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The efficacy of spindor dust (0.125% spinosad) in controlling the kola weevil, *Balanogastris kolae* (Desbr) infesting kolanuts in storage

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ABSTRACT: The efficacy of Spindor dust for the control of the kola weevil, *Balanogastris kolae* (Desbr.) was investigated in the laboratory at ambient temperature of 27 ±2^{o}C; 70±5 relative humidity and 12:12 h photoperiod. The insecticide was tested at three concentrations 2.5, 5 and 10g powder/kg of cured kolanuts. These were compared with the untreated nuts (control). Spindor dust was toxic to *B. kolae*, especially at 5 and 10g/kg concentrations. At 5g/kg and 10g/kg concentrations, Spindor dust caused high mortality of 93% and 100% on introduced weevils after 7 days whereas a total mortality was recorded 14 days after treatment. The level of weevil damage decreased with increase in concentration of Spindor dust. The mean number of feeding holes observed on nuts treated with 2.5g/kg, 5g/kg and 10g/kg concentration were 48.25, 17.13 and 4.55, respectively. No significant difference was observed between values obtained for the 5g/kg and 10g/kg concentrations in terms of percentage larval mortality. Spindox applied at the three different concentrations was found no to taint the kolanuts as the taste of the nuts were not affected. Therefore, spindor is an insecticide that could be explored by farmers to control *B. kolae* during primary processing and in storage of kolanuts.

Key Words: *Balanogastris kola;* Spindor dust ,Spinosad; Cured kolanuts; Weevil damage.

Introduction

Kolanut is a genus of the family Sterculiaceae in the order Malvales and *Cola nitida* is the species that is widely cultivated across West Africa, and Nigeria accounts for about 70% of the total World production (Daramola 1981). Apart from being consumed as a masticatory because of its stimulating property, the crop is useful in pharmaceutical and confectionery industries, where the essential oils and chemicals such as caffeine; theobromine and kolatine are utilized (Ogutuga, 1975). The development of the kola tree from seedling to maturity is characterized by problems such as nut dormancy; delay in flower initiation; low percentage fruit–set; incompability problems, (self and cross incompatibility) and inconsistent production of fruits and flowers (Ejinatten, 1973). Also, the long juvenile period (6-7 years) and the period of attainment of peak production (15-20 years) in kola cultivation constitute a major constraint to kolanut production in Nigeria (Odegbaro, 1973). The problems posed by insect pests most especially the kola weevils - *Balanogastris kolae* and *Sophrorhinus* species are of immediate importance to the current sub-optimal production level. The kola weevils, both as field and storage pests of kolanuts, cause between 30-

70% damage on stored nuts, and are capable of causing total damage (100%) in cases of delayed harvest and in storage (Daramola, 1983, Ojelade, 2000). The weevils feed, oviposit and complete their life-cycle entirely within the nuts, hence, fouling and lowering the market value of nuts, as well as exposing nuts to secondary invasion by other micro-organism especially fungi (Daramola, 1981, Ivbijaro, 1976 and Odebode 1990).As a result of the height of the kola tree (12m to 18m) and the blending of the kola pods with the tree canopy, efforts made towards the control of the kola weevils were concentrated mainly on the use of weaker concentration of such synthetic insecticides during primary processing stages and storage as Gammalin 20 E.C. (lindane), Actellic 25E.C.(Pirimiphos-methyl), Basudin 60 E.C (Diazinon), Decis 10 E.C (Deltamethrin), Cymbush 10 E.C (Cypermethrin) and Phostoxin/ Trogocide (phosphate and sulphides of carbon and aluminium,) applied at weaker concentrations were found effective for the control of the weevils in storage (Ivbijaro, 1976b, Ojo 1977). Although use of synthetic insecticides remains the most efficacious control measure against the kolanut weevils, however issues of safety to man must be taken into consideration because kolanut is eaten in Nigeria without undergoing any form of processing. Some of the insecticides used today in Nigeria for the protection of nuts against the kola weevil are highly persistent and could bioaccumulate in the adipose tissue of the consumer as it is with the case of lindane. It is against this backdrop that a safer product formulation such as the Spindor dust was evaluated for its efficacy in controlling the kolanut weevil *B. kolae* in storage. Spindor dust (Spinosad 0.125%) is a natural origin insecticide obtained from the fermentation from a soil bacterium, *Saccharopolyspora spinosa*. The mode of action is by contact and mainly by ingestion on larvae and adults.

Materials and Method

Source of Spindor dust and Kolanuts:

Samples of Spindor dust 0.125D was collected from Dr. (Mrs) K. A. Kemabonta of the National Stored Product Research Institute of Nigeria, Lagos, Nigeria. Healthy kolanut samples used for the study were extracted from pods harvested at maturity, that is, before follicle dehiscence. Extracted kolanuts were heaped in a woven basket, left for about 5 days where they were occasionally turned and sprinkled with water to enhance decay and easy removal of the testa (skinning process). Thereafter, the nuts were thinly spread on the laboratory side benches for about 7 hours to facilitate gradual loss of excess water retained in the nuts (curing process). Nuts observed with entry/exit holes, oviposition hole, feeding marks and any of the developmental stages of the weevil were considered as damaged nuts. These were either discarded or used for raising the insect culture.

Insect Culture

The insect culture for this experiment was raised from field infested kolanuts extracted from dehisced fallen pods picked from plantation floors. Extracted nuts were kept in woven baskets at room temperature of $27^oC \pm 2^oC$ and relative humidity ranging from 55% to 75% for a period of four weeks since the average developmental period ranges between 19 – 114 days. To enhance easy collection of emerging weevils, the nuts were transferred into transparent polythene bags (0.038mm thick) pierced severally with entomological pins (size No - 5) to encourage gradual loss of water from the nuts. Where high condensation of water were noticed on polythene bags, nuts were turned into plastic bowls and aerated on laboratory side benches for about 15 minutes, while condensed water were wiped off before returning the nuts into the polythene bags. Emerging adult weevils were collected at two weeks interval and used for the study. Neonatal adult weevils collected from dehisced pods were also added to the ones incubated in the laboratory to make up the number required. In order to ensure that insects oviposited on nuts, dead insects from the culture sample were replaced with the same sex and number for the first two weeks.

Application of Treatments:

Fifty healthy kolanuts were sorted into separate polythene bags and applied with three concentrations of Spindor dust at 2.5g, 5g and 10g of powder/kg nuts, and mixed by shaking vigorously to ensure proper coverage of powder on nuts. There was no powder application on the nuts in the control (check). Five pairs of one week old male and female adult weevils sexed according to the method of Ojo (1977), were collected from the raised insect culture and introduced into each of the polythene bags containing the treated and untreated nuts. Complete randomized design was used for the experiment.

Determination of Treatment Efficacy:

The treated and untreated kolanuts in the separate polythene bags were sieved on daily basis in order to determine the mortality of adult *B kolae* which was obtained by direct counting until 14 days after treatment application.

The efficacy of the Spindor dust was also considered by determining the number of feeding marks; oviposition holes, developmental stages of the weevils and adult emergence from each polythene bag. Data obtained were subjected to analysis of variance, while Least Significant Difference (LSD) was used to compare the means.

Results

Table 1, shows the efficacy of the three concentrations of Spindor dust on the mortality of *B. kolae* (Desbr.). The highest concentration of the powder, 10g/kg of nuts, recorded 100% mortality after 7 days of exposure, while 5g/kg of nuts gave 93%, while no mortality was recorded in the control experiments throughout the duration of weevil exposure. The percentage mortality of the weevils at application treatment of 2.5g/kg was only 55% after 14 days of treatment. The mortality recorded may be attributed to the contact toxicity of the powder to the weevil. The efficacy of the dust of Spindor increased with increase in concentration of the powder and incubation period.

Table 1: Cumulative percentage of adult mortality of *Balanogastirs kolae* with different concentrations of Spindor powder

Concentration (g/kg nuts)	**Period of weevil exposure**		
	2days	**7days**	**14days**
10	11a	100a	100a
5	6b	93b	100a
2.5	1c	46c	55b
0	0c	0d	0d

Each value represents a mean of five replicates.
Means in columns with different letters are significantly different from each other at 5% level of probability; Least Significant Difference (LSD).

The mean number of feeding holes observed on nuts treated with 2.5g/kg, 5g/kg and 10g/kg concentration were 48.25, 17.13 and 4.55, respectively. These were relatively lower than the value of 63.46 obtained from the check. Also, the percentage nut damage recorded from nuts treated with higher concentrations, 5 and 10g/kg of nuts were lower, being 11.62 and 7.45%, respectively, whereas with 46.79 and 82.04% were recorded for the 2.5g/kg concentration and the check respectively. Similar trends were observed when the numbers of oviposition holes were compared (Table 2).

The number of larvae observed within infested nuts decreased as concentration increased from 2.5g/kg to 10g/kg (Table 3). However, no significant difference was observed between values obtained for the 5g/kg and 10g/kg concentrations. Higher percentage larval mortality was recorded from bags treated with 5g/kg and 10g/kg concentrations. The lowest adult weevil emergence was recorded from bags treated with 10g/kg concentration (4.50), followed by 40g/kg concentration which recorded 6.25, while 87.50 was recorded in the control.

Table 2 Effect of Spintox powder on feeding marks, oviposition and damage of *Cola nitida* nuts

Treatment (g/kg Kolanut)	**Number of feeding marks holes**	**Number of oviposition**	**% Damage**
10	4.55a	5.22a	7.45a
5	17.13b	18.75b	11.62a
2.5	48.25c	46.25c	46.79b
0	63.46c	50.05c	82.04c

Each value represents a mean of five replicates
Means in columns with different letters are significantly different from each other at 5% level of probability; Least Significant Difference (LSD).

Table 3: Effect of Spindox powder on the developmental stages of *Balanogastris kolae*.

Number of larvae	**Number of Adult Emergence**	**Larvicidal effect of treatment**	
10	55.35^a	4.50^a	84.50
5	56.05^a	6.25^a	78.15
2.5	92.15^b	44.06^b	39.20
0	124.85^c	87.5^c	-

Means in a column with different superscripts are significantly different from each other at 5% level; LSD.

Discussion

The mortality of adult *B. kolae* recorded in the course of this work may be attributed to the contact toxicity of Spindor dust while the larvicidal effect on the developmental stages of the weevil may be as a result of the stomach poison characteristics of the dust. A similar result was recorded in Kenya in 2003 when Spindor 0.125 D was evaluated on some stored grains such as wheat, barley, oat, rice, corn, sorghum, legumes and potatoe. Liburd *et. al* (2003) reported that Spinosad could be used in integrated control programmes for the control of blue berries thrips as the insecticide was found not to reduce the thrips' primary enemy, *Orius insidiosus.* Being a biological insecticide and as effective as the conventional insecticide and comparable to Malathion, was able to reduce drastically the incidence of thrips in blue berries.

The studies have revealed Spindor dust (a.i. Spinosad 0.125%) as a potential insecticide that could be used to protect kolanuts in storage. No off – flavor taste was felt on treated nuts as the insecticide was found to be odourless and tasteless. Farmers could exploit the insecticidal properties of Spindor dust for improved kolanut production coupled with the fact that the insecticide has a very low acute toxicity for humans as well as possessing a low residue limit making it low risk for the consumers of kolanuts.

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