Evaluations on the Efficacy of some Biopesticidal Powders on the Natality (Birth rate) of *Callosobruchus maculatus* (F) (Coleoptera: Bruchidae) in some Leguminous grains.

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Abstract-Evaluations on the efficacy of some biopesticides viz *Aframomum melegueta* seed, *Capsicum nigrum* seed, *Allium sativum* bulb, *Zingiber officinale* rhizome, *Azadirachta indica* leaves and *Ocimum gratissimum* leaves and pirimiphos methyl powder in the suppression of a grain pest *Callosobruchus maculatus* damage in stored leguminous grains viz: *Vigna unguiculata*, *Cajanus cajan* and *Vigna subterranean* in various concentrations were conducted . The biopesticides used was applied at the rate of 0, 0.2, 0.4, 0.6, 0.8 and 1.0 grams while the synthetic pesticide (Primiphos methyl) were applied at 0.1g per 20grams of each of the grains. Split plot design of six treatments replicated three times was adopted. Three pairs of one day old adult *C. maculatus* were introduced into each jar, when eggs were noticed (within 7days) the adult *C. maculatus* were removed. The experiment was allowed for one month period to observe all stages of development and emergence of new adult *C. maculatus*. Maximum suppression of natality of *C. maculatus* was observed with pirimiphos methyl where very few eggs emerged in all the grains viz: 2.00 ± 0.21 for *Vigna unguiculata*, 2.00 ± 0.21 for *C. cajan* and 3.00 ± 0.21 for *V. subterranean* but no adult emerged in all the grains viz 0.00 ± 0.00.The biopesticides used acted variously where the best results that yielded least *C. maculatus* was seen in *Aframomum melegueta* for all the grains at the highest dose rate viz: 11.75 ± 0.08 at egg stage and 8.00 ± 0.00 at adult stage for *V. unguiculata*, 13.25 ± 1.38 at egg stage and 8.50 ± 0.05 at adult stage for *C. cajan*, 12.00 ± 0.00 at egg stage and 8.75 ± 0.95 at adult stage for *V. subterranean* followed by *Capsicum nigrum*, while the biopesticides that suppressed least *C. maculatus* was seen in *Zingiber officinale* in all the grains viz: 20.75 ± 1.80 at egg stage and 11.75 ± 0.08 at adult stage for *V. unguiculata*, 29.50 ± 8.67 at egg stage and 19.75 ± 0.50 at adult stage for *C. cajan* also 26.25 ± 0.02 at egg stage and 16.75 ± 0.08 at adult stage for *V. subterranea*. All other biopesticides behaved alike. There was no significant difference in the actions of the biopesticides.. The proximate analysis of the legumes revealed that the protein content of *V. unguiculata* was more than others. The phytochemical analysis revealed that Alkaloids, steroids, glycosides and terpenoids were present in the biopesticides. *Aframomum melegueta* and *Capsicum nigrum* gave maximum suppression of natality of *C. maculatus* similar to the synthetic pesticide and therefore is recommended.

Key Words:Efficacy, Natality, Legumes, *Callosobruchus maculatus*, Biopesticides, Pirimiphos Methyl, Proximate, Photochemical

INTRODUCTION

Pulses have a prominent place in daily diet as a rich source of vegetable protein, minerals and vitamin B. They are of special significance to the people in developing countries, who can hardly afford animal protein in adequate quantities. Pulse seeds suffer a great damage during storage due to insect attack [27]. Infestation by insect pests of cowpea, *Vigna unguiculata* (L) Walp, particularly at the post flowering phase of plant growth remains the major hindrance to its production [12].

Among the insect pests attacking stored pulses, *Callosobruchus maculatus* is a serious one. [1] This insect has been reported from all over the world. It is a notorious pest of chickpea, mung, cowpea, bambara nut, garden pea, lentil etc. The extent of damage to pulse seeds is very high both qualitatively and quantitatively [3]. Infestation of legumes by *Callosobruchus* mainly begins in the field, where the beetles lay eggs on the mature pods of the pulses. The immature stages are internal feeder, causing a total damage to the pulse seeds. Because of the increasing threats of the conventional insecticides to environment and human beings, other nature pest control measures are being searched throughout the globe. The use of plants and minerals as traditional protectants of stored products is an old practice used all over the world [10] but has been largely neglected by farmers, with the advent of synthetic or petroleum based insecticides.

However crude extracts of some spices, herbs and plants which possess insecticidal activity, have been evaluated to control storage pests. Extracts of *Nicotiana tabacum* (L), *Derris elliptica* (L), *Lonchocarpus unica* (L), [16], *Melia azaderach* (L), *Argemone mexicana* Linn [23], *Chrysanthemum cinerariaefolium* (L) [28], *Azadiracta indica* A. (J) [17]; [11]**;** [29]; [12];

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[8]. *Syzygium aromaticum* (L) *Allium sativum* (L). **[9]** and *Monodora myristica* (G) **[20],[21]** have been reported to possess insecticidal activity against a number of insect pest species.

In Nigeria, there is a wealth of information on the number of naturally growing plants as biopesticides but there is a dearth of information on their application and usage in the farm and in the store [19] [7]. The zeal for the present work was born to evaluate and establish from the wealth of natural products the botanicals that can interfere and reduce the menace of this cowpea beetle. Therefore, the effectiveness of six biopesticides/botanicals viz *Capsicum nigrum* seed, *Aframomum melegueta* seed, *Allium sativum* bulb, *Zingiber officinale* rhizome, *Azadiracta indica* leaves and *Ocimum gratissimum* leaves were assessed against *Callosobruchus maculatus* in three stored leguminous grains.

Materials and Methods:

Insect culture:

Selected leguminous seeds infested by *C. maculatus* were collected from the local market and brought to the Entomology laboratory of Department of Zoology and Environmental Biology of University of Nigeria Nsukka. The infested seeds were set aside in a plastic container and covered with muslin cloth till the emergence of adult *C. maculatus*. Healthy adult *C. maculatus* as described by [30] emerged from the container were shifted to other plastic containers and provided clean cowpea seeds, clean bambara seeds and clean pigeon pea seeds for oviposition and maintained at room temperature and relative humidity. When oviposition was noticed, the adult *C. maculatus* was removed using 2 mm sieve. The containers of seeds with eggs were left undisturbed until the emergence of adults. Freshly emerged adults of F_1 progeny and subsequent generations were used for the study and for further experiments.

Procurement of legume seeds:

Cowpea seed (*Vigna unguiculata*), Bambara groundnut seed (V. *subterranea*) and Pigeon pea seed (*Cajanus cajan*) were fumigated for 24 hours with phostoxin before the commencement of the experiment in order to get rid of any insect pest present. The seeds were then exposed for 48 hours to get rid of the gas and then sieved with a 2 mm sieve to remove dead insects, insect parts and feaces. These seeds were then packaged into polythene bags and later used for the experiment.

Preparation of Plant materials

The botanicals used for this study were collected from International Centre for Ethno-medicine and Drug Development (InterCEDD), Nsukka, Nigeria and identified to species level. The voucher specimens number, AM2011, CN2011, AS2011, ZO2011, OG2011 and AI2011 were kept in the herbarium, Department of Plant Science and Biotechnology, University of Nigeria Nsukka, Enugu State, Nigeria for reference purposes. The plant materials were shade-dried until a constant weight was maintained. They were properly ground into powder and sieved with 0.20 mesh sieves [13]**; [24]**. The processed plant materials were preserved in plastic air-tight bottles and kept in a refrigerator (4 ± 2^0C) until needed. The Pirimiphos methyl powder (Synthetic compound) used in the experiment was purchased from Zhejing Linghua, China.

Experimental design/procedure

Three leguminous grains were selected for the study and six biopesticide treatments were used. Each of the biopesticide was used at different concentrations of (0, 0.2, 0.4, 0.6, 0.8, 1.0 g) on the three legume grains. Split plot design of six concentrations replicated 3 times was adopted in the experiment. The biopesticide concentrations were applied in different jars (Diameter 0.09 m, v = $3.69^{-3}m^3$.Each jar contained 20 grams of a particular legume (either *V. unguiculata/C.cajan/V.subterranea*), a concentration of a particular treatment (either *C. nigrum* / *A. melegueta* / *O. gratissimum* /*A. sativum* / *A. indica* / *Z. officinale*) and 2 pairs of male and female *C. maculatus* and covered with muslin cloth. The experimental control group was set up as 0 mg with grains and *Callosobruchus maculatus* but there was no treatment. The synthetic pesticide used was applied in a concentration of 0.1g per 20 g of each legume seeds. The set up was allowed for (one month in other to observe all the stages of *C. maculatus*).Four weeks period and observations were made on daily basis to note the presence of *C. maculatus* eggs. When eggs were noticed (within 7 days), the adult *C. maculatus* deposited on the set up was removed. Then the seeds with eggs were left undisturbed and the animal specimens monitored for their developmental stages.

Data analysis:

All the experimental data were reported as mean value ± SE. The statistical analysis was performed by one way analysis of variance and means were compared by least significance difference test (P<0.05) using the SPSS statistical software package.

Results

There was decreased natality of *Callosobruchus maculatus* with the application of botanicals in all studied grains during the study period (Table 1). Natality of *C. maculatus* was dependent on biopesticide concentration as higher concentration doses decreased natality of pests significantly (Table 1). The least number of pest was seen in the grains with pirimiphos methyl at the egg stage viz 2.00±0.21 for *Vigna unguiculata,* 2.00±0.21 for *C. cajan* and 3.00±0.21 for *V. subterranea* while at the adult stage, no pest survived with pirimiphos methyl. The biopesticides used acted variously where the best result that yielded least *C. maculatus* was seen in *Aframomum melegueta* for all the grains sampled at the highest dose rate viz 11.75±0.08 at egg stage and 8.00±0.00 at adult stage for *V. unguiculata*,13.25±1.38 at egg stage and 8.50±0.05 at adult stage for *C. cajan*, 12.00±0.00 at egg stage and 8.75±0.95 at adult stage for *V. subterranea* followed by *Capsicum nigrum* viz 11.00±2.65 at egg stage and 8.25±0.00 at adult stage for *V.unguiculata*, 15.00±4.60 at egg stage and 10.00±3. 08 at adult stage for *C. cajan*, also 12.27±0.78 at egg stage and 9.25±0.02 at adult stage for *V. subterranea,* while the biopesticide that produced least result was seen in *Zingiber officinale* viz 20.75±1.80 at egg stage and 11.75±0.08 at adult stage for *V. unguiculata*, 29.50±8.67 at egg stage and 19.75±0.50 at adult stage for *C. cajan*, also 26.25±0.02 at egg stage and 16.75±0.08 at adult stage for *V. subterranea*. All other biopesticides acted alike and were effective compared with the control (table 1)

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Table 1: Biopesticidal effects botanicals on the natality rate of *Callosobruchus maculatus* in some selected legumes.

Grain	Biopesticide	Conc.	Egg stage	Larva stage	Adult stage	P- value
Vigna unguiculata	*Aframomum melegueta*	0g	28.25±1.65	20.75±2.56	18.00±2.94	0.01
		0.2g	20.75±1.80	17.00±1.29	16.50±1.04	0.01
		0.4g	15.50±5.56	16.75±3.15	15.75±2.78	0.01
		0.6g	15.75±1.38	14.75±1.11	14.00±1.08	0.01
		0.8g	13.00±1.08	11.75±0.08	11.75±0.08	0.01
		1.0g	11.75±0.08	8.00±0.00	8.00±0.00	0.01
	Capsicum nigrum	0g	37.75±9.53	11.50±2.96	20.50±8.31	0.01
		0.2g	22.75±6.06	12.25±3.28	13.50±5.11	0.01
		0.4g	24.25±9.40	21.75±8.75	10.00±3.08	0.01
		0.6g	28.50±7.93	16.00±7.40	14.00±7.36	0.01
		0.8g	19.25±2.42	10.25±2.14	7.50±2.63	0.01
		1.0g	11.00±2.65	9.50±2.18	8.25±0.00	0.01
	Allium sativum	0g	29.25±7.95	13.50±3.48	12.75±3.33	0.01
		0.2g	12.25±2.75	4.50±0.65	13.75±0.48	0.01
		0.4g	20.25±3.64	13.75±1.60	13.50±1.76	0.01
		0.6g	13.25±2.29	17.00±1.47	16.25±1.65	0.01
		0.8g	16.12±1.86	15.00±1.78	12.50±0.90	0.01
		1.0g	12.12±0.02	11.00±0.00	11.50±0.05	0.01
	Zingiber officinale	0g	57.50±12.52	29.75±8.71	28.50±8.07	0.01
		0.2g	27.50±1.95	14.50±7.29	13.25±7.33	0.01
		0.4g	18.00±6.12	18.00±1.35	17.50±0.87	
		0.6g	25.25±3.40	18.25±1.11	16.25±0.63	0.01
		0.8g	23.00±4.50	14. 25±0.75	13.75±0.48	0.01
		1.0g	20.75±1.80	12.00±0.01	11.75±0.08	0.01

	Azadiracta indica	0g	32.50±9.28	13.25±2.78	11.50±2.25	0.01
		0.2g	24.25±11.30	18.75±3.20	17.50±2.63	0.01
		0.4g	22.50±7.60	19.50±2.72	18.50±3.28	0.01
		0.6g	24.25±12.26	17.00±2.12	16.25±1.97	0.01
		0.8g	17.15±2.43	14.50±2.18	14.00±1.08	0.01
		1.0g	15.45±1.12	12.00±0.01	11.75±0.08	0.01
	Ocimum gratissimum	0g	34.50±10.07	12.00±4.74	11.25±4.59	0.01
		0.2g	33.25±11.72	11.00±3.89	19.25±3.94	0.01
		0.4g	30.75±10.64	11.50±4.17	10.75±3.71	0.01
		0.6g	24.00±7.30	18.00±2.16	17.00±2.38	0.01
		0.8g	13.50±3.48	14.00±1.08	12.75±0.95	0.01
		1.0g	13.00±0.69	13.00±0.00	11.50±0.05	0.01
	Pirimiphos methyl	0.1g	2.00±0.21	00.00±0.00	00.00±0.00	0.00
Cajanus cajan	*Aframomum melegueta*	0g	23.25±4.05	15.50±3.57	11.25±3.82	0.01
		0.2g	20.75±3.04	12.50±1.89	16.25±1.65	0.01
		0.4g	17.00±3.16	11.25±2.50	15.00±2.65	0.01
		0.6g	21.25±2.46	12.25±2.72	14.00±0.41	0.01
		0.8g	19.25±2.42	11.00±2.25	12.75±0.95	0.01
		1.0g	13.25±1.38	10.75±1.15	8.50±0.05	0.01
	Capsicum nigrum	0g	30.25±7.33	25.50±6.96	20.25±4.46	0.01
		0.2g	29.75±3.90	25.75±3.52	19.50±4.73	0.01
		0.4g	23.50±2.90	19.50±2.36	12.25±2.02	0.01
		0.6g	20.00±4.04	16.25±4.11	11.50±3.59	0.01
		0.8g	16.50±6.20	13.00±2.58	10.75±3.71	0.01
		1.0g	15.00±4.60	9.15±3.94	10.00±3.08	0.01
	Allium sativum	0g	29.50±6.89	17.25±1.38	21.75±7.14	0.01
		0.2g	19.75±2.29	15.75±2.17	21.75±2.46	0.01
		0.4g	21.75±1.11	23.00±6.24	19.50±2.06	0.01
		0.6g	19.75±5.20	12.75±3.25	10.50±2.99	0.01
		0.8g	18.00±7.36	11.50±2.96	12.75±0.95	0.01
		1.0g	16.25±1.65	11.75±3.12	11.50±0.05	0.01
	Zingiber officinale	0g	49.25±15.31	24.00±5.21	21.25±4.37	0.01
		0.2g	32.00±5.58	28.75±1.18	17.75±1.49	0.01
		0.4g	25.25±4.50	21.75±3.71	13.00±4.53	0.01
		0.6g	33.25±10.77	20.25±10.42	16.75±10.08	0.01
		0.8g	30.75±5.38	14.75±0.63	14.25±0.75	0.01
		1.0g	29.50±8.67	12.25±0.35	19.75±0.50	0.01

	Azadiracta indica	0g	50.50±8.84	22.50±4.33	19.50±4.43	0.01
		0.2g	30.25±15.28	13.75±2.53	22.00±2.48	0.01
		0.4g	30.75±5.38	12.75±3.42	21.50±3.38	0.01
		0.6g	20.50±3.01	11.25±4.61	20.75±4.77	0.01
		0.8g	29.75±18.76	19.75±3.94	20.00±3.08	0.01
		1.0g	28.25±18.47	18.25±2.66	12.25±3.07	0.01
	Ocimum gratissimum	0g	50.50±11.15	20,25±5.45	17.75±5.54	0.01
		0.2g	40.25±12.82	16.25±4.27	13.75±2.29	0.01
		0.4g	24.25±7.04	16.25±2.84	15.00±3.92	0.01
		0.6g	28.50±6.75	17.50±2.78	15.75±2.56	0.01
		0.8g	18.25±2.66	14.25±7.50	12.50±2.70	0.01
		1.0g	17.75±3.42	13.25±2.78	11.25±5.18	0.01
	Pirimiphos methyl	0.1g	2.00±0.21	1.00±0.00	00.00±0.00	0.00
Vigna subterranea	*Aframomum melegueta*	0g	26.50±14.26	22.25±2.14	20.00±1.78	0.01
		0.2g	22.00±4.51	16.75±1.38	16.50±1.19	0.01
		0.4g	18.25±4.73	15.25±1.03	14.25±0.75	0.01
		0.6g	16.25±2.14	16.25±1.49	14.75±1.60	0.01
		0.8g	16.00±0.01	14.25±0.75	13.50±0.97	0.01
		1.0g	12.00±0.00	9.25±0.38	8.75±0.95	0.01
	Capsicum nigrum	0g	43.50±1.71	22.25±1.65	20.00±1.35	0.01
		0.2g	21.50±6.20	19.25±1.70	17.25±1.44	0.01
		0.4g	14.75±7.85	15.00±1.68	16.00±0.71	0.01
		0.6g	13.75±8.53	12.75±2.95	10.75±3.17	0.01
		0.8g	14.00±7.85	13.25±0.38	12.75±0.95	0.01
		1.0g	12.27±0.78	10.75±0.95	9.25±0.02	0.01
	Allium sativum	0g	30.25±1.86	19.75±3.94	18.50±3.48	0.01
		0.2g	31.25±1.57	18.00±2.04	16.50±1.66	0.01
		0.4g	27.00±1.00	15.75±3.12	14.50±2.18	0.01
		0.6g	12.00±2.74	18.50±2.10	16.00±1.58	0.01
		0.8g	22.75±6.06	13.00±0.71	13.00±0.71	0.01
		1.0g	18.00±4.02	11.75±0.75	11.50±0.05	0.01
	Zingiber officinale	0g	58.75±1.66	26.00±3.58	22.50±2.96	0.01
		0.2g	29.00±1.11	18.75±4.09	21.25±3.28	0.01
		0.4g	16.00±4.56	16.50±3.23	19.25±2.93	0.01
		0.6g	34.75±1.40	15.75±2.78	18.25±2.66	0.01
		0.8g	12.75±0.95	13.25±0.38	17.25±0.65	0.01

	1.0g	26.25±0.02	11.00±0.00	16.75±0.08	0.01
Azadiracta indica	0g	69.50±1.25	25.75±7.43	23.00±4.60	0.01
	0.2g	26.50±1.18	19.25±4.13	17.25±3.68	0.01
	0.4g	12.00±1.08	16.00±0.41	14.75±0.63	0.01
	0.6g	44.00±1.52	15.75±7.09	13.00±6.61	0.01
	0.8g	12.75±0.95	13.75±0.48	13.50±0.97	0.01
	1.0g	11.25±0.02	12.25±0.65	11.50±0.05	0.01
Ocimum gratissimum	0g	49.00±1.31	13.75±4.59	10.75±3.84	0.01
	0.2g	19.50±1.67	16.00±2.68	14.50±1.89	0.01
	0.4g	16.00±9.35	12.50±6.36	10.75±5.71	0.01
	0.6g	18.50±2.90	11.00±5.15	19.00±4.08	0.01
	0.8g	17.50±1.95	19.50±2.98	17.25±3.68	0.01
	1.0g	11.50±2.18	18.00±2.04	10.50±1.24	0.01
Pirimiphos methyl	0.1g	3.00±0.21	1.08±0.00	00.00±0.00	0.00
$LSD_{(0.05)}$		23.25	10.08	9.48	
P-value		0.01	0.01	0.01	

Table 2: Efficacy and Performance of Biopesticide Concentrations on Natality Activites of *Callosobruchus maculatus* in Grains

CONCENTRATION	STAGE	BIOPESTICIDES	GRAINS *V. unguiculata*	*C. cajan*	*V. subterranea*
0g	E28	*Aframomum melegueta*	28.25 [b]	17.00 [a]	10.25 [a]
		Capsicum nigrum	24.25 [a]	30.25 [a]	25.75 [a]
		Allium sativum	20.25 [a]	19.75 [a]	30.25 [a]
		Zingiber officinale	18.00 [a]	49.25 [b]	58.75 [b]
		Azadiracta indica	32.50 [a]	50.50 [b]	69.50 [b]
		Ocimum gratissimum	30.75 [a]	28.50 [a]	49.00 [b]
	L28	*Aframomum melegueta*	15.75 [a]	11.25 [a]	6.25 [a]
		Capsicum nigrum	11.50 [a]	25.50 [a]	12.75 [a]
		Allium sativum	13.75 [a]	12.75 [a]	9.75 [a]
		Zingiber officinale	8.00 [a]	24.00 [b]	16.00 [a]
		Azadiracta indica	13.25 [a]	22.50 [a]	18.75 [a]
		Ocimum gratissimum	11.50 [a]	17.50 [a]	13.75 [a]
	A28	*Aframomum melegueta*	14.00 [a]	10.00 [a]	4.75 [a]
		Capsicum nigrum	10.00 [a]	20.25 [a]	9.75 [a]
		Allium sativum	13.50 [a]	10.50 [a]	8.50 [a]
		Zingiber officinale	7.50 [a]	21.25 [a]	12.50 [a]
		Azadiracta indica	11.50 [a]	19.50 [a]	13.00 [a]
		Ocimum gratissimum	10.75 [a]	15.75 [a]	10.75 [a]
0.2g	E28	*Aframomum melegueta*	10.75 [a]	09.75 [a]	12.00 [a]
		Capsicum nigrum	12.25 [a]	19.75 [a]	12.00 [a]
		Allium sativum	22.75 [a]	29.75 [a]	16.50 [a]
		Zingiber officinale	57.50 [b]	25.25 [a]	29.00 [a]
		Azadiracta indica	24.25 [a]	20.50 [a]	26.50 [a]
		Ocimum gratissimum	33.25 [a]	50.50 [b]	16.00 [a]

	L28	*Aframomum melegueta*	4.00 [a]	12.50 [a]	6.75 [a]
		Capsicum nigrum	12.25 [a]	12.75 [a]	7.25 [a]
		Allium sativum	7.50 [a]	15.75 [a]	8.00 [a]
		Zingiber officinale	29.75 [b]	15.75 [a]	8.75 [a]
		Azadiracta indica	8.75 [a]	13.75 [a]	9.25 [a]
		Ocimum gratissimum	11.00 [a]	20.25 [a]	6.00 [a]
	A28	*Aframomum melegueta*	5.50 [a]	8.25 [a]	6.50 [a]
		Capsicum nigrum	3.50 [a]	11.50 [a]	5.25 [a]
		Allium sativum	13.75 [a]	19.75 [a]	6.50 [a]
		Zingiber officinale	28.50 [b]	13.00 [a]	6.25 [a]
		Azadiracta indica	7.50 [a]	12.00 [a]	7.25 [a]
		Ocimum gratissimum	9.25 [a]	17.75 [a]	4.50 [a]
0.4g	E28	*Aframomum melegueta*	15.50 [a]	10.25 [a]	11.25 [a]
		Capsicum nigrum	17.75	13.50 [a]	14.75 [a]
		Allium sativum	29.25	21.75 [a]	27.00 [a]
		Zingiber officinale	27.50 [a, b]	32.00 [b]	16.00 [a]
		Azadiracta indica	22.50 [a]	30.75 [b]	12.00 [a]
		Ocimum gratissimum	34.50	24.25 [a]	28.50 [a]
	L28	*Aframomum melegueta*	8.75 [a]	15.50 [a]	5.25 [a]
		Capsicum nigrum	11.00 [a]	11.25 [a]	5.00 [a]
		Allium sativum	13.50 [a]	17.25 [a]	5.75 [a]
		Zingiber officinale	14.50 [a]	15.75 [a]	6.50 [a]
		Azadiracta indica	9.50 [a]	12.75 [a]	6.00 [a]
		Ocimum gratissimum	12.00 [a]	16.25 [a]	12.50 [a]
	A28	*Aframomum melegueta*	7.75 [a]	11.25 [a]	4.75 [a]
		Capsicum nigrum	8.00 [a]	12.25 [a]	3.00 [a]
		Allium sativum	12.75 [a]	9.50 [a]	4.50 [a]
		Zingiber officinale	13.25 [a]	7.75 [a]	5.25 [a]
		Azadiracta indica	14.50 [a]	11.50 [a]	4.75 [a]
		Ocimum gratissimum	11.25 [a]	13.75 [a]	10.75 [a]
0.6g	E28	*Aframomum melegueta*	9.75 [a]	11.25 [a]	10.50 [a]
		Capsicum nigrum	08.50 [a]	10.00 [a]	13.50 [b]
		Allium sativum	13.25 [a]	29.50 [b]	31.25 [b]
		Zingiber officinale	25.25 [a]	33.25 [a]	34.75 [a]
		Azadiracta indica	24.25 [a]	30.25 [a, b]	44.00 [b]
		Ocimum gratissimum	24.00 [a]	40.25	29.50 [a]
	L28	*Aframomum melegueta*	4.75 [a]	12.25 [a]	6.25 [a]
		Capsicum nigrum	07.75 [a]	11.25 [a]	11.25 [a]
		Allium sativum	21.00 [a]	23.00 [b]	8.50 [a]
		Zingiber officinale	8.25 [a]	28.25 [b]	9.75 [a]
		Azadiracta indica	7.00 [a]	16.25 [a]	15.75 [a]
		Ocimum gratissimum	8.00 [a]	16.25 [a]	22.00 [a]
	A28	*Aframomum melegueta*	4.00 [a]	7.00 [a]	6.50 [a]
		Capsicum nigrum	5.50 [a]	6.50 [a]	7.00 [a]
		Allium sativum	6.25 [a]	21.75 [b]	16.00 [a]
		Zingiber officinale	6.25 [a]	26.75 [b]	18.25 [a]
		Azadiracta indica	6.25 [a]	10.75 [a]	13.00 [a]
		Ocimum gratissimum	7.00 [a]	15.00 [a]	9.00 [a]

0.8g	E28	*Aframomum melegueta*	4.50 [a]	6.00 [a]	5.50 [a]
		Capsicum nigrum	6.50 [a]	4.50 [a]	8.00 [a]
		Allium sativum	6.25 [a]	18.75 [b]	16.00 [a]
		Zingiber officinale	7.25 [a]	26.75 [b]	28.25 [a]
		Azadiracta indica	8.25 [a]	10.75 [a]	13.00 [a]
		Ocimum gratissimum	10.00 [a]	25.00 [a]	11.00 [a]
	L28	*Aframomum melegueta*	3.00 [a]	9.00 [a]	8.50 [a]
		Capsicum nigrum	7.50 [a]	8.50 [a]	5.00 [a]
		Allium sativum	6.25 [a]	21.75 [b]	16.00 [a]
		Zingiber officinale	9.25 [a]	26.75 [b]	18.25 [a]
		Azadiracta indica	10.25 [a]	10.75 [a]	13.00 [a]
		Ocimum gratissimum	11.00 [a]	35.00 [a]	20.00 [a]
	A28	*Aframomum melegueta*	3.00 [a]	8.00 [a]	7.50 [a]
		Capsicum nigrum	6.50 [a]	7.50 [a]	8.00 [a]
		Allium sativum	9.25 [a]	21.75 [b]	16.00 [a]
		Zingiber officinale	13.25 [a]	26.75 [b]	18.25 [a]
		Azadiracta indica	15.25 [a]	10.75 [a]	13.00 [a]
		Ocimum gratissimum	17.00 [a]	19.00 [a]	19.00 [a]
1.0g	E28	*Aframomum melegueta*	4.75 [a]	12.25 [a]	6.25 [a]
		Capsicum nigrum	07.75 [a]	11.25 [a]	11.25 [a]
		Allium sativum	21.00 [a]	23.00 [b]	8.50 [a]
		Zingiber officinale	8.25 [a]	28.25 [b]	9.75 [a]
		Azadiracta indica	7.00 [a]	16.25 [a]	15.75 [a]
		Ocimum gratissimum	8.00 [a]	16.25 [a]	22.00 [a]
	L28	*Aframomum melegueta*	5.05 [a]	08.25 [a]	6.15 [a]
		Capsicum nigrum	06.55 [a]	10.25 [a]	11.55 [a]
		Allium sativum	19.00 [a]	33.00 [b]	18.50 [a]
		Zingiber officinale	8.25 [a]	21.25 [b]	9.75 [a]
		Azadiracta indica	17.00 [a]	17.25 [a]	15.75 [a]
		Ocimum gratissimum	18.00 [a]	14.25 [a]	22.00 [a]
	A28	*Aframomum melegueta*	4.75 [a]	4.25 [a]	6.25 [a]
		Capsicum nigrum	03.75 [a]	5.25 [a]	6.00 [a]
		Allium sativum	19.00 [a]	23.00 [b]	8.50 [a]
		Zingiber officinale	18.25 [a]	28.25 [b]	9.75 [a]
		Azadiracta indica	11.00 [a]	15.25 [a]	14.75 [a]
		Ocimum gratissimum	28.00 [a]	26.25 [a]	21.00 [a]
LSD ($p \leq 0.05$) 14.46					

Superscript with the same letter not significant

Superscript with different letter significant

The result showed a significant difference between the performance of the treatment at egg and adult stages but there was no significant difference in larva and Adult stages. (P<0.01) (Table 1)

The FLSD showed that there were significant differences in the actions of the biopesticide concentrations used in the study.

The proximate result of the legume grains used in this study revealed the percentage levels of the nutrients contained in them (Table3). The proximate result revealed that moisture level in cowpea (6.95%) is approximately similar to that of *Cajanus cajan* (8.1%) and both are significantly different from that of *Vigna subterranea* (1.2%). The ash, fat and crude fibre percentages in the three legumes

The protein percentage of *V. unguiculata* (24.44%) differed not significantly from that of *V. subterranea* (22.60%) and *C. cajan* (21.08). (Table 3)

The carbohydrate content of *V. unguiculata* (56.66%) differed significantly from that of *V. subterranea* (64.22%) and *C. cajan* (63.29%)

Table 3: Proximate analysis of leguminous grains

	% Composition		
Nutrients	*Vigna unguiculata*	*Vigna subterranean*	*Cajanus cajan*
Moisture	6.95	1.2	8.1
Ash	4.3	3.65	3.35
Fat	5.5	6.5	2.5
Crude fibre	2.15	1.83	1.68
Protein	24.44	22.60	21.08
Carbohydrate	56.66	64.22	63.29

Table 4: Phytochemical composition of varied botanicals studied for their biopesticidal activities

		Azadiracta indica	*Aframomum Melegueta*	*Capsicum Nigrum*	*Allium sativum*	*Zingiber officinale*	*Ocimum gratissimum*
1.	Alkaloids	+	+++	++++	++++	++++	+
2.	Glycosides	+++	+++	+++	+++	++++	++++
3.	Saponins	++	-	+	+	-	+++
4.	Tannins	++	++++	-	-	-	++
5.	Reducing sugar	+	++	+++	+	+	++
6.	Steroids	+	++++	+	+++	++	+
7.	Terpenoids	+	++++	+	+++	++	+
8.	Acidic compounds	-	-	-	+	-	-
9.	Flavonoids	+	++++	+	-	++	+++
10.	Resins.	+	+	++++	-	+	+

Key: **-** Not present, + present in very small concentration, ++ present in moderately high concentration, +++ present in very high concentration, ++++ abundantly present

The phytochemical studies of the six biopesticides used in this study indicated that alkaloids were abundantly (++++) present in *Capsicum nigrum*, *Allium sativum* and *Zingiber officinale*. It was also found to be present in high concentration (+++) in *Aframomum melegueta* and present in very small concentration (+) in *Azadiracta indica* and *Ocimum gratissimum*. Similarly, glycosides were found to be abundantly present in *Z. officinale* and *O. gratissimum*, present in high concentration in *A. indica*, *A. melegueta*, *C. nigrum* and *A. sativum*. Moreso, Saponins were present in high concentration in *O. gratissimum*, moderately (++) present in *A. indica*, present in very small concentration in *C. nigrum* and *A. sativum* and absent (**-**) in *A. melegueta* and *Z. officinale* (Table 4). Tannins were found to be abundantly present in *A. melegueta*, moderately present in *A. indica* and *O. gratissimum* and absent in *C. nigrum*, *A. sativum* and *Z. officinale*. Furthermore, reducing sugar was present in high concentration in *C. nigrum*, moderately present in *A. melegueta* and *O. gratissimum*, present in very small concentration in *A. indica*, *A. sativum* and *Z. officinale*. Steroids and terpenoids were abundantly present in *A. melegueta*, highly present in *A. sativum*, moderately present in *Z. officinale* and present in small concentration in *A. indica*, *C. nigrum* and *O. gratissimum*. Acidic compounds were not present in the biopesticides studied, except in. *sativum* where it was present in very *A* small concentration. Flavonoids were abundantly present in *A. melegueta*, present in high concentration in *O. gratissimum*, moderately present in *Z. officinale*, present in very small concentration in *A. indica* and *C. nigrum* and was absent in *A. sativum*. Lastly Resins were abundantly present in *C. nigrum*, present in very small concentration in *A. indica*, *A. melegueta*, *Z. officinale* and *O. gratissimum* and was absent in *A. sativum* (Table 4).

Discussion

The biopesticide treatments were variously effective since they caused decrease in natality of *C. maculatus* especially at the highest dose rate. *A. melegueta* and *C. nigrum* were very effective in inhibiting natality of *C. maculatus*, therefore, it could be infered that they can replace synthetic pesticide in natality studies.It has been reported that some pests have grown resistance to aluminium phosphate and that some synthetic pesticides such as methyl bromide are carcinogenic [7]. The natality of eggs and adults were inversely proportional to each other unlike the larva and adult that were directly proportional. This is similar with [26] where the activities of *Aegle marmelos* (L) *correa* essential oil against four stored grain insect pests were studied

From this study, it was observed that higher concentration of treatments significantly reduced all stages of natality of *C. maculatus*. This is in consonance with the work of Olaifa and Erhun (1998) who worked with *Piper guineensis* and found that it significantly reduced emergence of adult and egg laying.

It has been reported by[2] **and [25]** that botanicals inhibited adult emergence in C. *maculatus* in cowpea. The present work is in agreement with this result because even amongst the 3 legumes studied, treated cowpea (*V. unguiculata*) experienced the least natality of *C. maculatus*. This can be attributed to the fact that cowpea is a preferred host for *C. maculatus* than other legumes probably because of the nutrient level of the grain and nature of seed endosperm [6]**, [31]**.

They also submitted that even when the eggs are attached to treated seeds, the toxic substance present in the extract may enter in to the egg through chorion and suppress further embryonic development. The present study agreed with this report because adult emergence was greatly reduced in treated seeds than control seeds.

The differential performance of biopesticide treatments at the highest dose rate and synthetic pesticide used in this study can be attributed to the constituent and active ingredient present in them.

Proximate studies revealed that legumes contain high concentration of protein, carbohydrates and dietary fibre and make important contributions to human diet in many countries [5]**.** The present work agreed with this statement where the proximate result revealed the percentage levels of nutrient constituents in leguminous grains studied and it was seen that they contained high percentages of protein and carbohydrate. Studies by **[4] and [5]** have revealed that the nutritional value of grain legumes includes high protein and lysin content which allows legumes to serve as excellent protein supplement to cereal grains. The health related value of legume includes their positive effect on blood cholesterol and glucose levels [32]**; [14])** possibly through the dietary fibre present in them.

The moisture percentages of legumes in the present work agreed with the work of **[22] and [15]**. The protein level of the legume seeds studied differed with the report of[15] who worked with guar gum seed, but the differences in the protein percentages of these legumes was attributed to variations in the seed types and processing method. Following the result it could be suggest that *Aframomum melegueta* and *Capsicum nigrum* powders can replace synthetic pesticides in natality studies.

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