

SUSCEPTIBILITY OF *TERETRIOSOMA NIGRESCENS* LEWIS
(COLEOPTERA: HISTERIDAE) TO INSECTICIDE

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Abstract

Teretriosoma nigrescens Lewis is an obligate predator of *Prostephanus truncatus*, a major new pest of maize in farm stores in Africa. Current practices for the control of this pest employ the use of pyrethroid insecticides. There are advantages in replacing or supplementing insecticide use with the application of the predator. Firstly, it would reduce the rate of resistance development. Secondly, it would remove the onus of undertaking control measures from the individual farmer and place it on government agencies, thereby ensuring a better level of management. However, predatory beetles released into the environment in East Africa would need to survive under conditions in which insecticides have been widely used for several years and will probably continue to be used in the future.

Laboratory experiments were conducted to determine the susceptibility of *T. nigrescens* to insecticides currently used to protect grain in areas of Africa where *P. truncatus* is found. Technical grade materials were applied both topically and to filter papers to which adult beetles were exposed. *T. nigrescens* was as susceptible as *P. truncatus* to pyrethroids but much more susceptible to pirimiphos-methyl.

The implications of the results are clear. If the predator is released in grain stores in Tanzania and Kenya where insecticides are used to control *P. truncatus*, it is unlikely to survive. It is, therefore, necessary to develop an insecticide-resistant strain of *T. nigrescens* which could then be released wherever insecticides are used.

INTRODUCTION

Prostephanus truncatus (Horn) is able to cause substantial damage and losses to farm-stored maize (Hodges 1982). The pest is indigenous to Meso America where it is known to be of minor economic importance. In Africa where it has been well established for only ten years *P. truncatus* is a pest of major significance effecting both smallholder farming systems and the international grain trade alike.

One reason for the difference in importance of the pest between the two continents is due to the presence of *Teretriosoma nigrescens* Lewis. This member of the Histeridae has a larvae which is an obligate predator of *P. truncatus* and the adult is also an effective predator. *T. nigrescens* is capable of restricting the development of pest populations so that little damage is caused (Rees, 1985). The predator is found widely in Meso-America but has not been reported from Africa. Its use in programmes to control the pest West Africa is being contemplated by the Togolen Government. and it may find more widespread use in IPM campaigns in East Africa.

Currently in Tanzania and Kenya where *P. truncatus* occurs control of the pest is accomplished on the farm by a mixture of contact insecticide dusts. In

Tanzania, for example, the annual requirement for Actellic Super dust (Twiga Chemicals) which contain pirimiphos-methyl and permethrin is between 350-500t (Mushi.A., pers comm). If *T.nigrescens* is to be used as an integral component of the control package for *P.truncatus* it will need to tolerate these chemicals currently in widespread use.

Experiments were undertaken to determine the insecticidal effect on *T.nigrescens* of compounds used commonly for control of *P.truncatus*. A comparison was made with effects on a series of strains of *P.truncatus* originating from different geographical zones.

METHODS

Adults used in the experiments were of unknown age and sex. *T.nigrescens* was of Mexican origin and *P.truncatus* strains were obtained from Mexico, Tanzania, Togo and Costa Rica. Only a single strain of *P.truncatus*, that from Tanzania, was used as a comparison to determine the effect of topical application.

Topical application

A range of dilutions of permethrin, deltamethrin and pirimiphos-methyl were prepared in butanone. 0.25µg were applied to the abdominal sternites of adults using a GLC-calibrated microcapillary glass tube. Each concentration was applied to 90 individual adults in three replicate batches, controls were treated with butanone alone. Insects were maintained at 27°C or 70% rh without food for 24 hours when mortality was assessed.

Exposure to treated filter paper

Whatman No. 1 filter papers (7cm diameter) were impregnated with 0.5ml of serial dilutions of either permethrin or deltamethrin in petroleum ether, Risella oil and acetone (3:1:1) or with permethrin in polyethylene glycol and acetone (1:4). Treatments and controls were replicated three times. 40 adults were exposed to each replicate for 5 hours, after which mortality was assessed.

RESULTS

The effects of topical application and of exposure to treated filter papers are illustrated in tables 1 and 2 respectively.

T.nigrescens was much more susceptible to pirimiphos-methyl than *P.truncatus*. This was not unexpected as the latter is controlled only with difficulty by organophosphates. However, the predator was as susceptible to permethrin and more susceptible to deltamethrin, compounds which have been specifically recommended for control of the pest.

Table 1

Susceptibility of *Teretriosoma nigrescens* and *Prostephanus truncatus** to insecticides applied topically.

	Slope	LD ₅₀ (µg/insect)	LD ₉₉ (µg/insect)	CHI ² **
Permethrin				
<i>T. nigrescens</i>	1.9	0.35x10 ⁻³	5.46x10 ⁻³	-
<i>P. truncatus</i>	2.2	1.21x10 ⁻³	13.40x10 ⁻³	68.1
Deltamethrin				
<i>T. nigrescens</i>	2.2	6.34x10 ⁻⁵	3.87x10 ⁻⁵	-
<i>P. truncatus</i>	2.5	2.45x10 ⁻⁵	20.58x10 ⁻⁵	144.9
Pirimiphos-methyl				
<i>T. nigrescens</i>	2.2	0.32x10 ⁻²	0.36x10 ⁻¹	-
<i>P. truncatus</i>	1.9	3.60x10 ⁻²	6.04x10 ⁻¹	154.3

* *P. truncatus* were of Tanzanian origin. Maximum likelihood method was used to compare regressions.

** CHI² at which a 5% probability is greater than CHI² for 1 df = 3.84. In all cases. *T. nigrescens* was significantly more susceptible than *P. truncatus*

Table 2.

Susceptibility of *Teretriosoma nigrescens* and *Prostephanus truncatus* exposed for 5 hours to filter papers impregnated with insecticides.

	Origin of strain	Slope	LD ₅₀ (% active ingredient in primary solvent)	LD ₉₉ (% active ingredient in primary solvent)
Permethrin				
<i>T. nigrescens</i>	Mexico	3.4	0.62	3.02
<i>P. truncatus</i>	Togo	2.8	0.25	1.67
<i>P. truncatus</i>	Mexico	1.9	0.39	8.11
<i>P. truncatus</i>	Costa Rica	2.7	0.54	3.93
<i>P. truncatus</i>	Tanzania	2.6	0.42	3.47
Deltamethrin				
<i>T. nigrescens</i>	Mexico	2.7	0.12x10 ⁻²	0.93x10 ⁻²
<i>P. truncatus</i>	Togo	1.9	1.4 x10 ⁻²	21.8 x10 ⁻²
<i>P. truncatus</i>	Mexico	2.3	1.2 x10 ⁻²	12.1 x10 ⁻²
<i>P. truncatus</i>	Costa Rica	2.6	0.66x10 ⁻²	5.2 x10 ⁻²
<i>P. truncatus</i>	Tanzania *	2.4	1.17x10 ⁻²	8.0 x10 ⁻²
Pirimiphos-methyl				
<i>T. nigrescens</i>	Mexico	3.4	0.30	1.48
<i>P. truncatus</i>	Togo	2.3	3.07	33.00
<i>P. truncatus</i>	Mexico	1.9	1.75	30.75
<i>P. truncatus</i>	Costa Rica	2.2	1.83	21.12
<i>P. truncatus</i>	Tanzania *	2.7	2.77	29.29

* Data relating to Tanzanian strains: a composite mean of four samples collected from different locations within the country.

DISCUSSION

The results suggest that field strains of *T.nigrescens* would not survive in storage environments where contact insecticides are used widely. In East Africa, where permethrin is used extensively for protection of stored maize against *P.truncatus* infestation (Golob 1988), farmers are unlikely to discontinue their use of chemicals as they have become accustomed to them and are satisfied with the effectiveness. It would be necessary under those circumstances to develop lines of *T.nigrescens* resistant to the insecticides if the predator is to be used in any integrated programme for control of *P.truncatus* in farm stores.

The need for an insecticide-tolerant strain of *T.nigrescens* may not be as essential if the predator is to be used extensively for controlling the pest population outside of the immediate farm store ecosystem. Rees et al (1989) has found *P.truncatus* existing in many habitats outside of the store, including in maize growing in the field, in forests and in sisal plantations. It is likely that *P.truncatus* has many hosts in the wider environment, additional to harvested produce. These hosts are not protected by insecticides and are unlikely to be so because of the impracticality of applying pesticide before harvest and because of the cost. *T.nigrescens* introduced into the general environment, for example, into African Woodland, may control *P.truncatus* effectively in the absence of chemicals. How important control of the pest outside of the maize store is in terms of reducing post-harvest losses is not known.

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LA SENSIBILITE DE *TERETRIOSOMA NIGRESCENS* LEWIS
(COLEOPTERA HISTERIAE) AUX INSECTICIDES

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RESUME

Teretriosoma nigrescens Lewis est un prédateur de *Prostephanus truncatus*, un des principaux déprédateurs du maïs stocké dans les magasins de stockage africains. Les méthodes conventionnelles de lutte contre ce ravageur passent par l'utilisation des insecticides pyréthrinoïdes. On aurait avantage à remplacer ces insecticides par l'emploi du prédateur. D'abord, il réduirait le risque de développement d'une résistance. Ensuite, cela supprimerait la prise en charge des mesures de lutte par le petit fermier pour la laisser aux agences gouvernementales, assurant ainsi un meilleur niveau de gestion. Cependant, les coléoptères prédateurs relâchés dans le milieu africain devront survivre dans un environnement où les insecticides sont employés depuis longtemps et continueront à l'être dans l'avenir.

Des études de laboratoire ont été menées pour mesurer la sensibilité de *T. nigrescens* aux insecticides les plus courants, employés dans la protection du grain en Afrique, là où on trouve *P. truncatus*. *T. nigrescens* s'est montré aussi sensible que *Prostephanus truncatus* aux pyréthrinoïdes, au cours d'expériences faites avec les insecticides en application en topique ou suivant le test papier filtre, mais il s'est montré beaucoup plus sensible au pyrimiphos-méthyl.

La signification de ces résultats est claire. L'insecte prédateur ne survivrait pas en magasin, que ce soit en Tanzanie ou au Kenya, pays où l'on utilise les insecticides pour éliminer *P. truncatus*. Il est donc nécessaire de développer une souche de *T. nigrescens* résistante aux insecticides qui pourrait être relâchée là où ils sont utilisés.