

Field trials of formulated neem seed oil at different rates and frequencies on pigeonpea flower blister beetle, *Mylabris pustulata* Thunberg in Owerri Rainforest Zone, Nigeria

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Abstract

In this study, the efficacy of Formulated Neem Seed Oil (F-NSO) on the population of blister beetle, *Mylabris pustulata* Thunberg (Coleoptera: Meloidae) was evaluated. The data were recorded from beginning of May 2009 and 2010 planting seasons. The experiment was laid out in 3×5 factorial comprising three rates of neem seed oil, 4.2 L ha⁻¹, 8.3 L ha⁻¹, 12.5 L ha⁻¹ with Control (0 L ha⁻¹), and synthetic pyrethroid, cypermethrin (1.5L ha⁻¹) as checks plots. There were also three intervals of application: once a week, once in two weeks, and once in three weeks. Results showed that application of F-NSO at higher dosage of 12.5L ha⁻¹ and at four regime spraying intervals of once a week significantly (P<0.05) reduced the population of blister beetles on flowers of short duration pigeonpea cultivar (ICPL 84023). This

effective application dose of 12.5L ha⁻¹ at four regime spraying intervals of once a week can be an ideal Integrated Pest Management tool for the management of *M. pustulata* in Rainforest Zone of Southeastern, Nigeria.

Introduction

Pigeonpea (*Cajanus cajan* L.) Millsp, the traditional landraces in particular, is one of the main staple legumes cultivated by farmers in South Eastern, Nigeria.¹ It is a short-lived perennial shrub grown either as annual or perennial in the Semi-arid tropics, though it is well adapted to several environments.² Pigeonpea is well-balanced nutritionally, and an excellent source of protein. The green seeds serve as vegetable peas while the dry seeds serve as food for human beings. The wood is used as fuel and the leaves and husks provide livestock feeds. Extracts of pigeonpea seeds have exhibited antisickling action on red blood cells.³ This activity was attributed to the presence of phenylalanine and hydroxybenzoic acid contained in the seeds.³

The adult blister beetles (*Mylabris pustulata*) have been reported to be one of the major insect pest damaging pigeonpea flowers.⁴ In Nigeria, this insect pest has often been mentioned as one of the major constraints to the production of pigeonpea especially with regards to improved pigeonpea,^{1,5} when planted in April as early planting. Earlier,⁶ while revising the Indian blister beetles, seven species were recorded in Rajasthan and commonly referred to be occasional pests at the flowering and milk stages of millet and sorghum. They feed on the flowers and panicles of these crops and thus inhibit grain formation. Blister beetles attack a wide variety of weeds, ornamental plants and crops belonging to family Leguminosae and Cucurbitaceae. A species of blister beetle, *M. cylindrothorax* has been reported to be very common in Namibia and has been designated to be notorious for causing blisters due to the presence of a chemical cantharidin in their body fluids.⁷

Cantharidin was discovered in haemolymph and gonads of the blister beetles, commonly known as the Spanish fly (*Lytta vesicatoria* L.), in quantity larger than any other member of blister beetles.⁸ It is highly toxic to a wide variety of mammals, amphibians and birds.⁹ The male blister beetle in the Coleoptera order and of the meloidae family produces cantharidin in an oral fluid that is stored in its alimental canal.¹⁰ However, medical applications of cantharidin have varied and include its use as an oral aphrodisiac agent and for the topical treatment of warts.^{10,11} In addition, can-

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tharidin, has been used as an inflammatory model and in cancer treatment.^{12,13}

The management of the blister beetles has been achieved successfully with the use of conventional insecticides. The health risks and environmental hazards associated with the use of insecticides necessitated the development of alternative strategies for sustainable management of blister beetles in pigeonpea.¹⁴ Plant-based insecticides have been used for centuries,¹⁵ among limited resource farmers in developing countries to control insect pests of field crops and stored produce. Nicotine, rotenone, and pyrethrum were popular among the plant-based insecticides used to some extent against storage pests and other pests in green houses.¹⁶ The extracts of some indigenous plants sprayed at seven days intervals have been used successfully for the control of legume pod borer, *Maruca vitrata*.¹⁷ The aqueous crude extracts from plants have been used for centuries as bio-agents.¹⁸ Crude extract of neem seed oil has also widely been used as bio-agents. There is dearth of information on the application of Formulated Neem Seed Oil (F-NSO) as bio-agent on the management of blister beetle (*M. pustulata*) population in Nigeria. Hence, this study was primarily carried out to determine the efficacy of F-NSO at different application rates and spraying schedules on the population of flower blister beetles in Owerri Rainforest Zone, Nigeria.

Materials and Methods

Experimental site

Field research was carried out in the Postgraduate Teaching and Research Farms, Department of Crop Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria. Experiment was carried out in the months of May 2009, 2010 and July 2010. The research field is located in the rain forest belt, longitude 7°12' E and latitude 5°27' N of equator. An improved pigeonpea cultivar, ICRISAT pigeonpea lines (ICPL) 84023 with maturity duration of 3-4 months was used for the research. The cultivar was procured from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) India.

Field layout and planting

An area measuring 15.00 m×40.00 m (600.00 m²) was cleared and mapped out for the research trial. There were three replications with 3.0 m pathways between replications and each replication comprised of 15 plots of size 2.4 m×2.0 m and separated by 1.0 m pathways between plots. There were five ridges per plot and each ridge contained twelve pigeonpea plants. Within ridge planting spacing was 0.2 m and 0.4 m between ridges. Three seeds were planted per hole on 4th May 2009, 2010, July 2010 and later thinned down to one plant per hole, two weeks after planting (WAP) to give a plant population of 60 plants per plot and 125,000 plants per hectare.

Experimental treatments

There were five treatments comprising three rates of F-NSO [2 mL (4.2L in 840 litres of water ha⁻¹), 4 mL (8.3L in 840 litres of water ha⁻¹) and 6 mL (12.5L in 840 litres of water ha⁻¹)], control plot (0L ha⁻¹) and synthetic pyrethroid [Cyperforce (cypermethrin 30g/l +dimethoate 250 g/L EC) at 0.72 mL (1.5L in 840 litres of water ha⁻¹) as checks]. These treatments were sprayed at three intervals of application (once in a week, once in two weeks, and once in three weeks).

Experimental design and treatments allocation

The experimental design was a 3×5 factorial laid out in Randomized Complete Block Design (RCBD) with three replications. There were fifteen treatments allocated at random to each replication. Spraying was carried out weekly starting from flower bud initiation till first pods formation using hand operated knapsack sprayer. Formulated neem seed oil from neem tree *Azadirachta indica* A. Juss marketed by National Research Institute for Chemical Technology (NARICT), Basawa Zaria Road, Kaduna was used for spraying at recommended rate of 1.0 litre in 200 litres of water per hectare. The different rates were diluted with a constant water volume of 1.0 litre of clean water/plot during the time of spraying and later converted to hectare, basis as indicated above.

Data collection and analysis

Data on *M. pustulata* population started from the flower bud initiation using four plants selected at random from each three middle ridges giving a total of twelve sampled plants per plot till first pod formation. The blister beetles on the flowers were examined visually and counted once a week between 6.30 am to 7.30 am when they were less mobile. Following Levene's test for homogeneity of variance, data were transformed (square root transformation) prior to analysis of variance (ANOVA) using¹⁹ Genstat Discovery Edition 3, (2009). Significant observations ($\alpha=0.05$) were displayed graphically.

Cultural practices applied

Weeding was done manually with the use of hoe at two weeks and six weeks after planting. There was no application of organic or inorganic fertilizers to all the pigeonpea plots. The pigeonpea were raised on natural soil fertility as guided by.²⁰

Results

Figures 1A and B present the response of *M. pustulata* to application of synthetic pyrethroid (spy) and F-NSO at spraying frequencies in 2009 planting season. The population of *M. pustulata* in unprotected plots increased progressively from 43 days after planting (DAP) and reached maximum at 63 days after planting (DAP). The population of *M. pustulata* was high on the flowers before spraying the insecticides and after application of F-NSO, the population of *M. pustulata* reduced ($P<0.05$); however, higher reduction ($P<0.05$) was obtained in synthetic pyrethroid sprayed plots.

Figures 2A and B present the response of the flower beetle to application of synthetic pyrethroid, and F-NSO at spraying frequencies in 2010 planting season. The results showed increased population of *M. pustulata* in F-NSO plots before spraying at 47 days after planting (DAP) 54 DAP and 61 DAP and later reduced ($P<0.05$) after spraying F-NSO and synthetic pyrethroid at 48 DAP, 55 DAP, and 62 DAP while population in the unprotected plots continued to increase significantly ($P<0.05$) with maximum population at 62 days after planting (DAP). However, the plots sprayed with synthetic pyrethroid recorded the least population of *M. pustulata* after spraying, even though there was no significant effect ($P>0.05$) with plots sprayed with F-NSO. Also application of F-NSO at 6 mL/litre of water controlled the population of *M. pustulata* better than other test concentrations but were less effective to synthetic pyrethroid at rate 0.72 mL/litre. In the year 2010, it is important to stress that the application of the formulated neem seed

oil and synthetic pyrethroid at once a week and 2 weeks were not significant ($P>0.05$) in controlling *M. pustulata* but gave higher control than application at once in 3 weeks.

Discussion

With regards to the effectiveness of F-NSO on cowpea, Epidi *et al.*²¹ and Jackai²² reported that *M. vitrata*, *A. curvipes* and *C. shadabi*, could be controlled with extracts from neem seeds. Spraying at once a week had significant control of *M. pustulata* compared with application at once in 2 or 3 weeks indicating that *M. pustulata* requires weekly spraying in order to manage its population on pigeonpea flowers. The efficacy of F-NSO recorded in

both 2009 and 2010 planting seasons are attributable to repellence, feeding deterrence, reduced ingestion and digestion of food effects by the active ingredient azadirachtin in the formulated neem seed oil. A number of earlier reports have shown neem seed kernel extracts as efficient bio-pesticide against pests of crops such as rice,²³ and groundnut.²⁴

These findings agreed with Dialoke *et al.*²⁰ which reported that the population of *R. dentipes* Fab. on improved pigeonpea cultivar reduced drastically at application rate of 6 mL of F-NSO/litre of water. That the application of the F-NSO and synthetic pyrethroid (in 2010) at once a week and 2 weeks were non-significant in managing *M. pustulata* population; however gave better control than application at once in 3 weeks is probably related to the dilution of the azadirachtin in the F-NSO by rain soon after spraying, thus making them ineffective to control the blister beetles adequately.

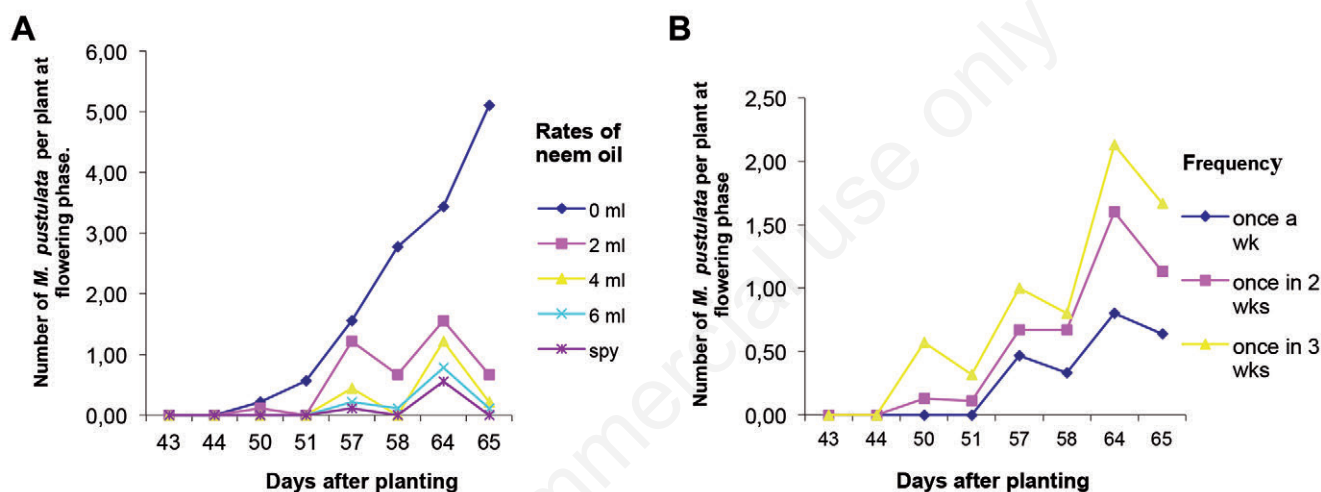


Figure 1. A) Effect of rates of formulated neem seed oil on number of flower blister beetle (*M. pustulata*) per plant at flowering phase during May 2009 planting. B) Effect of frequency of spraying of formulated neem seed oil on number of flower beetles blister beetle (*M. pustulata*) per plant at flowering phase during May 2009 planting season.

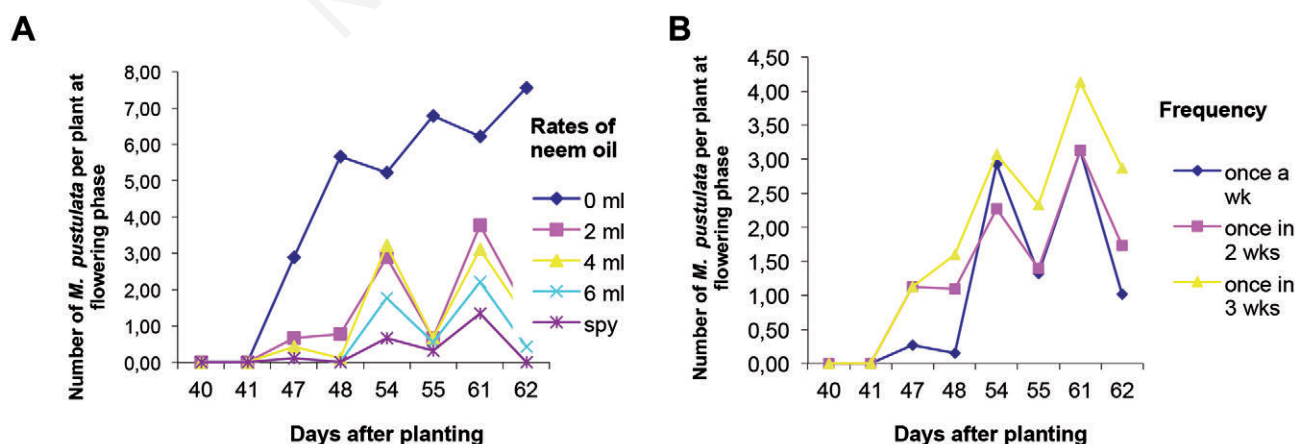


Figure 2. A) Effect of rates of formulated neem seed oil (F-NSO) on number of flower blister beetles, (*M. pustulata*) per plant at flowering phase during May 2010 planting season. B) Effect of frequency of spraying formulated neem seed oil (F-NSO) on number of flower blister beetles, (*M. pustulata*) per plant at flowering phase during May 2010 planting season.

Indeed, during July 2010 planting, there was complete absence of *M. pustulata* in the field. Perhaps, weather changes contributed to the disappearance of the pest. Earlier study reported high population of *M. pustulata* on pigeonpea only at the onset of rainy season.²⁵ While working on improved pigeonpea plants, Dialoke *et al.*²⁶ reported absence of *M. pustulata* in the months of July, but high abundance in the months of April planting. From these information, the impacting influence of season on the efficacy of neem seed oil is a possibility.

Conclusions

The population of the blister beetle, *M. pustulata* on improved pigeonpea flower was very high on the unprotected pigeonpea plots. In the sprayed plots, the population of *M. pustulata* was high before spraying but reduced drastically after spraying 12.5L ha⁻¹ dose of F-NSO at weekly intervals of once a week. However, greater control was achieved in the plots sprayed with synthetic pyrethroids. For increased interest in the consumption of organic food, it will be most appropriate for farmers to control *M. pustulata* on pigeonpea farms with F-NSO especially at dosage of 6 mL/litre of water ha⁻¹ (equivalent: 12.5L in 840 litres of water ha⁻¹) at weekly intervals. The chemical from the body fluid of the blister beetle inflict painful injuries on the skin of farmers (cause blisters on human skin) and thus scare them from entering into pigeonpea farms for important farm operations such as weeding, spraying and harvesting. Invariably, these problems can be prevented by planting the improved cultivar particularly in the month of July when blister beetles are absent on flowers.

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