

EVALUATION OF *TETRAPLEURA TETRAPTERA* (SCHUM & THONN) FRUIT FOR THE CONTROL OF *BALANOGASTRIS KOLAE* (DESBR.) INFESTING STORED KOLANUTS

J.C. ANIKWE⁺ and K.T.M. OJELADE

Entomology Group, Cocoa Research Institute of Nigeria, P.M.B. 5244, Ibadan, Nigeria.

(Submitted: 19 October 2004; Accepted: 08 January 2005)

Abstract

The efficacy of the powder of *Tetrapleura tetraptera* fruit (Schum & Thonn) in the control of the kola weevils, *Balanogastriis kolae* (Desbr). was investigated in the laboratory. The plant material was tested at three concentrations 20, 40 and 80 g powder/kg of cured kolanuts. These were compared with the untreated nuts (control). *T. tetraptera* powder was toxic to *B. kolae*, especially at 40 and 80 g/kg concentrations. At 40g/kg and 80g/kg concentrations, *T. tetraptera* powder caused high mortality (100 %) on introduced weevils after 7 and 14 days, respectively. The level of weevil damage observed on nuts treated at concentration of 40 g and 80 g were significantly lower than at 20 g concentration and the control, when parameters such as feeding holes, oviposition holes and percentage damaged were considered. Although the colour and texture of nuts were not affected by the treatments, the flavour from the application was slightly felt at the 80 g/kg level.

Keywords: *Balanogastriis kolae*, *Tetrapleura tetraptera*, cured kolanuts, weevil damage

1. Introduction

Cola nitida is widely cultivated across West Africa. 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 (Oguntuga, 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, incompatibility 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 - *Balanogastriis 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). 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 (Ivbijaro, 1976a; Daramola, 1981; Odebode 1990). As a result of the height of the kola tree (12 m to 18 m) 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, such as Gammalin 20 E.C. (lindane), Actellic 25 E.C. (Pirimiphos-methyl), Basudin 600 E.C. (Diazinon), Decis 10 E.C. (Deltamethrin), Cymbush 10 E.C. (Cypermethrin) and Phostoxin/Trogocide (phosphate and sulphides of carbon and aluminium) (Ivbijaro, 1976b; Ojo 1977). Although use of synthetic insecticides remains the most efficacious control measure against the kolanut weevils, its negative attributes such as high cost, toxicity to humans, pest resistance and scarcity, necessitate further research on the efficacy of alternative biopesticides that are safe, biodegradable and environmentally friendly. Reports abound on the efficacy of ethnobotanicals on the control of insect pests of other stored products such as cowpea, rice, maize and bread flour where extracts from Neem (*A. indica*), pepper (*Pipper species*), *Capsicum species*, Tobacco (*Nicotiana spp*) and Pepper mint (*Denettia triquetata*) effectively controlled *Sitophilus*; *Tribolium*, *Callosobruchus*, *Dermestes*, and *Rhizopertha* species (Ivbijaro and Agbaje, 1986; Ofuya, 1986).

⁺ corresponding author (email: jachuks@yahoo.com)

2. Materials and Method

(a) Source of Powdered Material

Matured fruits of *Tetrapleura tetraptera* (Schum and Thonn) (*Leguminosae, Mimosaceae*) were collected from a natural forest in Cocoa Research Institute of Nigeria (CRIN), Ibadan in February, 2003. The fruits were air dried in the laboratory on side benches for 7 consecutive days and thereafter, oven-dried at 72 °C for 3 hours. The oven-dried material was pulverized into fine powder with a high-speed blender and kept in sealed transparent polythene bags of 0.038 mm thickness, for subsequent use.

(b) Source of Kolanuts

Healthy kolanut samples used for the study were extracted from pods harvested at maturity 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 used for raising the insect culture.

(c) 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 ± 2 °C and relative humidity ranging from 55 % to 75 % for a period of four weeks since the average developmental period ranges between 19 to 114 days. To enhance easy collection of emerging weevils, the nuts were transferred into transparent polythene bags (0.038 mm 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.

(d) Application of Treatments

Fifty healthy kolanuts were sorted into separate polythene bags and mixed with three concentrations of the *T. tetraptera* powder at 20, 40 and 80 g of powder/kg nuts. The mixture was shaken 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.

(e) Determination of Treatment Efficacy

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

The efficacy of the powder of *T. tetraptera* fruit 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.

3. Results

Table 1 shows the efficacy of the three concentrations of *T. tetraptera* powder on the mortality of *B. kolae* (Desbr.). The highest concentration of the powder, 80 g/kg of nuts, recorded 100 % mortality after 7 days of exposure, while 40 g/kg of nuts gave 73 %, but no mortality was recorded in the control experiment throughout the duration of weevil exposure.

Table 1. Cumulative percentage of adult mortality of *Balanogastis kolae* with different concentrations of *Tetrapleura tetraptera*.

Concentration (g/kg nuts)	Period of weevil exposure		
	2 days	7days	14 days
80	11a	100a	100a
40	6b	73b	100a
20	1c	6c	15b
0	0c	0c	0b

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 20 g/kg, 40 g/kg and 80 g/kg concentration were 50, 19 and 5.5, respectively. These were relatively lower than the value of 60 obtained from the check. The percentage nut damage recorded from nuts treated with higher concentrations, 40 and 80 g/kg of nuts were also lower, being 12.22 % and 8.41 % respectively, whereas 77.9 % and 79.06 % nut damage were recorded for the 20 g/kg concentration and the check respectively. Similar trends were observed when the numbers of oviposition holes were compared (Table 2). A related result was reported when the powder of *Ricinus communis* was applied to control *Callosobruchus species* in stored cowpea (Okonkwo and Okoye, 1992). The number of larvae observed within infested nuts decreased as concentration increased from 20 g/kg, to 80 g/kg (Table 3). However, no significant difference was observed between values obtained for the 40 g/kg and 80 g/kg concentrations. Higher percentage larval mortality was recorded from bags treated with 40 g/kg and 80 g/kg concentrations. The lowest adult weevil emergence of 4.75 was recorded from bags treated with 80 g/kg concentration, followed by 40 g/kg concentration which recorded 12.65, while 91.0 was recorded in the control.

Table 2. Effect of *Tetrapleura.tetraptera* fruit on feeding marks, oviposition and damage of *Cola nitida* nuts.

Treatment (g/kg Kolanuts)	Number of feeding marks	Number of oviposition holes	% Damage
80	5.5a	5.0a	8.41a
40	19b	17.5b	12.22a
20	50c	47.5c	77.92b
0	60c	50c	79.06b

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 *Tetrapleura.tetraptera* fruit powder on the Developmental stages of *Balanogastriis kolae*.

Treatment (g/kg Kolanuts)	Number of larvae	Number of Adult Emergence	Larvicidal effect of treatment
80	50.15 ^a	4.75 ^a	90.50
40	60.0 ^a	12.65 ^a	81.51
20	95.25 ^b	55.35 ^b	41.92
0	166.75 ^c	91.0 ^c	45.0

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

4. Discussion

The mortality recorded may be attributed to the contact toxicity of the powder materials to the weevil. The efficacy of the powdered material of *T. tetraptera* fruit increased with increase in concentration of the powder and incubation period. Similar trends were reported by Jembere *et al.* (1995) and Lajide *et al.* (1998) when the efficacy of pulverized plant materials such as *Ocimum kilimand sharium*, *Uvaria afzelli*, *Eugenea aromatica* and *Afrimomum melegueta* were tested on the mortality of *Sitophilus zeamais*, *Rhizoperta dominica* and *Sitotroga ceredella*.

The efficacy of *T. tetraptera* fruit in the control of *B. kolae* maybe due to its contact and/or fumigative properties as suggested by Lale (2001) and Lajide *et al.*, (1998). Consequently, the assertion by Jackai (1993) that *T. tetraptera* has no insecticidal properties apart from its molluscicidal property and ability to emulsify neem oil is contradicted.

The studies have revealed the effect of *T. tetraptera* fruit as an insecticide of plant origin that could be used in the control of *B. kolae* during primary processing and storage of kola nuts. At the highest concentration 80 g/kg, an off flavor taste was slightly felt on treated nuts. Farmers could exploit the insecticidal properties of *T. tetraptera* for improved kola nut production since the plant is readily available and easily prepared.

Acknowledgement

We wish to thank the Director and Management of the Cocoa Research Institute of Nigeria for their support during the study and permission to publish the result.

REFERENCES

- Daramola, A.M., 1981. The biology of the kola weevils *Balanogastriis kolae* (Desbr) on *Cola acuminata* and *Cola verticillata*. *Insect Science and Its Application* 4, 201-204.
- Daramola, A.M., 1983. Studies on the control of kolanut weevils *Balanogastriis kolae* (Desbr) (Coleoptera: Curculionidae) during storage in South Western Nigeria. *Tropical Stored Product Information* 46, 11-16.
- Eijnatten van, C.L.M., 1973. Kola - A review of the literature. *Tropical Abstracts* 28, 540-550.
- Ivbijaro, M.F., 1976a. The feeding and oviposition behaviour of the kola weevil, *Balanogastriis kolae* (Desbr) (Coleoptera: Curculionidae) on stored kolanuts. *Ghana Journal of Agricultural Science* 9, 155-159.
- Ivbijaro, M.F., 1976b. The susceptibility of the immature and adult stages of the kolanut weevils, *Balanogastriis kolae* Desbr (Coleoptera: Curculionidae) to Phosphine. *Nigeria Journal of Entomology* 3, 53-56.
- Ivbijaro, M.F. and Agbaje, M., 1986. Insecticidal activities of *Piper guineense* (Schum and Thonn), and *Capsicum species* on the cowpea bruchid, *Callosobruchus*

- maculatus*. *Insect Science and Its Application* 7, 521-524.
- Jembere, B., Obeng-Ofori, D. and Hassanah, A., 1995. Products derived from the leaves of *Ocimum killimandscharicum* (Labiata) as post harvest grain protectants against the infestation of three major stored product insect pests. *Entomological Research* 85, 361-367.
- Jackai, L.E.N., 1993. The use of neem in controlling cowpea pests. *IITA Research Bulletin* 7, 5-11.
- Lajide, L., Adedire, C.O., Muse, W.A. and Agele, S.O., 1998. Insecticidal activity of powders of some Nigeria plants against the maize weevil (*Sitophilus zeamais* Motsch). *Entomological Society of Nigeria Occasional Publication* 31, 227-235.
- Lale, N.E.S., 2001. The impact of storage insect pest on post harvest losses and their management in the Nigerian Agricultural system. A symposium paper at the 32nd Annual Conference of the Entomological Society of Nigeria, Kaduna, October, 8-11. 18pp.
- Odebode, A.C., 1990. Post-harvest rot of kola nuts caused by *Betryodiplodia theobroma* and *fusarium pallidoroseum*, Ph.D. thesis, University of Ibadan, 180pp.
- Odegbare, O.A., 1973. Regeneration of old trees *Cola nitida* (Vent) Schot & Endl. by Coppicing. *Turialba* 23(3), 334-340.
- Ofuya, T.I., 1986. Use of wood ash, dry Chilli pepper and onion scale leaves for reducing *Callosobruchus maculatus* (F) damage in cowpea seed during storage. *Journal of Agricultural Science (Cambridal)* 107, 467-468.
- Ogutuga, D.B.A., 1975. Chemical composition and potential commercial uses of kolanuts, *Cola nitida* Vent (Schott and Endlicher). *Ghana Journal of Agricultural Science* 8, 121-125.
- Okonkwo, E.U. and Okoye, W.I., 1992. The control of *callosobruchus maculatus* (F) in stored cowpea with dried ground *Ricinus communis* (L) leaves in Nigeria. *Tropical Pest Management* 39(3), 237-238.
- Ojo, A.A., 1977. Observation on the sexual dimorphism in *Balanogastriis kolae* (Desbr) (Curculionidea: Coleoptera) *CRIN Annual Report*, 55pp.
- Yusuf, S.R., Ahmed, J.P., Chaudhary and Yusuf, A.U., 1998. Laboratory evaluation of some plants for the control of maize weevil (*Sitophilus zeamais*) in stored maize. *Entomological Society of Nigeria Occasional Publication* 31, 203-221.