BIOACTIVITY OF TWO POWDERED SPICES [*PIPER GUINEENSE* THONN & SCHUM AND *XYLOPIA AETHIOPICA* (DUNAL) A. RICHARD] AS HOME MADE INSECTICIDES AGAINST *CALLOSOBRUCHUS SUBINNOTATUS* (PIC.) ON STORED BAMBARRA GROUNDNUT.

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Abstract

African black pepper, Piper guineense Thonn & Schum and African pepper, Xylopia aethiopica (Dunal) A. Richard were assessed against Callosobruchus subinnotatus (Pic.) on bambarra groundnut, Vigna subterranea (L.) Verde. Piper guineense powder exhibited acute toxicity on bruchid (over 90% mortality in all the three concentrations: 2.5; 5.0 and 7.5 % per 150 g seed) assayed in 48 h. P. guineense powder also significantly reduced oviposition by 85,44 to 90 percent while adult emergence and seed damage were reduced by 100 percent each. This paper highlights the potential of P. guineense as seed protectant against the bambarra seed bruchid. X. aethiopica powder was not effective in all the parameters assessed.

Key words: Bambarra groundnut, bruchid, insecticidal, spices, storage protection.

INTRODUCTION

The bambarra groundnut, *Voandzeia subterranea* (L.) Verde (Leguminosae) is an important crop in tropical Africa. It thrives in poorer soils and in areas with uncertain rainfall and high disease incidence where other crops may fail to perform. The crop ranks third in importance after groundnut and cowpea (Sellchop, 1962) and contains about 20 % protein (Busson, 1970), 6 % oil, 60 % carbohydrates (Stauton, 1966), and more methionine than in other legumes (Anonymous, 1978). The world annual output in 1982 was 330,000 tonnes and more than half is produced in West Africa (Sellchop, 1962) where Nigeria is the most important producer.

Bambarra groundnut seed is infested during storage by *Callosobruchus maculatus* Fab. (Amuti and Larbi, 1981), *Callosobruchus subinnotatus* Pic. (Caswell, 1980) and *Genocarpa hilda* Druce (Hepper, 1970). The most important of these storage pests is *C. subinnotatus* which may cause seed damage of about 30 – 70 % in the absence of effective pest control measures (Caswell, 1980), thereby reducing the dietary protein level, lowered income and insufficient planting stock for next cropping season. Although, synthetic insecticides are currently generally used in the control of this pest, its adoption and use by poor resource farmers in rural areas is limited due to high cost, unavailability at critical period, low level of application skill and perhaps, most importantly, product adulteration.

This scenario elucidates the need for alternative pest management strategies that would protect the farmers and their produce in addition to being affordable and available when needed. In Nigeria, nature has bestowed on us an array of insecticidal /medicinal plants across the various ecological zones which could play a fundamental role in pest management strategy. These plants include tobacco leaves (Linneman, 1988); *Capsicum* spp. (Onu and Aliyu, 1995; Linneman, 1988; Nezan, 1983; Ofuya,1986), neem products (Ivbijaro,1983; Oparaeke *et al.*, 1998), black pepper (Ivbijaro and Agbaje, 1986; Olaifa and Erhun, 1989). This paper highlights the results of investigations on the effect of three application rates of West African black pepper, (*P. guineense*) and African pepper (*X. aethiopica*) for the control of *C. subinnotatus* in stored bambarra groundnut.

MATERIALS AND METHODS

Sun dried spikes of West African black pepper (*P. guineense*) and African pepper (*X. aethiopica*) were sourced from a local market in Zaria, Nigeria. The materials were dried in an electric oven at 80° C for 24 h and later grounded into powder using an electric hammer mill. The powder obtained from each material was weighed into three lots of 2.5; 5.0 and 7.5 % per 150 g seeds using a metler weighing balance. A local variety of bambarra groundnut (about 100 kg) purchased from the same source as the spices was pre-fumigated with one tablet of aluminum phosphide (Phostoxin) in an air-tight plastic drum for seven days. Before use, the bambarra groundnut seeds were spread on the laboratory table for 72 h to remove fumigant effect. Insect culture was raised in three kilner jars containing 300 g of bambarra groundnut seeds for 30 days to breed sufficient number of the insects used in the trial.

From the pre-fumigated bambarra groundnut seeds, 150 g were weighed into kilner jars. *P. guineense* and *X. aethiopica* powders each measuring 2.5, 5.0 and 7.5 % per 150 g bambarra groundnut seeds were added to the content of the jars and vigorously shaken to ensure an effective admixture. The contents were allowed to settle for about 30 minutes before introducing five pairs of freshly emerged adult *C. subinnotatus* into each jar based on the degree of elytral pigmentation (Southgate *et al.,* 1957). The jars were covered with wire-gauze lined with muslin cloth to ensure good aeration in the jar. The experiments consisted of six treatments plus an untreated control and were replicated three times. The jars were arranged in a randomized block design on a laboratory table at room temperature between 30 - 35° C and relative humidity 65 – 80 % for 56 days (8 weeks). The following parameters were assessed: insect mortality (48 h), number of eggs laid on a random sample of 20 seeds per jar at 14 days post treatment (DPT), number of F1 progeny at 28 DPT and number of bambarra groundnut seeds showing at least one emergence hole of bruchid from a random sample of 100 bambarra groundnut seeds at 56 DPT. All the data obtained from the above parameters were subjected to analysis of variance and significance tested using least significant difference (LSD).

RESULTS

The results (Table 1) showed that *P. guineense* powder at the three rates of treatment manifested acute biological activity as shown by high percentage mortality (93 – 100 %) of adult bruchid in 48 h. Bruchid mortality in *X. aethiopica* treated bambarra groundnut seeds at the three treatment levels was below 35 % during the period. From this study, it was observed that bruchid mortality increased with increasing application dosage of the powdered treatments. Oviposition was significantly reduced in *P. guineense* powder than in *X. aethiopica* treatments and the control. It was also observed that the powder of *X. aethiopica* encouraged more oviposition on bambarra groundnut seeds compared with the control.

Progeny emergence (Table 2) followed similar pattern to that of egg count at two weeks post treatment in the three treatment rates. All the *P. guineense* treatments completely inhibited progeny emergence conferring higher degree of protection to bambarra groundnut seeds compared to *X. aethiopica* treatments and the control. Comparing the three rates of *X. aethiopica* powder and the control, it was observed that the former induced/encouraged the development of more progenies and higher grain damage than the control.

DISCUSSION

The present study has shown that the powder of *P. guineense* was more toxic to *C. subinnotatus* and reduced damage to cowpea seeds than *X. aethiopica* powder irrespective of dosage. This result is in agreement with that obtained using crude extract of West African black pepper against rice weevil, *Sitophilus oryzae* L. (Su, 1977). Similarly, greater bruchid toxicity and protection of cowpea seeds with powdered products of *P. guineense* were observed in another experiment (Ivbijaro and Agbaje, 1986).

The exact mechanism of action of *P. guineense* in effecting acute biological activity against *C. subinnotatus* is not very clear. It could cause physical discomfort to the bruchid when in direct contact as evidenced by staggering, loss of direction (hallucination effect), motionlessness (even after touch with a pin) and finally death. It has been suggested (Ogunwolu *et al.,* 1988) that the powder of *P. guineense* could cause physical abrasion of the insect cuticle (with consequent loss of body fluid or blockage of spiracles). The high toxicity of *P. guineense* powder to bruchid was attributed to the presence of Piperine type amine alkaloids. From this study, it was observed that the powder of *X. aethiopica* was unsuitable as protectant of stored bambarra groundnut at the dosages assessed. It is however unclear if higher doses of powdered *X. aethiopica* would be required to confer protection to bambarra groundnut seeds since there seemed to be a reduction in seed damage as the concentration increased.

The spices used in this study are major cash crops in Nigeria (and other third world countries) and are readily available in the local markets for use as grain protectants. Their powders are unlikely to pose any health problem to users in view of their ethno-medical importance. Furthermore, the cost implication of treating bambarra groundnut seeds with these spices is low compared with the synthetic insecticides and the technology for adoption by untrained local farmers and traders is simple. The potential of powdered *P. guineense* in imparting acute toxicity, discouraging oviposition and damage to bambarra groundnut seeds by *C. subinnotatus* has been demonstrated in this study. *P. guineense* is a tropical perennial plant whose cultivation is already popular in the southern parts of Nigeria and elsewhere in the tropics. Its adoption for use as grain protectant may provide suitable alternative to the synthetic insecticides for small-scale farmers in rural environment. It is pertinent to point out that none of the plants investigated in this study is traditionally used for storage pest control in Nigeria.

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