

Research Article

Effect of Piper Guineense and Dennettia Tripetala, two Insecticidal Plants on Eggs Laid by Female Callosobruchus maculatus on Infested Cowpea Seeds

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Abstract: A laboratory bioassay was carried out to determine the efficacy of two botanical powders, Piper guineense and Dennettia tripetala on the protection of cowpea seeds from a notorious pest Callosobruchus maculatus oviposition on infested cowpea seeds. Powders of particle sizes 212µm, 300 µm, 500 µm, 1000 µm controlled egg lay, adult emergence and number of holes bored on cowpea seeds by the beetle. The application of particle size 212 µm of P. guineense at 0.5 g/ 20 g seeds resulted in the lowest values of number of laid eggs, emerged adults and number of bored holes (3.21, 0.44 and 4.81 respectively). The control experiment recorded the highest mean number of laid eggs (77.02), emerged adult (47.77) and number of bored holes (66.49). A progressive increase in the mean number of egg laid, emerged adults and holes bored on cowpea seeds by adult beetle recorded in protected cowpea seeds was as a result of increase in the particle sizes of the powders. The effect of powders of Dennettia tripetala on egg laid, adult emergence and mean number of holes bored on cowpea seeds followed the same trend. Powders of P. guineense and D. tripetala have proven to be effective in the control of C. maculatus. As it causes reduction in egg laid, emerged adults and number of holes bored on cowpea seeds. Lowest values were also recorded at the application of 5 g/ 20 g seeds of cowpea in D. tripetala in the number of laid eggs, emerged F1 adults and number of bored holes (24.99, 11.80 and 17.48, respectively).

Keywords: Piper guineense, Dennettia tripetala, Egg laid, Emerged adults, Holes bored, Cowpea, Callosobruchus maculatus, particle sizes.

INTRODUCTION

Cowpea, Vigna unguiculata Walp is a leguminous crop of the family Fabaceae which is cultivated in the tropics [1]. It is an important source of vegetable proteins and a very cheap source of protein in the African sub-Saharan regions [2,3].

Over the years, cowpea an indigenous crop, has helped to fill in the gap of body protein requirement of the poor people in the tropics who could not afford animal source of protein [4]. The leaves and seeds can be processed into various edible forms such as Moimoi, Cookie Gbegiri, Red-Red Stew, Akara, Koki, Ndambe, Bread, Kathiak, Couscous, and Ekuru [5,6]. Despite the importance of this crop, the problem of storage pest infestation has reduced the available consumable quantity to the lowest ebb which is a great challenge to the well-being of man [7-9].

The cowpea bruchid, Callosobruchus maculatus (Coleoptera: Chrysomelidae) is a notorious pest that ravages stored cowpea seeds in the tropical sub-Saharan region of the world [10,11]. Invasion of cowpea by beetle starts from the farm and completes its destructive prowess in the store, boring holes through the pods into

the seeds and reducing it into un-consumable non-nutritional powder of no value. Similarly, infested salvaged seeds are often found with bored holes and not good for planting due to loss in viability [12]. C. maculatus is known as a pest of virtually all pulses, this may be due to the palatability of this group of crops [11]. Piper guineense of the family Piperaceae found to be growing in the wet regions of West Africa. It is a spice which is derived from its dried fruit. It is known by different names by different people, these include Benin pepper, Ashanti pepper, etinkeni, Edo pepper, guinea pepper, masoro, false cubeb and kanafuru [13]. P. guineense contains between 5-8 % of the chemical piperine which is responsible for the spiciness, hotness and the pungent attribute of the plant [14].

D. tripetala is a member of the Annonaceae, a family confined to Eastern Nigeria and Cameroon was discovered to be effective in the control of C. maculatus. The presence of pyridine and benzylnitrite which are some of the compounds which constituted the phytochemicals present in D. tripetala must have been responsible for the activity in the botanical [15,16]. The effectiveness of insecticidal powder in the control of insect pests as protective for stored products have been reported (Ofuya and Osadahun, 2005; Babarinde et al.,

2015; Babarinde et al., 2016) [17,4,18]. The effect of mixing powders of *P. guineense* and *D. tripetala* on stored products have been reported (Dawodu and Ofuya, 2000). Despite the reports on the effectiveness of powders on the control of pest in storage, attention on the particle sizes of powders for greater efficacy need be reported. This has necessitated the report of this bioassay. Therefore, the objective of this study is to evaluate the effectiveness of particle size of powders of *P. guineense* and *D. tripetala* (a) on egg laid by *C. maculatus* and (b) to determine number of adults that emerged from the cowpea.

METHODOLOGY

Study site, Bruchid and cowpea

The study was carried out in the laboratory of the Department of Agricultural Science and Technology, Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti. Adult beetle were collected from an infested bag of cowpea from a local market, Oja-Oba in Ikere-Ekiti. The beetle were used to re-infest a clean un-infested variety of cowpea Ife Bimpe which were kept in a kilner jar. Generations of adult beetles used throughout the period of the bioassay were maintained at an ambient temperature of $35 \pm 5^\circ\text{C}$ and relative humidity of 70% in the laboratory. The cowpea variety used for the experiment was collected from Obafemi Awolowo University, Institute of Agricultural Research and Training, Moor Plantation Ibadan.

Insecticidal plant materials

Insecticidal plant parts, seeds of *Piper guineense* and fruits of *Dennettia tripetala* were obtained and authenticated from Forestry Research Institute of Nigeria, Ibadan. Each of the material was oven dried at a temperature of 40°C for 72 hours to a constant weight. Each plant part was grind into powder and sieved using Engineer standard sieve size $212\mu\text{m}$, $300\mu\text{m}$, $500\mu\text{m}$, $1000\mu\text{m}$. Each particle size of sieved powder was kept in a plastic container with a tightly fitted lid, labelled and kept on the shelf until being used for the bioassay under ambient conditions.

RESULTS AND DISCUSSION

The efficacy of *Piper guineense* on *Callosobruchus maculatus* oviposition and emergence of adult is presented in Fig. 1. The mean number of eggs laid by female *C. maculatus* on infested cowpea seeds protected with *P. guineense* powder at different particles sizes and doses shows that there were significant differences ($P < 0.05$) with respect to the effect of particle size and doses applied, but the interaction between particle size and doses applied was not significant ($P > 0.05$). Each dose applied significantly reduced oviposition by female beetle compared with the control. Regardless of the sizes of powder of *P. guineense* applied at 0.5 g/20 g of seed, significantly ($P < 0.05$) reduced oviposition by the female beetle when compared with the application of 0.1 g/20 g of seed. Also, regardless of the

applied dose, powder from *P. guineense* with particle size $212 \mu\text{m}$ significantly ($P < 0.05$) reduced oviposition by the beetle when compared with powder of particle size of $1000 \mu\text{m}$. Regardless of the particle sizes, all doses of *P. guineense* suppressed oviposition of *C. maculatus*.

The result of the effect of *P. guineense* doses and particle sizes on the F1 adult emergence follow the same trend with the result of oviposition deterrence. There were significant differences ($P < 0.05$) with respect to effect of particle size and doses applied, but the interaction between size of particles and doses applied was not significant ($P > 0.05$). Regardless of the dose applied, there were significant reduction in the number of adult beetles that emerged from the eggs laid on protected seeds when compared with the control, in all the particle sizes (Fig.2). Regardless of the particle sizes, application of *P. guineense* at 0.5 g/20 g of seed significantly reduced the number of adult beetles that emerged from the eggs oviposited on protected seeds compared with the application of 0.1 g/20 g of seed, except with particle size of $212 \mu\text{m}$. Also, regardless of the dose applied, *P. guineense* powder with particle size $212 \mu\text{m}$ caused significant reduction in the number of adult beetles that emerged from the eggs oviposited on the protected seeds compared with powder of particle size $1000 \mu\text{m}$, however when *P. guineense* powders with particle size $500 \mu\text{m}$ was applied at $0.2, 0.3, 0.4$ and 0.5 g/20 g of seed, adult beetle emergence was not significantly affected.

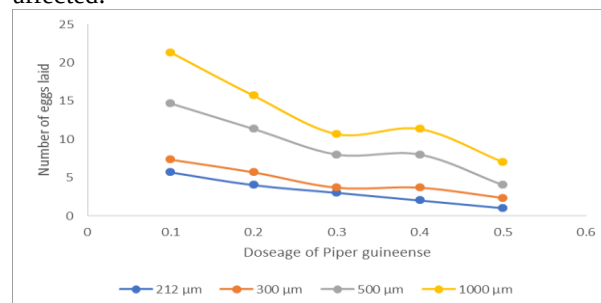


Fig.1: Mean number of eggs laid by female *Callosobruchus maculatus* on infested cowpea seeds protected with *Piper guineense* powders of different particle sizes and doses

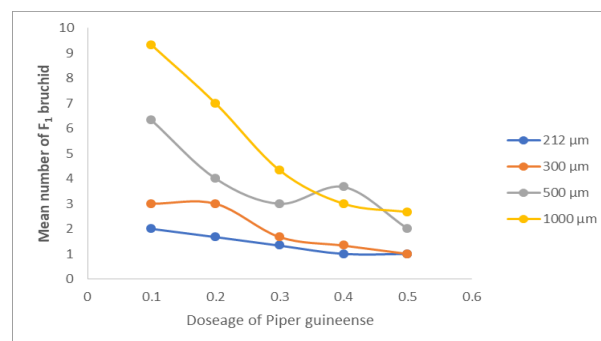


Fig.2: Mean number of adult beetles that emerged from eggs laid on cowpea protected with Piper guineense powder with different particle sizes and doses

The Efficacy of Insecticidal formulation from excipient materials and 212 μm particle size Piper guineense on oviposition, adult emergence and cowpea seeds damaged by Callosobruchus maculatus is presented in Table 1. The dosage of 212 μm particle size P. guineense significantly ($p < 0.05$) caused mortality of the beetle at all the period of observations as well as the number of eggs laid, the number of emerged F1 adult and the number of holes bored on cowpea seeds due to C. maculatus when compared with the control. Application of P. guineense at 0.5 g/20 g seeds consistently produced the highest mean number of dead bruchid at all observation periods (6.21, 7.88, 8.76, 9.57 and 9.96, respectively) while the control steadily resulted in the lowest mean number of dead bruchid (0.00). The control experiment however recorded the highest mean number of laid eggs (77.02), emerged F1 adult (47.77) and number of bored holes (66.49) while application of P. guineense at 0.5 g/ 20 g seeds resulted in the lowest values of number of laid eggs, emerged F1 adults and number of bored holes (3.21, 0.44 and 4.81 respectively).

The excipient materials had significant effect ($p < 0.05$) on the beetle mortality throughout the study period. It however had no significant effect on the number of eggs laid while it significantly influenced the number of holes bored and the number of emerged F1 bruchid (Table 1). Highest mortality of bruchid was recorded with seeds treated with the flour of cowpea pod, as it steadily increased with increase in the study period of 24 hours, 36 hours, 48 hours, 60 hours and 72 hours (4.48, 5.91, 6.64, 7.57 and 8.01, respectively) while the lowest

number of mortalities throughout the study was observed with seeds treated with rice bran powder (2.85, 4.32, 5.25, 6.57 and 7.28, respectively). There was no significant difference in the number of eggs laid on seeds treated with the excipient materials. The highest number of emerged F1 adults (14.69) was observed in rice bran and bored holes (25.04) while maize husk produced the lowest (13.40 and 22.48).

The formulation ratio significantly influenced mortality, oviposition, and adult emergence of F1 bruchid (Table 1). Ratio 70:30 formulation of P. guineense to each of the three excipients resulted in the highest mortality of bruchid between 24 and 60 HAT (5.22, 6.87, 7.44 and 7.78, respectively) while ratio 30:70 formulation resulted in the lowest mean mortality of adult C. maculatus (2.64, 4.14, 4.69 and 6.27, respectively). At 72 HAT, ratio 50:50 of P. guineense to each of the three excipients in the formulations resulted in the highest mean number of mortalities of bruchid (8.20) which was not significantly different from the mortality produced by 60:40 and 70:30 formulations while ratio 30:70 produced the lowest mortality of adult bruchid (7.51). With ratio 60:40, the highest mean oviposition (28.91) was recorded while the lowest mean number of eggs (20.97) occurred with ratio 40:60. Ratio 30:70 formulation produced the highest mean number of F1 adult emergence and mean number of bored holes on cowpea seeds (19.70 and 39.60, respectively). The interaction between the dose, excipient materials and the formulation ratio significantly influenced ($p < 0.05$) the mortality, F1 emergence and the number of holes bored on cowpea seeds but it had no significant effect on oviposition, (Table 1).

Table 1: Effects of treatment, excipient materials and the formulation ratios of Piper guineense at 212 μm on the mortality, oviposition, F1 emergence and hole bored on cowpea seeds by Callosobruchus maculatus

	Mortality at Hours After Treatment					Number of eggs laid	Emergent F ₁	Number of holes
	24	36	48	60	72			
Dose (g/20 g seed)								
0.10	2.21	4.19	5.40	7.37	8.36	29.91	18.47	27.55
0.20	3.16	5.21	6.51	8.07	8.88	20.41	11.15	20.5
0.30	4.63	6.27	7.40	8.67	9.32	12.09	5.07	13.79
0.40	5.64	7.12	7.83	8.97	9.64	7.11	1.99	8.73
0.50	6.21	7.88	8.76	9.57	9.96	3.21	0.44	4.81
Control	0.00	0.00	0.00	0.00	0.00	77.02	47.77	66.49
Excipient materials								
Cowpea pod	4.48	5.91	6.64	7.57	8.01	25.21	14.35	23.45
Maize husk	3.60	5.10	6.05	7.18	7.79	24.75	13.40	22.48
Rice bran	2.85	4.32	5.25	6.57	7.28	24.92	14.69	25.04
Ratio								
30:70	2.64	4.14	4.69	6.27	7.51	26.33	19.70	39.60
40:60	3.67	4.76	5.40	6.10	6.80	20.97	16.57	37.04
50:50	3.16	4.71	6.01	7.73	8.20	22.71	11.02	13.10
60:40	3.52	5.08	6.37	7.67	7.93	28.91	11.96	15.07
70:30	5.22	6.87	7.44	7.78	8.02	25.88	11.49	13.47

LSD Dose	0.28	0.29	0.26	0.19	0.16	2.52	1.67	1.86
LSD Exp mat	0.2	0.2	0.18	0.14	0.11	Ns	1.18	1.31
LSD Ratio	0.25	0.26	0.23	0.18	0.14	2.3	1.53	1.7
LSD D x E x R	***	***	***	***	***	Ns	***	***

The efficacy of powders of *Dennettia tripetala* on *Callosobruchus maculatus* oviposition and F_1 emergence is presented in Fig. 3. The mean number of eggs laid by female *C. maculatus* on infested cowpea seeds protected with *D. tripetala* powder at different particles sizes and doses shows that significant differences ($P < 0.05$) were observed at the application of each particle size and dose, but the interaction between particle sizes and doses applied were not significant ($P > 0.05$). Each dose applied caused significant reduction in egg laid by the bruchid when compared with the control. Regardless of particle sizes, *D. tripetala* applied at 0.5 g/ 20 g of seed significantly ($P < 0.05$) reduced egg laid by the bruchid when compared with the application of 0.1 g, 0.2 g and 0.3 g/20 g of seed. Also, regardless of the applied dose, powder from *D. tripetala* with particle size 212 μm significantly ($P < 0.05$) reduced egg laid by the bruchid when compared with powder of particle sizes 500 μm and 1000 μm . Regardless of the particle sizes, all doses of *D. tripetala* suppressed oviposition of *C. maculatus*.

The result of the effect of *D. tripetala* doses and particle sizes on the F_1 adult emergence follow the same trend with the result of oviposition deterrence. Significant differences ($P < 0.05$) were observed at the application of each particle size and at all the doses applied, but the interaction between particle sizes and doses applied were not significantly different ($P > 0.05$). Each dose applied significantly reduced F_1 beetle that emerged from the eggs laid on protected seeds by the bruchids compared with the control, in all of the particle sizes (Fig. 4). Regardless of the particle sizes, application of *D. tripetala* at 0.5 g/20 g of seed significantly reduced the number of F_1 beetle that emerged from the eggs laid on protected seeds compared with the application of 0.1 g and 0.2 g/20 g of seed. Also, regardless of the dose applied, *D. tripetala* powder with particle size 212 μm powder significantly reduced the number F_1 bruchid that emerged from the eggs laid by female *C. maculatus* on protected seeds compared with particle size 1000 μm , however. When *D. tripetala* powder with 500 μm was applied at 0.2, 0.3, 0.4 and 0.5 g/20 g of seed, oviposition was not significantly affected.

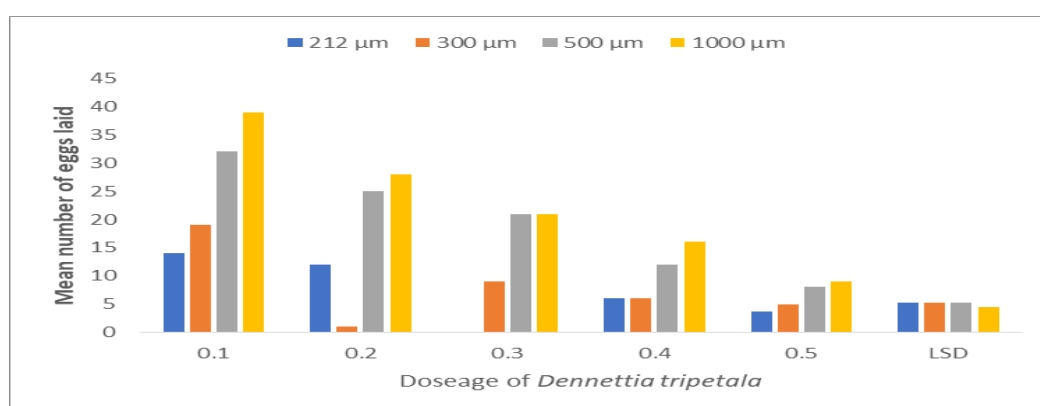


Fig.3: Mean number of eggs laid by female *Callosobruchus maculatus* on infested cowpea seeds protected with *Dennettia tripetala* powders of different particles sizes and doses

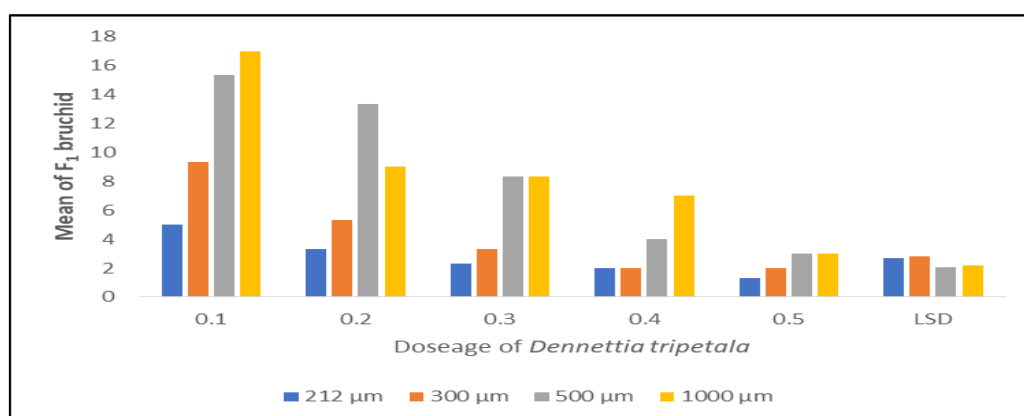


Fig.4: Mean of F_1 bruchid that emerged from eggs laid on cowpea protected with *Dennettia tripetala* powder with different particle sizes and doses

Efficacy of Insecticidal formulation from excipient materials and 212 μm particle size *Dennettia tripetala* on mortality, oviposition, F₁ emergence and cowpea seeds damaged by *Callosobruchus maculatus*

The interaction amongst doses, excipient materials and the formulation ratios significantly ($p < 0.05$) influenced adult beetle mortality, number of laid eggs, number of emerged F₁ adults and number of bored holes on cowpea seeds by *C. maculatus*.

The dosage of 212 μm particle size *D. tripetala* significantly ($p < 0.05$) caused mortality of the beetle at all the periods of observations as well as reduced number of eggs laid, the number of emerged F₁ adults and number of bored holes on cowpea seeds due to *C. maculatus* when compared with the control (Table 4.10). Application of *D. tripetala* 0.5 g/20 g seed consistently recorded the highest mean number of dead bruchids at all observation periods between 24 HAT and 72 HAT (2.01, 2.91, 3.64, 4.16 and 4.75, respectively) while the control steadily resulted in the lowest mean number of dead bruchids (0.00). The control experiment however recorded the highest mean number of laid eggs (116.21), emerged F₁ adults (91.45) mean number of bored holes (106.48) while application of *D. tripetala* at 0.5 g/20 g seeds resulted in the lowest values of number of laid eggs, emerged F₁ adults and number of bored holes (24.99, 11.80 and 17.48, respectively).

The excipient materials had no significant effect ($P > 0.05$) on bruchid mortality throughout the study period except at 24 HAT. It also had no significant effect on the number of eggs laid and the number of bored holes on cowpea seeds due to *C. maculatus* when compared with the control. It significantly influenced the number of emerged F₁ bruchids (Table 4.10). Highest mortality of bruchid was recorded in seeds treated with cowpea pod flour as it steadily increases with increased with time: 24 HAT, 36 HAT, 48 HAT, 60 HAT AND 72 HAT (0.98, 1.56, 2.03, 2.40 and 2.85, respectively) while lowest number of dead bruchid was observed in seeds treated with maize husk powder at 24 HAT and 60 HAT (0.88 and 2.33, respectively) and seeds treated with rice husk flour produced the lowest number of dead bruchids at 36 HAT (1.47).

There was no significant difference between the number of laid eggs and number of bored holes on seeds treated with the excipient materials. The highest number of emerged F₁ adult bruchids was observed in seeds treated with maize husk powder (37.56) while cowpea pod flour recorded the lowest (34.99). Similarly, there was no significant difference in the number of emerged F₁ adult from seeds treated with the excipient materials.

The formulation ratio significantly ($p < 0.05$) influenced mortality, oviposition, bored holes and emergence of the F₁ adult bruchid (Table 4.10). Ratio 50:50 formulation resulted in the highest number of dead adults bruchids at 24 HAT (1.27) while 30:70 formulation resulted in the lowest number of dead adult bruchid (0.60). Ratio 70:30 formulations steadily recorded the highest number of dead adults bruchids between 36 HAT and 72 HAT (2.40, 3.24, 4.14 and 4.88, respectively) while ratio 30:70 recorded the lowest mortality (0.79, 1.07, 1.24 and 1.40, respectively). With ratio 30:70 the highest number of oviposition, emerged F₁ and bored holes on seeds treated with cowpea seeds (26.36, 21.03 and 22.97, respectively) and ratio 70:30 formulation recorded the lowest oviposition, emerged F₁ and bored holes (26.36, 21.03 and 22.97, respectively).

Table 2: Effects of treatments, excipient materials and the formulation ratios of *Dennettia tripetala* at 212 μm on the mortality, oviposition, F₁ emergence and hole bored on cowpea seeds by *Callosobruchus maculatus*

Dose (g/20 g seed)	Mortality at Hour After Treatment					Number of eggs laid	Emergence of F ₁	Number of holes
	24	36	48	60	72			
0.1	0.35	0.83	1.16	1.57	2.03	54.03	38.31	45.37
0.2	0.61	1.24	1.77	2.31	2.71	47.96	32.56	40.31
0.3	1.13	1.81	2.32	2.79	3.31	40.05	25.16	31.47
0.4	1.57	2.32	2.88	3.35	4.07	31.33	16.44	23.32
0.5	2.01	2.91	3.64	4.16	4.75	24.99	11.80	17.48
Control	0.00	0.00	0.00	0.00	0.00	116.21	91.45	106.48
Excipient materials								
Cowpea pod	0.98	1.56	2.03	2.40	2.85	51.82	34.99	43.21
Maize husk	0.88	1.52	1.93	2.33	2.82	52.34	37.56	44.85
Rice bran	0.98	1.47	1.93	2.36	2.76	53.13	35.31	44.15
Ratio								
30:70	0.60	0.79	1.07	1.24	1.40	75.18	52.49	64.43
40:60	0.99	1.19	1.38	1.57	2.00	70.03	45.49	57.47
50:50	1.27	1.68	2.20	2.61	3.06	53.92	35.12	44.90

60:40	1.04	1.53	1.92	2.24	2.71	36.66	25.63	30.59
70:30	0.83	2.40	3.24	4.14	4.88	26.36	21.03	22.97
LSD Dose	0.13	0.16	0.17	0.19	0.17	1.97	3.23	2.74
LSD Exp mat	0.09	Ns	Ns	Ns	ns	Ns	2.28	Ns
LSD Ratio	0.12	0.15	0.15	0.17	0.15	2.87	2.94	2.50
LSD D x E x R	**	**	***	***	**	Ns	Ns	Ns

***, ** and * = significant at $p < 0.05$, and 0.05 probability levels respectively; ns = data not significant at $P > 0.05$.

DISCUSSION

Over the years, *C. maculatus* have caused man a great deal of reduction in the quantity of cowpea for feature usage. They have reduced the quality of the produce by contamination through excreta, dead remains, detached body parts and attraction of different types of micro-organisms which have acted and denatured unprotected produce [19,4]. The result of the study on *P. guineense* and *D. tripetala* shows that plants with insecticidal qualities are effective for the control of storage pests (Dawodu and Ofuya, 2000; Ofuya and Dawodu, 2002a; Babarinde et al., 2017a, Babarinde et al., 2017b, Dawodu et al., 2021) [1,20-23]. Regardless of the quantity of the insecticidal powders applied, both plants materials-controlled egg laid and the number of adult that emerged. This is consistent with previous works (Chukwulobe and Echezona, 2014; Olayinka-Olagunju, 2014) [24,25] that powders and extracts of *P. guineense* is effective in the control of adult bruchid in stored cowpea. In this bioassay, the efficacy of particle size has been found to have greater insecticidal effect on *C. maculatus* number of egg laid and adult emergence. Jayaram et al., (2022) [27] reported the ovicidal effect of the activities of botanicals against pulse beetle.

Dispersion of powder is easily influenced by the size of the powder thus greater surface area coverage is achieved with smaller particle sizes. This may be responsible for the why particle size 212 μm was most effective when compared with 300 μm , 500 μm and 1000 μm . Invariable, as beetle tries to reach out to cowpea seeds, it rubs both thorax and abdominal parts on the protected seeds thus tiny sizes of powder particles find their way into the respiratory tracts of the bruchid and causing a blockage of the structure which often lead to mortality. The use of varying proportions from rhizomes of *Zingiber officinale* (Rosc). exhibited effective control of *C. maculatus* [28]. Formulation ratio 70:30 *P. guineense* to each of (rice husk powder, cowpea pod powder and maize husk powder) was the most effective of all the ratios in the formulations, as the least number of eggs laid and the least number of adult emergences was recorded. A gradual increase in the number of eggs laid and emerged adults was recorded as the ratio of active ingredient to excipients in the formulations reduced.

D. tripetala fruit powders was observed to be effective in the control of *C. maculatus*. This was corroborated by earlier reports of (Ofua and Dawodu, 2002b; Bamphitihiet et al., (2015) [29,30] in the use of *D. tripetala*

as protectants to cowpea seeds for the control of infestation, damage and destruction in store. Irrespective of the particle size, 0.1- 0.5 g of the powder reduced number of egg laid and emerged adults significantly. This may have resulted from the fumigant effect or and contact toxicity of the powder to the adult bruchid and already laid eggs. This was corroborated by (Jayaram et al 2022) [27] when the number of eggs laid was observed to have reduced as a result of the reduction in the fecundity and reproductive ability of beetle when powders of *Azadirachta indica* seed powder was used to control *C. maculatus*. It was further observed in this experiment that size of particles of powder contributed to the efficacy of lower quantities of *D. tripetala* applied to control the bruchid. This is evident as *D. tripetala* was more effective in the control of older bruchids than the younger ones. A similar observation was made on the susceptibility of differently aged adults of *C. maculatus* when *D. tripetala* was used for its control in storage [31,32].

In the formulated powders used for the protection of cowpea seeds, the number of eggs laid and the number of adults *C. maculatus* that emerged were significantly reduced as a result of the ovicidal effects exhibited in the bioassay. This was corroborated by (Mahdi & Rahman, 2008; Ekehet et al., 2013) [33,34] in the assessment of the effect of mixing plant materials on the mortality and oviposition of *C. maculatus*. It was observed that when *D. tripetala* was used as active ingredient separately with excipient materials (rice husk powder, cowpea pod powder and maize husk powder) as formulated insecticides, it controlled egg laid, reduced the number of holes on the seeds and adult emergence. This is in line with earlier worker (Babarinde et al., 2011; Ukeh, 2011) [35,36] on the use of botanicals with insecticidal properties for the control of *C. maculatus* in store. It was observed that lowest egg laid and lowest adult emergence occurred when formulations with each of the excipient material with particle size 212 μm at 0.5 g was applied but the reverse is the case when particle size 1000 μm at 0.5 g was applied when formulated with each of the excipients. This suggest that, particle size is a function of the effectiveness of particle size 212 μm over 1000 μm . Similarly, the effectiveness of ratios in the formulations increased with higher active ingredients to excipient materials. Ratio 70:30 *D. tripetala*: excipients was the most effective in all the formulations. This is in line with previous worker on the effectiveness of higher ratios of botanical extracts in the control of insect pests.

In all, any of the excipient materials could be used in the formulations since there is no significant difference in the activity of the excipient materials as each perform the role of a carrier of the active ingredient causing effective control of the target bruchid. This was corroborated by earlier workers in a laboratory experiment on the use of botanicals for the control *C. maculatus* [34].

CONCLUSION

In conclusion, *P. guineense* and *D. tripetala* has significant effect on the control of the number of eggs laid and emerged adults from cowpea in storage. Although, powders of *P. guineense* was observed to be more effective when compared with powders from *D. tripetala*. Particle size 212 μm at a dosage of 0.5 g was the most effective formulation in the bioassay. Any of the excipient materials will be good enough as a carrier to deliver the active ingredient to the target pest. Therefore, both powders are hereby recommended for the control of egg lay and adult emergence of *C. maculatus* in storage.

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