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Full Length Research Paper

A field bioassay of the biocidal potential of some plant extracts against a millipede species (*Spirostreptus assiniensis*) infesting cassava (*Manihot esculenta* Crantz)

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A field bioassay was conducted at Ndashi Etche, Rivers State, Nigeria to evaluate the biocidal potential of selected plant extracts against a millipede species *(Spirostreptus assiniensis* (Diplopoda: Spirostreptidae), infesting cassava (*Manihot esculenta Crantz).* The treatments comprised plant extracts from neem (*Azadirachata indica),* uziza (*Piper guineense*) and dragon tree (*Dracenea arborea)* and were arranged in a randomized complete block fashion. The cassava variety employed was Etche Local best. The plot size was 4 × 4 m and there were a total of 11 plots replicated three times including control. Cuttings treated with neem (*A. indica)* at 150 g/l and *D. arborea* at 150 g/l had fewer numbers of holes (2.5 - 6.0) compared with control (10.0). Similarly, treated cuttings significantly produced taller plants (30 - 44.5 cm) than untreated ones. Further more, mortality of the millipedes was highest among plants treated with neem (*A. indica)* (3.9), *D. arborea* (3.7) and uziza (*P. gunineense*) (3.4) in contrast to the control (0.0).

Key words: *Spirostreptus assiniensis*, *Manihot esculenta*, plant extracts, mortality.

INTRODUCTION

Millipedes are terrestrial arthropods, which have a single pair of antennae, elongated bodies and many legs. They have two pairs of legs per body segment except for the first 4-6 body segments with a pair of legs each (Hopkin and Read, 1992)

Tian et al. (1995) reported that millipedes were useful in farm litter decomposition. However they have been widely reported to cause damage to crops (Davidson and Lyon, 1986; Akinlosotu et al., 1987; Wightman and Amin, 1988; Inyang 1998). In Nigeria, millipedes breed during the rainy season and lay their eggs in the soil. These eggs form cysts, which enable them, survive the dry season as well as the heat resulting from bush burning common in some communities. As soon as the rains return in March/April, the encysted eggs dissolve, thereby releasing young devastating millipedes into the soil. Their first contact as herbivores at this stage are the newly planted cassava cuttings. These young millipedes feed on the cassava cuttings and impair their sprouting and growth. This forces the farmer to carry out repeated supplies, an exercise that weighs heavily on the farmer's purse. The species of millipede implicated is *Tibiomus* spp. and *Spirostreptus assiniensis* (Diplopoda: Spirostrepsidae) (Inyang, 1998).

In view of the tremendous damage caused to cassava by millipedes and also because of the growing resistance of these organisms to synthetic chemicals as well as their cost, it is high time alternative sources of control were exploited.

Recently scientists have focused their search on local

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Table 1. Effect of different plant extracts on cassava emergence and number of holes.

Treatment	Mean emergence of cuttings	Mean number of holes
Control	12.00 ± 0.58[bc]	10.00 ± 0.37[a]
Furadan (10 g)	11.50 ± 0.76[c]	4.00 ± 0.52[de]
D. arborea (50 g)	11.50 ± 1.18[c]	4.50 ± 0.06[cdf]
D. arborea (100 g)	12.50 ± 0.58[abc]	5.00 ± 0.52[bed]
D. arborea (150 g)	13.83 ± 1.17[a]	2.50 ± 0.34[f]
P. guineense (50 g)	13.50 ± 0.43[ab]	4.50 ± 0.43[cde]
P. guineense (100 g)	12.83. ± 0.01[abc]	4.50 ± 0.42[cde]
P. guineense (150 g)	11.50 ± 1.18[c]	3.67 ± 0.67[def]
A. indica (50 g)	14.00 ± 0.37[a]	5.50 ± 0.76[be]
A. indica (100 g)	13.00 ± 0.37[abc]	6.00 ± 0.26[b]
A. indica (150 g)	13.00 ± 0. 73[abc]	3.50 ± 0.76 [ef]

Means in the same column followed by the same letters are not significantly different (DMRT).

plants with biocidal properties; in this study neem (*Azadirachta indica*), '*uzuza'* (*Piper guineense*) and 'ukpo' plant (*Dracaena arborea*) are assessed for their biocidal efficacy against *S. assiniensis* infesting cassava. *P. guineense* belongs to the family Piperaceae. It is commonly known as climbing black pepper or Benin pepper. Both the fruits and leaves are useful and are used locally for treating worm infestation, tonsillitis, rheumatism and stomach aches. Extracts of a relative of *P. guineense*, *P. nigrum* has been used against nematodes (Krishnamurti and Murthy, 1993).

Neem has been used against many stored products pests (Lale, 1995) and for the control of field pests such as bean pod borer *Maruca vitrata* (Jackai, 1993), Colorado beetle, *Leptinotarsa decemlineata* (Schmutterer, 1995). Desert locust, *Schistocerca gregaria* (Graigne et al., 1985), and Diamond back moth *Plutella xylostella* (Schmetterer, 1995). While *Dracaena arborea* apparently has not been used against any field pest, it has been used against only two stored products pests, *Callosobruchus maculatus* and *Sitophilus zeamais* (Boeke et al., 2004; Epidi et al., 2008).

MATERIALS AND METHODS

Sources and preparation of plant materials

The experiment was carried out at Ndashi Etche Rivers State, one of the endemic areas of millipede infestation. A land space of 20 x 20 m^2 (0.04 ha) was prepared and marked out toward the end of March 2008.

Leaves of neem *(Azadriachta indica)* (A Juss), ukpo (*Dracaena arborea*), and uziza (*Piper guineense)* were obtained from the forest at Ndashi Etche, Port Harcourt, Nigeria while furadan was purchased from the Agricultural Development Programme (ADP) in Port Harcourt. The leaves were chopped into pieces, air dried for 3-4 weeks and pounded into powder. The extracts of the plant material were prepared by adding the powder to water, thoroughly mixing and allowing the mixture to stay over night for the extraction of the active ingredient (Vijayalakshmi et al., 1997). The rate of application of each of the leaf powders was 50, 100 and 150 g/litre of water. Furadan was applied at the rate 10 g/litre as a synthetic chemical check, and a control plot was included. The various treatments are indicated as follows:

A. indica (Neem): 50,100 and 150 g/l of water.
D. arborea (Ukpo): 50,100 and 150 g/l of water.
P. guineense (Uziza):50,100 and 150 g/l of water.
Furadan: 10g/l.

Control

Etche Local best cultivar of cassava obtained from the market in Etche was used for the study. Cassava cuttings 20 - 25 cm length were soaked for two (2) hours in each solution and were planted at 2 cuttings per hole and a planting space of 1 x 1 m on a flat bed was adopted. Control cuttings did not receive any treatment. The treatments were arranged in a Randomize Complete Block Design (RCBD) fashion and replicated thrice. Weeding was done after 4 weeks and fertilizer application was done at the sixth week. Emergence (sprouting) counts, number of damaged holes, plant height and mortality of millipede were determined at 2 weekly intervals up to 3 months. Data obtained were subjected to Analysis of Variance (ANOVA) using SAS (1999) and means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

Effect of plant extracts on cassava emergence and number of holes/cutting

The various plant extracts had significant ($P \leq 0.001$) influence on cassava emergence and number of damage holes (Table 1). The highest emergence of cassava cuttings was obtained from plots treated with neem 50 g/l (14.0 ± 0.37) and *Dracenea arborea* 150 g/l (13.83 ± 1.17), and they were significantly better than the control. The other treatments did not differ from the control in terms of cassava emergence. The highest mean number of holes was recorded on the control plot (10.0 ± 0.37) and it was followed by neem at 100 g/l (6.0 ± 0.26) while

Table 2. Effect of different plant extracts on the height of cassava.

Treatment	Mean ± SEM
Control	35.0 ± 0.73^{d}
Furadan (10 g/l)	40.5 ± 3.84^{c}
D. arborea (50 g/l)	30.0 ± 1.26^{f}
D. arborea(100 g/l)	41.5 ± 0.76^{c}
D. arborea (150 g/l)	44.5 ± 2.53^{b}
P. guineense (50 g/l)	32.0 ± 1.63^{ef}
P. guineense (100 g/l)	35.0 ± 2.29^{d}
P. guineense (150 g/l)	30.0 ± 1.8^{f}
A.indica (50 g/l)	32.67 ± 1.31^{def}
A.indica (100 g/l)	28.01 ± 2.07^{g}
A.indica (150 g/l)	33.5 ± 2.09^{de}

Means in the same column followed by the same letters are not significantly different (DMRT).

the least number of holes was obtained from plots treated with *Dracenea arborea* 150 g/l (2.5 ± 0. 34).

Effect of plant extracts on plant height

Table 2 shows the influence of plant extracts on height of cassava. Plots that were treated with furadan as well as those treated with *D. arborea* at 100 and 150 g/l had significantly ($P \leq 0.01$) higher plant height than the control. Other treatments were either lower than the control or did not differ from it.

Effect of plant extracts on mortality of *S. assiniensis*

Data on dead *A. assiniensis* showed highly significant ($p < 0.001$) differences attributable to treatments. The highest millipede mortality was obtained in the plots treated with *D. arborea* and *A. indica* irrespective of treatment level (Table 3). All levels of *A. indica* were as good as all levels of *D. arborea* in terms of mortality of *S. assiniensis*. Mortality due to *P. guineensis* generally did not differ from that caused by furadan except at 50 g/l.

DISCUSSION

Apart from neem at 50 g/l and *D. arborea* at 150 g/l which resulted in higher emergence than the control, the other treatments did not differ from one another and the control. This could be interpreted to mean that the other treatments were either too hash on the cassava cuttings (as in the case of neem at higher levels) or slower in action on the millipedes as is probably the case with *D. arborea* at lower levels. If harsh, this would adversely affect the buds and hence negatively impact on sprouting. If slower in action on the millipedes, they would continue their feeding activities on the cuttings, resulting in lower emergence and creation of more holes. In terms of number of holes on the cutting, extracts of neem *(A. indica),* boundary plant (*D. arborea),* and uzuza *(P. gunieense)* had significantly lower number of holes than the control. The fewer number of holes on treated cuttings may be as a result of the combination of repellency and toxicity of the extract to the millipedes soon after probing the cuttings. *P. guineense* is sometimes used for medicinal purposes and as a condiment for local barbecues called “suya” (Olorode, 1984), However, the insecticidal properties of a related species *P. nigrum* L has been reported from India (Deskmukh et al., 1982), while the chemical substances in neem responsible for repellency are salonnin and meliantrol (Vijayalakshmi et al., 1997).

The significant treatment effect on plant height is indicative of the fact that *S. assiniensis* caused tremendous damage to cassava. The control plant had significantly shorter plant height (35.0 ± 0.73) than those treated with furadan (40.5 ± 3.84) and boundary tree (*D. arborea)* (44.5 ± 2.53). When millipedes attack planted stem cuttings of cassava, they literally consume virtually the entire food composition which is needed by the buds for sprouting and growth, and lower food value ultimately means slower rate of growth. When millipedes are repelled or killed by the treated cuttings the sprouting buds will grow unabated and may in time attain their genetic potentials. It is not clear whether uzuza (*P. gunineense*) has repellent properties.

However, as indicated earlier, neem exhibits repellency (Saxena, 1989; Koul, 1985). Neem is also known to be toxic to a number of insect species, its major toxic component being Azadirachtin (Shmutterer, 1990; Schmutterer 1995; Saxena 1989; Lale and Abdulrahman, 1999; Olaifa and Akingboungbe, 1986).

The high mortality of *S. assiniensis* caused by the plant extract (*D. arborea*) (4.8 ± 0.29) and Neem *(A. indica)* (4.3 ± 0.3) is suggestive that these plant possesses biocidal or toxic properties. Odili (2006) demonstrated that (*D. arborea*) is toxic to the stored product pest (*Tribolium castaneum*).

A major component of neem, *azadirachtin,* is known to have a number of biological properties including toxicity (Shmutterer, 1990). In addition to being biocidal to *A. assiniensis*, it could slow down its developmental processes thus leading to an unusually long life cycle. An unusually long life cycle in turn would lead to faster crashing of the millipede’s population. Toye (1967) had reported that this millipede species had a mean short life cycle of 28 days. So even if they are not killed immediately they ingest toxic plant materials, their ability to cause damage is tremendously reduced.

Conclusion

The plant extracts of Neem *(A. indica),* uzuza *(P. guineense)* and Dragon tree (*D. arborea)* at 50 - 150 g/l

Table 3. Effect of plant extracts on mortality of *Spirostreptus assiniensis*.

Treatment	Mean number of *S. assiniensis*
Control	0.3 ± 0.15^{d}
Furadan (100 g/l)	2.8 ± 0.33^{c}
D. arborea (50 g/l)	3.7 ± 0.50^{abc}
D. arborea (100 g/l)	4.8 ± 0.33^{a}
D. arborea (150 g/l)	4.8 ± 0.29^{a}
P. guineense (50 g/l)	3.8 ± 0.66^{abc}
P. guineense (100 g/l)	3.4 ± 0.52^{bc}
P. guineense (150 g/l)	3.4 ± 0.52^{bc}
A. indica (50 g/l)	4.0 ± 0.30^{ab}
A. indica (100 g/l)	3.9 ± 0.31^{abc}
A. indica (150 g/l)	4.3 ± 0.30^{ab}

Means in the same column followed by the same letters are not significantly different (DMRT).

were toxic to *Spirostreptus assiniensis* and this was indicated by better sprouting, fewer number of damage holes, improved height, and high mortality of millipedes compared to the control.

Based on this study, it is recommended that *D. arborea*, *A. indica*, and *P. guineense* at 50 - 150 g/l be used for the control of *S. assiniensis* infestation on cassava. Insecticides of plant origin are relatively cheaper, friendly to environment and easily biodegradable compared with synthetic chemical.

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