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Short Communication

Laboratory Evaluation of Neem (*Azadirachta indica*) Seed and Leaf Powders for the Control of Khapra Beetle, *Trogoderma granarium* (Coleoptera: Dermestidae) Infesting Groundnut

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ABSTRACT

Bioassay evaluation of neem (*Azadirachta Indica* A. Juss) seed powder (NSP) and neem leaf powder (NLP) against the larvae of *Trogoderma granarium* in stored groundnut was conducted under open laboratory conditions of 27^{o}C and 70±10% relative humidity. Ripened neem seed fruits and leaves were collected from neem trees, adequately shade-dried, pounded and sieved to obtain fine powder. Treatments were applied at 2.5, 5 and 10% w/w Samnut-22 groundnut seed, with pirimiphos-methyl (2% Actellic dust) as standard check in addition to an untreated control. Larval mortality, progeny emergence, seed damage and viability were assessed. Results showed that NSP was next to Actellic dust in efficacy followed by the NLP; all significantly better than the untreated control in causing greater larval mortality, reduced progeny emergence and seed damage with no harm to seed viability. Actellic dust at 5 and 10% w/w was more effective than the plant materials as 100% mortality was achieved within 24 h post-treatment with no seed damaged. NSP treatment gave 100% mortality only at 10% w/w level with about 6.5% and 6.7% seed damage and progeny emergence respectively, while NLP was the least efficacious giving 50% mortality at 10% w/w, 28% seed damage and 33% progeny emergence in 24 h but better than the untreated control in all the parameters evaluated.

Key Words: Neem; Pirimiphos-methyl; Progeny; *Trogoderma granarium*

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is one of the most widely cultivated commercial grain legumes in Nigeria. Although grown in most parts of Nigeria, the soil and climate of the northern part is most suitable for its production (Misari *et al.*, 1980). The estimated world production of groundnut in 2007 was 35.1 million tons from 23.7 million hectares with Nigeria producing 1.8 million tons from 2.3 million hectares (FAO, 2007). The entire plant is of economic value, because its seeds can be eaten directly without any preparation or after lightly roasted or boiled. It is rich in protein (about 26%), good source of quality oil (48-49%) and the cake containing 50% protein is used in the production of animal feeds (Norden, 1980).

Groundnut was a revenue earner of first importance to Nigeria's economy in the 60^{s} prior to its production decline in the 1970^{s} as a result of unfavorable climatic conditions, pests and disease influx, notably the groundnut rosette disease transmitted by aphids. Insect pests can cause about 3-35% annual loss of groundnut both in the field and in stores during storage.

Among the insects that attack groundnut in the store, *T. granarium* Everts can cause serious damage by attacking both shelled and unshelled groundnuts. As larvae, they feed voraciously on grains and contaminate produce with their excreta and exuviae and once established, they are difficult to control, because larvae can easily go into facultative diapause in the absence of food or adverse environmental conditions and thus able to withstand both insecticide treatments and such environmental conditions for several years (Lale, 2002).

One modest way of increasing food availability to cope with the Nigerian ever-increasing population at less cost is to protect what has been produced and to achieve this, plant materials that are inexpensive, safe to the environment, users and consumers alike, need to be exploited as suitable alternatives to the expensive, toxic and environmentally unsafe synthetic insecticides (Magaji *et al.*, 2005). This work attempts to evaluate the potency of neem seed powder (NSP) and neem leaf powder (NLP) at three concentrations to protect groundnut grains against *T. granarium* Everts larval attack in storage.

MATERIALS AND METHODS

Insect culture: Initial *Trogoderma granarium* Everts larvae

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used for this research were obtained from an old culture of infested groundnut seeds in the storage laboratory of Crop Protection Department, Institute for Agricultural Research (IAR), Ahmadu Bello University, Zaria, Nigeria. Pure cultures were raised by infesting Samnut-22 seeds contained in two 1000 mL Raven Head Kilner jars with gravid adults. The jars were capped with 10 mesh/cm muslin cloth, which not only allowed proper ventilation but also precluded the entry or exit of insects and left in open laboratory conditions of 27±2^{o}C and 70±10% relative humidity. Larvae emerged after four weeks, sieved and were used for this experiment. Two trials were carried out between October, 2007-February, 2008 and April-August, 2008 and the combined results of their treatments' means were analyzed and reported in this work.

Source of Materials

(a). Neem seed powder (NSP): Ripened neem seed fruits were collected from the ground around IAR complex. These were depulped, adequately shade-dried and decorticated by pounding lightly in a mortar with pestle. The resulting seeds were pulverized into fine powder by pounding, sieved and then stored in a cool dry place until used.

(b). Neem leaf powder (NLP): Fresh leaves were collected from trees around IAR complex and shade-dried for about one week. The dried leaves were then pounded using pestle and mortar, sieved to obtain a fine powder which was also stored in a cool dry place until used.

(c). Groundnut seeds: Samnut-22 variety of groundnut used in this experiment was obtained from Plant science Department, IAR, Ahmadu Bello University, Zaria, Nigeria. The seeds were handpicked, fumigated with one tablet of aluminium phosphide (phostoxin) left enclosed for three days and thereafter spread for seventy-two (72) h to dissipate the fumigant effect before commencement of the experiment.

(d). Actellic dust used as a standard check was bought from an Agrochemical shop in Samaru Market, Zaria, Nigeria.

Application rates and infestation: Three levels of NSP, NLP and actellic dust formulations were applied at 2.5, 5.0 and 10%w/w groundnut seeds with an untreated control. Each level was replicated three times and all treated jars were thoroughly shaken to ensure effective coating of seeds with powders. Ten larvae of *T. granarium* were introduced into each jar and covered with perforated plastic caps lined with muslin cloth. These were laid out in a completely randomized design (CRD) and left on laboratory benches for three months (Oparaeke, 1996).

Parameters evaluated and Statistical analysis: Larval mortality count was conducted at 24 h, 48 h and 72 h post-treatment by sieving out all the larvae and the dead ones were counted and discarded, while live ones were returned into the jars. Progeny emergence was assessed after eight weeks of storage and an account of adults emerged in each jar was recorded. Seed damage and viability was conducted at the end of the storage period in which seed damage was evaluated by randomly picking 100 seeds from all the jars and separated into holed and whole seeds. Percentage damage was then determined. Seed viability was done by randomly picking 10 seeds from all the jars and placed on petri-dishes containing moistened filter paper and kept on laboratory benches and moistened daily for seven days. Percentage germination was also determined. Data obtained were subjected to analysis of variance using SAS general linear mode procedures (SAS, 1989) and all treatment means were separated using Duncan Multiple Range test (DMRT) and column graph used in reporting results.

RESULTS

Results of treatments on larval mortality are shown in Fig. 1. Both plant powders like actellic dust significantly ($P<0.05$) caused higher larval mortality compared to the untreated control. At 24 h post-treatment, complete larval mortality was achieved at 5 and 10%w/w Samnut-22 groundnut seeds of actellic dust treatment and at 10% w/w of NSP. No mortality was recorded in the untreated control however, 20% and 50% mortality was noted in NLP at 5 and 10%w/w groundnut seeds, respectively. At 48h post-treatment, an additional larval mortality of 50% was observed at 5.0 and 10%w/w groundnuts seeds of NLP treatment, while NSP at 2.5 and 5%, actellic dust at 2.5% as well as the untreated control gave 20% larval mortality each. At 72 h post-treatment, there was no record of larval mortality in actellic dust treatment however; NLP had the highest larval mortality of 40% at 2.5%w/w groundnut seeds, while NSP at 2.5% and the untreated control had 10% mortality each.

Fig. 2 shows results of NSP, NLP and actellic dust, on progeny emergence, seed damage and viability. It showed that at all applied levels, both plant powders like actellic dust significantly ($P<0.05$) suppressed progeny emergence of adult *T. granarium* when compared to the untreated control. Complete inhibition was noted at all levels of actellic dust treatment, however 3.33 and 0.67% emergence was recorded at 2.5 and 5.0%w/w Samnut-22 groundnut seeds of NLP treatment.

In terms of percentage seed damage, the untreated control had the highest with 71% followed by NLP at 5%w/w groundnut seeds (28.3%) and the least was in actellic dust treatment with no damage record.

There was no significant ($P<0.05$) difference in seed viability between the plant powders and actellic dust at 2.5%w/w groundnut seeds, which were significantly ($P<0.05$) better than the other higher levels and together better than the untreated control. The highest percentage germination was in NLP treatment (98%) at 2.5%w/w groundnut seeds, while the least was in the untreated control with 33.04%.

DISCUSSION

Bioassay evaluation of NSP and NLP against *T.*

Fig. 1: Effect of neem seed powder (NSP) and neem leaf powder (NLP) on larval mortality of *T. granarium* larvae

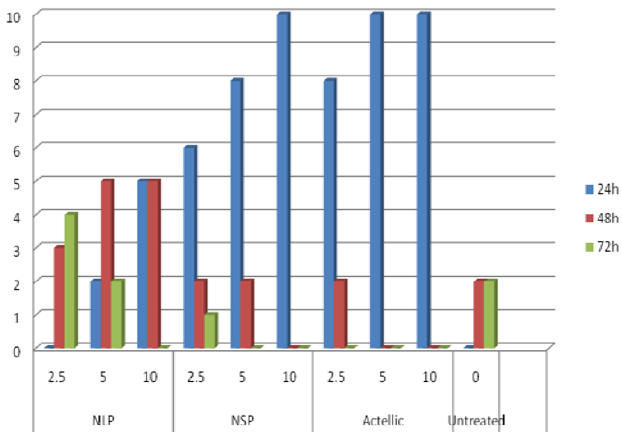
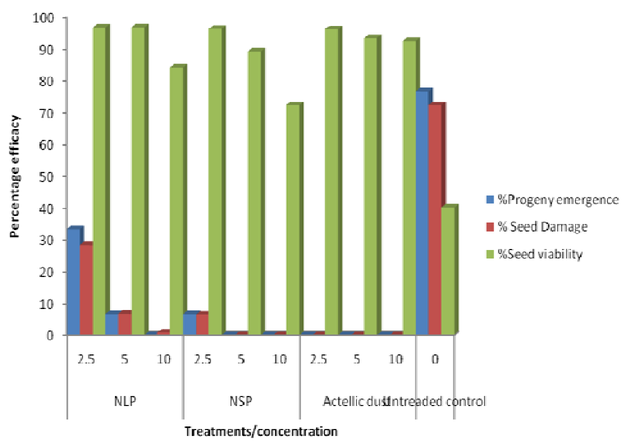


Fig. 2: Effect of neem seed powder and neem leaf powder on progeny emergence, seed damage and viability



granarium Everts using actellic dust as a standard check with an untreated control has demonstrated that, both plant powders like actellic dust were effective and significantly (P<0-05) caused higher insect larval mortality, suppressed progeny emergence, reduced seed damage with no harm on seed viability. The higher mortality noted in NSP compared to NLP could be attributed to the high oil content of the seeds in addition to the Azadirachtin widely known to be found in neem products (Norris, 1986). Oil can cause flooding of the spiracles and subsequently, death of insect through asphyxiation (Lale, 2002). This finding concurred with the reports of Ogunwolu and Odunlami (1996) who protected cowpea seeds for five months when neem leaf powder were compared with *Zanthoxylum zanthoxyloides* (Lam.) at 0.25 g/20 g seeds. Similarly, Sowunmi and Akinnusi (1983) protected maize seeds from attack by *Sitophilus granarium* using 1% and 2% neem kernel powder.

Inhibition of *T. granarium* progeny emergence and reduced groundnut seed damage as a result of treatment with NSP, NLP and actellic powder experienced in the research was probably due to the higher larval mortality recorded earlier in the experiment and thus, agreeing with the findings of Ivbijaro (1983) and Yusuf *et al.* (1998), who showed reduced oviposition and inhibition of F_1 progeny emergence of *S. oryzae* when neem seed powder was admixed at 0.5 g/20 g and neem leaf powder at 8% maize seeds, respectively. Insect knock-down effect by most neem products has been explained by most authors as due to either repellent, antifeedant or pesticidal properties (Lale, 2002).

Conclusively, this study has shown that NSP and NLP are as effective as actellic dust in protecting groundnut seeds against *T. granarium* attack for at least three months. Their usage is recommended for only seeds meant for next season planting as neem products are known to inflict a bitter taste on stored product commodity and may not be good for grains stored for consumption.

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