times and were completely randomized on a laboratory tableunder ambient temperature and relative humidity. The result indicated varying insecticidal effects of the plant parts on the adult weevil. However, significantly (p≥0.05)highest adult mortality(43.11%) was observed inseeds treated with 10% (w/w)B.dalzieliileaf powder, followed by stem back(25.00%)and young stem(17.24%)powdersat 24 hours post infestation period.

Keywords: *Boswelliadalzielii*, bio-pesticide, powder, Cowpea, *Callosobruchus maculatus.*

INTRODUCTION

The application of plant powders and extracts as alternatives to chemical pesticides in the control of cowpea pest is promising. Nigerian farmers use leaves, roots and stems of dozens plant species in the control of stored produce pests. The plant materials provide small-scale farmers with biodegradable, risk-free and inexpensive substitute for the control of pests[1-2]. However, the increased interest in the use of plant-derived pesticides for the control of cowpea pests including Cowpea weevil, *Callosobruchus maculatus* (Fab.), had intensified the search for plant based pesticides. Cowpea, *Vigna unguiculata*, remained the major source of protein in the diet of a common Nigerian. On the other hand, Insects in stored feed and food causes numerous quality and health issues (including allergy, blindness, poisoning and sudden death), which necessitates the promotion and development of possible methods to tackle these problems [3].

Cowpea weevil is a known cosmopolitan pest of cowpea grain, causing tens of millions of dollars' worth of damage annually [4]. The high variability in infestation, results in an inaccurate damage figure on cowpea due to the weevil infestation.Evidences have shown that the level of damage due to weevil infestation varies with cowpea variety, temperature, relative humidity and the weevil strain [1]. Mbata [5] provided a comprehensive list on annual estimate on losses in some African countries including Nigeria.

Boswellia dalzielii Hutch (Family Burseraceae), commonly known as the frankincense tree, is found mainly in the Savannah region of West Africa. The plant has a characteristic pale papery bark that peeled off in a ragged manner. It has a white, fragrant, flower appearing before the leaves, small regular and generally unisexual. The bark yields a whitish friable gum resin which readily dries off [6-7].

Different parts of the plant and products are widely employed in traditional medicines [6-8]. The phytochemical screening of the plant revealed 66.0%, 57.1% and 55.6% occurrence level of alkaloids, tannins and flavonoids in acetone respectively [6].Presence of carbohydrates, saponins, cardiac glycosides and terpenes was also reported by Bako *et al*. [9]. The leaves, stem bark and young stem of *B.dalzielii* is usually prescribed in traditional medicine for a variety of gastrointestinal disorders [7], antivenal activities [6] and antimicrobial activities [8]. This paper will analyze the effects of various doses of *B. dalzielii* leaf, stem bark and stem powders on the survival of adult cowpea weevil under laboratory settings.

MATERIALS AND METHODS

This study was conducted at Zoology Laboratory, Department of Biological Sciences, Usmanu Danfodiyo University Sokoto under ambient temperature and relative humidity.

2.1 Insect Culture

Adults *C. maculatus* collected from Sokoto granary were introduced into a 500 ml jar and allowed to oviposit for four days before it was discarded. Egg bearing seeds were kept in the jar undisturbed until the emergence of fully developed adults. Culture was maintained until the emergence of F_5 adults, each time by reintroduction of the newly emerged adults into a new jar containing fresh cowpea seeds following Sani *et al.* [10].

2.2 Collection and Preparation of Test Material

Leaves, young stem and stem back of *B.dalzielii* were collected from European Economic Community/Katsina State Government (EEC/KTSG) Katsina. Plant identity was verified at the Herbarium, Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto. Samples were properly washed and shed-dried until crisped, and then milled with mortar and pestle following Abdullahi and Majeed [11]. Each treatment of the plant powder was labeled accordingly and kept in an air-tight container. Powders were applied on the basis of percentage cowpea weight. Three different percentages 2.5, 5.0 and 10.0% were used. Thirty (30) seeds of healthy untreated cowpea grains were taken, weighted and admixed with appropriate treatment weight in a sterilized Petri dish until uniformly coated with the treatment powder following Denloye *et al.*[12]. Another set up was prepared with 30 untreated but infected cowpea grains to serve as check.

2.3 Mortality Assessment

To study the effect of various parts of *B. dalzielli* on adult *C. maculatus*, the modified procedure of Silassie [13] was adopted. Five pairs of day-old adult cowpea weevil were introduced into each of the Petri dishes containing treated and control cowpea seeds, and mortality was recorded at 12 hours intervals each time by picking out the dead insect and continued for 4 days (96 hours) post infestation. The weevils were considered dead when there was no response after proving the abdomen with a pin. The percentage insect control or corrected mortality was determined using Abbott [14] formula as follows:

$$\text{Corrected Mortality} = \left(\frac{\text{Pc - Pt}}{\text{Pc}} \right) \times 100$$

Where: Pt and Pc = Percent mortality in the treated and control samples respectively.

2.4 Data Analysis

Data were analyzed using SPSS Inc. version 17, 2006 respectively. To normalize the variances, data were Square Root Transformed before being subjected to analysis following Bland and Altman [15], and Agona and Muyinza [16]. One way ANOVA was used to compare the difference in insect's mortality. Means separations were conducted using Duncan New Multiple Range Test at 5% significant level.

RESULTS AND DISCUSSION

The result in Table 1 showed a progressive rise in mortality of adult *C. maculatus* from 24 to 94 hours in both treated and untreated cowpeas. Significantly highest mortality was recorded in seeds treated with higher doses of the leaf powder, followed by stem back and young stem powders.

Table 1 Effects of various doses of *B. dalzielii*parts on the mortality of bean weevil, *Callosobruchus maculatus* reared on treated cowpea seeds.

		Cumulative mean no. of dead adults±SE/post-exposure duration (Corrected Mortality %)			
Treatment	**Dose (ml)**	**24 hours**	**48 hours**	**72 hours**	**96 hours**
B. dalzielii Leaf	2.5	0.50^{ab}±0.29 (1.73)	3.25^{b}±0.48 (19.00)	8.00^{bcd}±0.48 (75.00)	9.00^{bcd}±0.71 (87.50)
	5.0	1.25^{abcd}±0.48 (9.49)	4.50^{bcde}±0.29 (34.00)	8.75^{cde}±0.48 (84.38)	9.50^{d}±0.29 (93.75)
	10.0	4.50^{e}±0.65 (43.11)	6.75^{fg}±0.48 (61.00)	10.00^{e}±0.00 (100.00)	10.00^{d}±0.00 (100.00)
B. dalzielii Stem Bark	2.5	1.25^{abcd}±0.25 (09.49)	4.00^{bcd}±0.41 (28.00)	8.75^{cde}±0.48 (84.38)	9.25^{cd}±0.48 (90.63)
	5.0	1.75^{bcd}±0.25 (14.66)	6.00^{efg}±0.41 (52.00)	9.50^{de}±0.29 (93.75)	97.50^{d}±0.25 (96.88)
	10.0	2.75^{de}±0.75 (25.00)	7.250^{g}±0.48 (67.00)	9.75^{de}±0.25 (96.87)	10.00^{d}±0.00 (100.00)
B. dalzielii Stem	2.5	1.00^{abcd}±0.00 (6.90)	3.50^{bc}±0.29 (22.00)	7.50^{b}±0.29 (68.75)	9.25^{cd}±0.48 (90.63)
	5.0	1.50^{abcd}±0.50 (12.07)	4.50^{bcde}±0.65 (34.00)	8.75^{cde}±0.48 (84.38)	9.25^{cd}±0.48 (90.62)
	10.00	2.00^{cd}±0.41 (17.24)	5.50^{defg}±0.50 (40.00)	8.75^{cde}±0.95 (84.38)	9.75^{d}±0.25 (96.88)
Control	0.00	0.33^{a}±0.33 (0.00)	1.67^{a}±0.33 (0.00)	2.00^{a}±0.58 (0.00)	2.00^{a}±0.58 (0.00)

****Means in the same column followed by similar alphabets are significantly the same (P≥0.05), DMRT (1951).*

The results clearly showed that both the three powdered sample of *B. dalzielii*, are effective on the survival of cowpea weevil. The effects tend to increase with increase in pesticide concentration. The effects may not be unconnected with the composition of as is reported by Genwa and Yero [6] and Bako *et al*.[9]. Presence of metabolites gives the plant materials their insecticidal ability. These compounds, upon consumption, led to poisoning effect or, when in contact, probably block the insect's respiration passages or injure the insect cuticle resulting in sudden death [1].

The difference in concentration or amount of active substances exhibit various degree of toxicity to the bean weevil. Umar [17] reported that difference in insecticidal efficacy could vary between one part of plant and the other, depending on the level of concentration of the anti-insect or anti-feedant compounds present therein.

CONCLUSION

The results above showed, although there is varying effects, that both the plant parts have significant insecticidal effect against adult *C. maculatus* and can therefore be used as a bio-pesticide for the control of the weevil pest.

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