Effects of frequency of spraying neem seed extract on the lepidopteran pests of the egg plant (*Solanum integrifolium*)

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SUMMARY

Six treatments of different intervals of spray (1, 2, 3, 4, 5 and 6 weeks) of neem seed extract at 20 kg neem seed/ha and a control of no neem spray, were evaluated against lepidopteran pests of the egg plant. Leaf, shoot and fruit damage on plants sprayed at either 1- or 2- week intervals was less (< 30 %) than on those with intervals of spray beyond 2 weeks (35-58 %). Nevertheless, the performance of the neem extract-treated plants sprayed at all the six frequencies was better than the untreated plants which produced the lowest yield per hectare (2.0 kg). This indicates the importance and pest status of the lepidopteran insects on the egg plant. The results from this experiment confirm the potential of neem extract as an alternative bio-pesticide for control of insect pests.

Original scientific paper. Received 26 Jan 95; revised 26 Sep 96.

RÉSUMÉ

AFREH-NUAMAH, E. : *Les effets de la fréquence de la pulvérisation de l' extrait du pépin de neem sur les ravageurs lepidopterans d'aubergine* (Solanum integrifolium). Six traitements à intervalles différents de la pulvérisation (1, 2, 3, 4, 5 et 6 semaines) de l' extrait du pépin de neem à 20 kg pépin de neem/ha et un contrôle de non-pulverisation de neem étaient évalués contre les ravageurs lepidopterans de l'aubergine. Les dégâts de feuille, de tige et de fruit sur les plantes pulvérisées soit à intervalles de 1 ou 2 semaines étaient moins (<30 pourcent) que ceux avec intervalles de pulvérisation au-déla de 2 semaines (35-58 pour cent). Néanmoins, la performance des plantes traitées d' extrait de neem pulvérisées à toutes les six fréquences était mieux que les plantes non-traitées qui ont produit le plus bas rendement par hectare (2.0 kg). Ceci indique l' importance et le status du ravageur d'insectes lepidopterans sur l'aubergine. Les résultats de cet expérience confirment le potentiel d' extrait de neem en tant qu'un bio-pesticide alternatif pour le contrôle d' insecte ravageurs.

Introduction

Susceptibility of the egg plant (*Solanum integrifolium*) to lepidopteran pests in West Africa, and Ghana in particular, is very high. The most important ones which inflict severe damage to the plant and thereby reduce economic yield include *Selepa docilis* Butter, *Scrobipalpa blapsigona* Meyr, and *Leucinodes orbonalis* Guen. These attack the leaves, flowers, shoots and fruits respectively (Forsyth, 1966; Owusu, 1980; Coffie-Agblor, 1982; Osei, 1986).

To reduce the damage caused by these and other pest species, most farmers adopt the use of insecticides like cypermethrin, diaxocarb, dimethoate and lindane (Blay, 1986). Such insecticides, even though effective, are undesirable because of their high costs, environmental unfriendliness and possible development of resistance among pest species, resurgence of certain pest populations and eradication of beneficial pollinators and predators. Currently, therefore, scientists are intensifying research into the possible use of insecticides of plant origin for the management of plant pests (Metcalf, Flint & Metcalf, 1962; Ware, 1986; Saxena, 1989; Jackai, 1993). Pyrethrum, rotenone and nicotine were among the first of such compounds used to control agricultural insects pests (Grainge & Ahmed,

1986).

Azadirachtin, a triterpenoid obtained from the neem plant *Azadirachta indica* A. Juss (Meliaceae), has been shown to possess some growth regulating and antifeeding materials against numerous pests (Pradham & Jotwani, 1968; Warthen, 1979; Heyde, Saxena & Schmutterer, 1984; Schluter, Bidman & Grieve, 1985; Koul, Amansi & Ohtak, 1987; Cobbina & Osei-Owusu, 1988; Olaifa & Adenuga, 1988; Saxena, 1989; Martins, Jacqueline & Ralph, 1994).

Work done by various researchers on the use of neem for control of insect pests has mostly consisted of the evaluation of the effects of different concentrations on target pests (Rwamputa & Schabel, 1988; Jackai, 1993; Przhyszeski, 1993; Afreh-Nuamah *et al.*, 1994). Rwamputa & Schabel (1988) in their laboratory studies found 1 per cent neem kernel extract as the most effective preparation, causing cummulative mortality of 100 per cent to first instar larvae of *Heteronygmia dissimilis* (pest of *Khaya nyasica*).

This study, however, sought to determine the intervals for spraying a neem seed extract of 75 g neem seed/*l* of water (i.e. 20 kg neem seed/ha), against lepidopteran pests of the egg plant. The selected dosage was the most effective in a previous trial to evaluate some biopesticides for the control of lepidopteran pests of the egg plant (Afreh-Nuamah *et al.*, 1994).

Materials and methods

The experiment was carried out from September 1993 to February 1994 at the Agricultural Research Station, Okumaning-Kade, in the Eastern Region of Ghana. Seeds of the local Okumaning variety of the egg plant were nursed on 1 Sep 93 and transplanted in the field 9 weeks later.

Twenty-eight plots each planted to 16 plants were used for the experiment under the randomized complete block design to test seven treatments consisting of six different spraying intervals of the neem extract and an untreated control. There were four replications per treatment.

Spraying was done once a week (SPT 1), once every 2 weeks (SPT 2), once every 3 weeks (SPT 3), once every 4 weeks (SPT 4), once every 5 weeks (SPT 5) and once every 6 weeks (SPT 6). The control plots (SPT 0) were not sprayed throughout the experimental period.

Each plot measured 2.7 m × 6.3 m and consisted of four rows spaced at 0.9 m apart.

One and a half weeks after transplanting, NPK 15:15:15 at 15 g/plant was applied in a ring of radius 15 cm. Spraying was started approximately 1 week after transplanting when the first sign of insect damage was noticed. The CP15 Knapsack sprayer (Cooper Peggler Ltd, U.K.) fitted with a hollow cone nozzle was used at a pressure of 3 bar. Weeding and watering were done as necessary.

The neem seed extract was prepared by grinding the required quantity of the dry seeds (kernels and hulls) into a coarse powder and mixing the powder with the required amount of water (i.e. 75 g/*l* in this case) to obtain a crude suspension. This was thoroughly stirred and left covered overnight, after which time the suspension was filtered (Using cheese cloth) to obtain the spray liquid.

Leaf damage was estimated using a 5-point scale (1 = no damage, 2 = 25 per cent surface damage, 3 = 26-50 per cent surface damage, 4 = 51-75 per cent surface damage, and 5 = greater than 76 per cent damage). Percentage of flower and fruits that had been infested out of 25 harvested from each plot as well as the number of infested shoots were recorded.

Data were taken on 10 randomly chosen plants from the middle rows within a plot (out of a total of 16). Fruit yield in kilogram per hectare was calculated for each treatment. All data collected were subjected to the analysis of variance and, where necessary, the Duncan's Multiple Range Tests were used to separate the means.

Results

Effect of the different treatments on leaf damage

All but two treatments SPT 1 and SPT 2 failed to

TABLE 1

Percentage Damage of the Egg Plant Leaves Under the various Treatments

Treatment	*November*	*December*	*January*
SPT 1	21.3[a]±0.9	20.4[a]±2.1	23.5[a]±1.5
SPT 2	22.3[a]±0.2	24.7[a]±1.3	26.6[a]±1.3
SPT 3	35.7[b]±0.1	37.5[b]±1.2	39.3[b]±1.8
SPT 4	37.4[b]±0.4	38.6[b]±1.1	37.6[b]±1.8
SPT 5	48.2[c]±1.3	47.6[c]±2.3	49.3[c]±0.3
SPT 6	48.1[c]±2.1	49.3[c]±1.4	52.3[d]±1.4
SPT 0	54.1[d]±1.3	57.3[d]±1.9	58.4[d]±2.2

Means within columns having one letter in common do not differ significantly at $P = 0.05$ using Duncan's Multiple Range Test.

TABLE 2

Mean Number of Infested Shoots per Ten Trees for the different Treatments

Treatment	*November*	*December*	*January*
SPT 1	18.0[a]±1.3	17.6[a]±1.6	19.3[a]±2.1
SPT 2	21.3[a]±1.2	19.2[a]±1.8	19.4[a]±1.9
SPT 3	36.2[b]±1.0	38.2[b]±1.7	39.4[b]±1.5
SPT 4	39.2[b]±1.2	42.1[c]±1.3	44.2[c]±1.3
SPT 5	43.1[c]±1.3	42.5[c]±1.5	46.2[c]±1.3
SPT 6	47.6[cd]±1.6	45.2[c]±1.7	47.1[c]±1.6
SPT 0	58.1[d]±2.1	59.3[d]±2.1	59.5[d]±1.3

Means within columns having one letter in common do not differ significantly at $P = 0.05$ using Duncan's Multiple Range Test.

protect the leaves effectively against the larvae of *S. docilis* (Table 1).

The damage on plants that had one spray every 3 weeks (SPT 3) and those with every 4 weeks (SPT 4) were not significantly different (Table 1).

Similarly, damage on plants with 5-week intervals between sprays (SPT 5) and those with 6 weeks between sprays (SPT 6) did not differ significantly (Table 1). Leaf damage in January 1994 for all treatments except SPT 4 were slightly higher than in the other months (Table 1).

Effects of the different treatments on the number of infested shoots

Shoot infestation was significantly affected by all treatments (Table 2). Even though plants sprayed at 1-week intervals recorded lower number of infested shoots than those with 2-week intervals of spray, the differences were not significant. The two treatments (SPT 1 and SPT 2), however, had significantly lower numbers of infested shoots than the other treatments. Performance of plots with 4-week interval of spray was not significantly different from those with 5- and 6- week intervals.

Effect of the treatments on flowers

Percentage number of good flowers recorded was significantly affected by the different spraying intervals (Table 3). Treatments SPT 1 and SPT 2 significantly reduced flower damage by the larvae of *S. blapsigona* and consequently recorded a higher percentage number of good flowers than the other treatments (Table 3). There was no significant difference between the percentage number of good flowers collected from plots that had 3 and 4 weeks between sprays (Table 3). However, percentage numbers of good flowers recorded from plots that had 3 and 4 weeks

TABLE 3

Percentage Number of Good Flowers[1] Recorded for the Different Treatments

Treatment	*December*	*January*	*February*
SPT 1	96.0[a]±1.3	98.4[a]±1.4	98.4[a]±1.3
SPT 2	96.8[a]±1.6	97.2[a]±1.8	97.8[a]±1.9
SPT 3	80.6[b]±1.6	81.4[b]±1.3	87.4[b]±1.8
SPT 4	81.2[b]±1.8	80.3[b]±1.5	82.4[b]±1.5
SPT 5	78.1[c]±1.3	79.3[b]±1.5	78.4[c]±2.1
SPT 6	74.6[c]±2.1	69.4[c]±1.8	72.4[c]±1.3
SPT 0	72.3[c]±1.7	70.1[c]±1.9	71.3[c]±2.1

Means within columns having one letter in common do not differ significantly at $P = 0.05$ using Duncan's Multiple Range Test.
[1] 25 flowers were collected from 10 trees in each plot for the analysis.

between sprays were significantly more than those on plots which had 5 and 6 weeks between sprays (Table 3). Flower damage was higher on the control plots as they recorded the lowest percentage number of good flowers throughout the experiment (Table 3).

Effect of the different treatments on yield parameters

Mean number of fruits (on per plant basis) collected from SPT 1 and SPT 2 were not significantly different at $P = 0.05$ (Table 4).

TABLE 4

Effect of the Different Treatments on Yield Parameters

Treatment	*Mean No. of fruits harvested per plot*	*No. of fruits damaged (% damage)*	*Mean fruit weight (kg) per plot*	*Yield per hectare (kg)*
SPT 1	$47.3^{a} \pm 1.3$	$10.2 \pm 1.2 (21.5)^{a}$	$3.8^{a} \pm 0.3$	$5.8^{a} \pm 0.7$
SPT 2	$46.2^{a} \pm 1.4$	$11.8 \pm 1.3 (25.5)^{a}$	$2.4^{b} \pm 0.4$	$4.2^{b} \pm 0.5$
SPT 3	$40.3^{b} \pm 1.8$	$15.3 \pm 1.6 (38.0)^{b}$	$2.0^{b} \pm 0.1$	$4.1^{b} \pm 0.4$
SPT 4	$40.4^{b} \pm 1.4$	$18.7 \pm 2.1 (46.3)^{b}$	$2.1^{b} \pm 0.1$	$4.0^{b} \pm 0.2$
SPT 5	$39.3^{c} \pm 2.1$	$24.3 \pm 2.4 (61.2)^{c}$	$1.8^{bc} \pm 0.3$	$3.6^{b} \pm 0.3$
SPT 6	$38.4^{c} \pm 1.8$	$25.6 \pm 2.1 (66.7)^{c}$	$1.4^{c} \pm 0.6$	$2.4^{d} \pm 0.4$
SPT 0	$33.3^{d} \pm 2.4$	$26.1 \pm 1.3 (78.3)^{d}$	$1.0^{c} \pm 0.3$	$2.0^{d} \pm 0.3$

Means within columns having one letter in common do not differ significantly at $P = 0.05$ using Duncan's Multiple Range Test.

Invariably, more fruits were harvested from the treated than from untreated plots and most of the fruits obtained from the untreated plots were damaged compared to those obtained from the treated plots (Table 4). Mean fruit weight did not vary much within the treatments. However, comparatively heavier fruits were harvested from plants that had 1-week intervals between sprays (Table 4).

Fruits obtained from plots with spray intervals of 2, 3, 4 and 5 weeks, even though slightly different in weight, did not show any significant differences. Nevertheless, plants that had no neem spray at all (SPT 0) produced smaller-sized fruits (Table 4).

The yield per hectare was significantly affected by the different treatments. Plants with 1-week intervals of spray had significantly higher yields than the other treatments. The unsprayed plots had the lowest yield (Table 4).

Yield per hectare calculated for treatments SPT 2, SPT 3 and SPT 4 were not significantly different. However, the three treatments (SPT 2, SPT 3 and SPT 4) had significantly higher yields per hectare than SPT 5, SPT 6 and SPT 0 (the control).

Discussion

Neem seed extracts of different concentrations have been shown to have detrimental effects on pests of different crops worldwide (Schmutterer, 1990). Its insecticidal action has been attributed to its growth regulatory and antifeeding ability (Cobbina & Osei-Wusu, 1988; Olaifa and Adenuga, 1988; Saxena, 1989; Schmutterer, 1990). However, the effect here is more of the anti-feeding action than the growth regulatory ability, which decreased feeding activity and, therefore, extent of damage caused.

Plants that had either 1 or 2 week intervals between sprays often recorded lower leaf damage than those on plots with 3, 4, 5 and 6 weeks intervals of spray. This indicates that neem seed extract at 0.075 per cent wt/vol. (20 kg seeds/ha) is effective in reducing flower, leaf, shoot and fruit damage when applied at 2-week intervals.

The significant differences observed between the treated and untreated plots show the pest status of larvae of *L. orbonalis* which bore into the fruits and shoots (Krishnarah & Vijah, 1975).

Conclusion

The potential of using neem seed extract as a biopesticide against lepidopteran pests of garden eggs is indicated in these experiments. The results suggest that the activity of neem seed extract could be retained for a maximum of 2 weeks, beyond which its effectiveness reduced drastically.

Standardization and formulation of the neem

extract would make it easier to use and, therefore, more acceptable to farmers.

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