The Sensitivity of Flower Bud Thrips, *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae)**, on Cowpea to Three Concentrations and Spraying Schedules of** *Piper guineense* Schum. & Thonn**. Extracts**

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Abstract

Oparaeke A.M. (2006): **The sensitivity of flower bud thrips,** *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae)**, on cowpea to three concentrations and spraying schedules of** *Piper guineense* Schum. & Thonn. **extracts**. Plant Protect. Sci., **42**: 106–111.

The extracts of pods of West African black pepper, *Piper guineense,* at 5, 10 and 20% (w/v), were applied at two, four and six weekly schedules to control the legume flower bud thrips, *Megalurothrips sjostedti* on flowers of cowpea, *Vigna unguiculata*. The trials were conducted for 2 years under rain fed conditions in the northern Guinea savanna region of Nigeria. The results showed that the *M. sjostedti* population was significantly controlled on treated plots compared with the untreated check in both years. The extracts at the 20 and 10% rates and with six or four weekly applications significantly ($P < 0.05$) reduced thrips pressure on cowpea flowers, were better than the 5% extract at all spraying schedules, and had the same efficacy as the synthetic insecticide treatment. Pod density per plant was significantly higher ($P < 0.05$) on plots treated with the 20% extract at six or four weekly applications compared to other extract rates and was similar to that of the synthetic insecticide treatment. Thus, the extracts could be a good alternative to the synthetic insecticides on organically managed farms as well as on farms of limited resource farmers in the tropics and subtropics.

Keywords: control of *Megalurothrips sjostedti*; extracts of *Piper guineense*; *Vigna unguiculata*; application schedules

Insect pests may cause serious damage (80–100%) on field cowpea, *Vigna unguiculata* (L.) Walp., where modern pest control measures are absent. Currently, these measures rely heavily on synthetic insecticide application. The indiscriminate use of these chemicals has given rise to problems such as resistance of the pest species to insecticide (Champ & Dyte 1976; Georghion & Lagunes-Tejeda 1991), accumulation of toxic residues in food (Snelson 1987), health risks to the user and livestock, and environmental contamination. These problems have much increased the need for alternative, safe and effective biodegradable insecticides from natural sources with greater selectivity. The search for new types of insecticides and the re-evaluation and use of traditional botanical pest control agents thus seems to be a promising alternative.

For many centuries, crude extracts from plants have been used by farmers to control insect pests on crops. Plant materials (powder, water extracts, oils and wood ash) contain complex mixtures of

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active principles, which confer different pesticidal activity (such as repellency, antifeedant, insecticidal, bactericidal, fungicidal, nematicidal and growth regulatory functions) on such plants (Grainge *et al.* 1985). These active principles in crude extracts from plants may act synergistically (Berenbaum 1985) to inhibit pest populations on crops compared with a single constituent extract (Berenbaum *et al.* 1991; Chen *et al.* 1995) and are unlikely to develop pest resistance problems when used over time.

Extracts of *Nicotiana tabacum* L., *Derris elliptica* L., *Lonchocarpus* spp. (Matsumura 1975), *Melia azaderach*, *Argemone mexicana* L. (Pandey *et al.* 1981), *Chrysanthemum cinerariaefolium* L. (Stoll 1986), *Azadirachta indica* (Jackai & Oyediran 1991; Jackai *et al.* 1992; Olaifa & Adenuga 1988; Tanzubil 1991), *Syzigium aromaticum* (L.) Merr & Perr. (Oparaeke *et al.* 2002), *Allium sativum* L. and *Monodora myristica* (Gaertn.) Dunal (Oparaeke *et al.* 2000), *Piper guineense* Schum. & Thonn. (Scott & McKibben 1978) and many others have been reported to possess insecticidal properties against a number of insect species. In Nigeria, there is a dearth of literature on the application of naturally growing plants as insecticides for pests control on field crops (Olaifa *et al.* 1987).

The present work was conducted to establish the effectiveness of different concentrations and spraying schedules of a water extract of West African black pepper (*P. guineense*) against the legume flower bud thrips, *Megalurothrips sjostedti* Trybom, on cowpea plants.

MATERIAL AND METHODS

Preparation of extracts of *P. guineense*

Dried fruits of *P. guineense* were purchased in markets at Aba in Abia State of Nigeria, dried in an oven at 80°C for 4 h to stabilise the moisture content and ground into powder using an electric hammer mill. Different amounts (250 g, 500 g and 1000 g) of the powder were weighed separately into 10 l plastic buckets containing 3 l of tap water. These were stirred vigorously for 10 min and allowed to stand for 12 h before filtration with additional 1.5 l tap water using a double folded muslin cloth to obtain crude extracts of the concentrations of 5, 10 and 20% w/v, respectively. To each extract, 250 ml each of a 20% soap and of a starch solution (50 g bar soap flakes and 50 g starch powder, each dissolved in 250 ml of boiling water) were added to give them a slightly sticky and emulsifiable characteristic. The extracts were then labeled and ready for application.

Field layout and preparation

The trials were conducted during 1999 and 2000 under rain fed conditions on the research farm of the Institute for Agricultural Research, Samaru, Zaria (11°11'N and 07°38'E), situated in the northern Guinea Savanna of Nigeria. The field used for each trial had an area of about 0.40 ha. It was sprayed with glyphosate at 2.5 kg a.i./ha and the weeds allowed to wilt for 21 d before disc harrowing and ridging at 0.75 m spacing. The treatments were applied in three spraying schedules as indicated below. Of the two controls, one was the synthetic insecticide Uppercott and the other an untreated control. The main plots (3.75 m × 54 m) consisted of the three concentrations of black pepper extract, Uppercott and the untreated control. Sub plots (3.75m × 6.0 m) received the three different weekly application schedules. Each plot (consisting of five ridges: three main and two discard ridges) was replicated three times and was separated by a 2 m wide border along the ridge and two unplanted ridges.

The cowpea cv. Sampea 7 was used for the trials. It is of medium duration (80–85 days), of semi erect growth habit and is highly susceptible to the major post flowering pests whose peak populations synchronise with the growth period of the plant in the savanna ecological zone where this study was conducted. The seeds were treated with Apron Plus 50 D (one satchet/2 kg seeds) before sowing. Three seeds were sown per hole between August 3 and 7 in both years with intrarow spacing of 25 cm, giving 24 plants per row. The pre-emergence herbicide Galex (Metalachlor 250 a.i. + Metabromuron 250 a.i./l) was applied at 1.5 kg a.i./ha immediately after sowing to control early growth of weed. Seedlings were thinned to two plants per hole 2–3 weeks after sowing (WAS) and NPK (15:15:15) fertiliser was used to top-dress the seedlings at the rate of 35 kg a.i./ha. The plots were weeded once at 6 WAS with a hoe to ensure a clean environment for crop growth. A tank mixture of benomyl and mancozeb was applied at the rate of 0.30 kg a.i./ha every week for four weeks to control fungal diseases beginning from the fourth week after sowing. The black pepper extracts at the three concentrations of 5, 10 and 20% (w/v) were applied at two, four and six weekly intervals using a pressurised air low volume knapsack sprayer at the discharge rate of 150 l/ha beginning at the flower bud formation or onset of flowering (6 WAS). Uppercott was sprayed once weekly for 4 weeks at the rate of 1 l/ha; the untreated control remained unsprayed.

Field bioassay

Insect pests sampling was conducted every week between 6.30 a.m. and 8.30 a.m. within the three inner rows before spraying. The number of *M. sjostedti* was assessed by randomly picking 20 flowers per plot, placing them in vials containing 30% alcohol (Amatobi 1994), dissecting them next day in the laboratory and the insects found were identified and counted. Pod load was assessed by random selection of 10 plants within the main ridges and counting the total number of pods produced per plant.

Data obtained were subjected to analysis of variance (ANOVA) after square root transformation and treatment means separated using Student Newman Keuls test ($P < 0.05$) (SAS Institute 1990).

RESULTS

The aqueous extracts of West African black pepper (WABP) and the synthetic insecticide caused significant reduction of the *M. sjostedti* population in both years of the study compared with the untreated check. Among the extracts rates, 20 and 10% concentrations at six or four weekly applications performed better in the suppression of thrips on cowpea flowers than the 5% rate, but the difference between them (20 and 10%) was not statistically significant. Similarly, the synthetic insecticide treatment was not superior to the WABP extracts applied at higher concentrations (20 and 10%) and more frequent sprayings (six and four weekly applications) (Table 1).

Mean pod load was highest on plots sprayed with 20 and 10% extracts at both the six and four weekly applications compared with other WABP treatments. Application of the 20% extract at six or four weekly intervals was statistically comparable to the synthetic insecticide in both years of

Table 1. Effect of three concentrations and spraying schedules of black pepper extracts on the thrips populations on cowpea in the 1999 and 2000 cropping seasons

Treatment	Mean no. of *M. sjostedti*/flower		Mean no. of pods produced/plant	
	1999	2000	1999	2000
Control (0.0)	3.18 *a*	3.27 *a*	9.4 *a*	10.0 *a*
C^1 R^1	1.60 *b*	1.86 *b*	30.9 *b*	32.8 *b*
C^1 R^2	1.40 *bc*	1.60 *bc*	32.3 *c*	34.3 *c*
C^1 R^3	1.0 *cd*	1.26 *cd*	34.3 *c*	38.3 *c*
C^2 R^1	0.80 *de*	1.06 *de*	39.9 *d*	41.3 *d*
C^2 R^2	0.68 *ef*	0.92 *ef*	42.9 *e*	46.3 *e*
C^2 R^3	0.40 *ef*	0.72 *ef*	46.7 *fg*	48.2 *fg*
C^3 R^1	0.54 *ef*	0.80 *ef*	45.6 *f*	46.2 *f*
C^3 R^2	0.26 *f*	0.60 *f*	48.9 *gh*	49.5 *gh*
C^3 R^3	0.26 *f*	0.60 *f*	50.1 *h*	49.7 *h*
Uppercott	0.26 *f*	0.46 *f*	50.1 *h*	50 2 *h*
S.E ±	0.14	0.14	0.41	0.43

C^1 = 5 w/v; C^2 = 10% w/v; C^3 = 20% w/v; R^1 = two weekly sprayings; R^2 = four weekly sprayings; R^3 = six weekly sprayings

Means followed by the same *letter(s)* in a column do not differ significantly ($P < 0.05$; SNK test) the study (Table 1). Data analysis also indicated that pod load was negatively correlated (–0.91 and –0.92 in 1999 and 2000, respectively) with thrips population on cowpea, which showed that the pest had exerted a great influence on cowpea podding.

DISCUSSION

Plant extracts (aqueous or oil) have been used for pest management worldwide by limited resource farmers and have been found effective in various trials by scientists (Grainge & Ahmed 1988; Jacobson 1989; Schmutterer 1990). In this study, three concentrations (5, 10, 20% w/v) and weekly applications (two, four or six times) of West African black pepper extracts were evaluated for efficacy against thrips on cowpea flowers in 2 years of fieldwork. The results indicate that 20 and 10% extracts of WABP with six and four weekly applications caused significant reduction of thrips on flowers and increased pod carrying capacity of cv. Sampea 7 of cowpea and was not inferior to the synthetic insecticide treatment. This result is consistent with the reports of Ogunlana *et al.* (2002), Ekesi (2000), Tanzubil (1991) and Jackai and Oyediran (1991) who worked on different plant materials at various concentrations against different species of crop pests.

The mode of activity of WABP extracts in suppressing pest pressure on cowpea flowers and ensuring high pod numbers is not very clear. Yet since thrips live and feed inside the flowers and out of reach of most insecticides, any chemical that shows a remarkable efficacy against it must have systemic action and must be applied within the first 3 weeks of the reproductive phase (6 to 9 weeks after sowing) and at more frequent spraying intervals. Botanicals are slow acting mortality agents, so that two weekly applications may not be adequate to protect flowers from pests because only the flowers that were formed first were retained and developed into pods, an effect of the first two sprayings. As observed in this study, flowers formed after spraying had ceased were aborted, resulting in low pod yields in plots treated only twice, no matter what concentration of extract had been applied.

After spraying, the extract or its active principle(s) might have been translocated from other plant parts into the flowers where the insects live and feed through osmotic pressure thereby exposing them to the lethal action of extract. This observation corroborates the findings of Ekesi (1999) with microbial insecticides to control thrips on cowpea flowers. In similar trials, Okech *et al.* (1997), Duerden (1953) and Lawani (1982) found that the stalk borer population on maize stalk could be effectively reduced if the chemical applied was placed in the funnels before the larvae bore into the stem. The observed ineffectiveness of 20% WABP extract with less frequent application schedules (two weekly sprayings) could be due to inappropriate timing of application, the slow acting nature of plant extracts generally and/or the changes in the population pattern of the pest within a season. The pest population might have been built up at a time when there were favourable environmental conditions between sprayings (less rainfall within a few days), causing considerable pest damage to flowers.

Piper guineense is a tropical spice of West African origin. Its extracts (aqueous and oils) contain a large number of chemical compounds such as piperine, chavicine, myristicin (sarisan, safrole, elemeicin and 51-mono-sesquiterpenoids) that have insecticidal properties. The effectiveness of the extract for thrips control in this trial has shown the great potential it has as a bio-pesticide. The chemical constituents of WABP should be isolated, purified and used in formulation of pesticidal sprays for the benefit of farmers. In some rural communities in West Africa, the powder and/or aqueous extract of WABP is used for prophylactic or therapeutic treatment of various body disorders and as condiments in food preparations; therefore, the material may be unlikely to pose any health hazard to man and livestock. More research is needed to verify the results obtained in this trial with a view to utilising the natural endowments of the plant for protection of other field crops. Since WABP proved effective against insect species belonging to different Orders (Oparaeke *et al.* 2005), which is one of the conditions for any plant species to be considered for use as bio-pesticide (Ahmed *et al.* 1984), further tests are required using the essential oil of WABP as emulsifiable concentrate (e.c.) formulation or as ultra low volume (ULV) spray to reduce the water requirements of an aqueous formulation in water deficient ecologies. Although pods of WABP are currently expensive in markets in Nigeria because a substantial quantity is imported from the Cameroun Republic, farmers could be encouraged to cultivate the plant (which is becoming popular now in the eastern part of the country) as a cash crop, thereby reducing the price in local markets.

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