Population dynamics of the red palm, mite (*Roaiella Indica* Herst) and the search for sustainable management practices in Jamaica

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ABSTSRACT

The red palm mite (*Raoiella indica* Hirst), first detected in Jamaica in April 2007, has spread to several parishes, affecting coconut and ornamental palms, some severely. The search for sustainable management practices for the pest involved two initial studies: population dynamics including a hunt for natural enemies and the determination of an environmentally friendly treatment for coconut palm seedlings under nursery conditions.

The seasonal dynamics of *Raoiella indica* were studied between July 2007 and May 2008. The study was conducted in a commercial orchard, to which bi-weekly visits were made. *Raoiella indica* populations increased during dry periods, and declined during periods of persistent rainfall. Two predators; a phytoseiid mite (*Amblyseius largoensis)*, and a ladybird beetle (Coleoptera: Coccinellidae) were found feeding on the red palm mite. *Amblyseius largoensis* was the most abundant predator. This predator and *R. indica* exhibited similar population fluctuations throughout the sampling period.

Twelve plots, each measuring 1m x 2m and containing 55 coconut palm seedlings (at the 6-leaf stage) were established in Spring Gardens, Portland and treated with six chemicals: abamectin, diafenthiuron, soybean oil, sulphur, insecticidal soap and spiromesifen. The treatments were replicated two times in a randomized complete block design and included two unsprayed (control) plots. All the treatments were effective in reducing red palm mite populations. Insecticidal soap had the least impact on the predators (efficacy 53%). Thus low populations of *Raoiella indica* are favoured by high rainfall conditions and can be achieved by the application of select chemical treatments.

Keywords: *Raoiella indica*, population dynamics,Jamaica

INTRODUCTION

The red palm mite, *Raoiella indica* Herst (Acari: Tenupalpidae), invaded the Western Hemisphere in 2004 and quickly spread across the Caribbean region, infesting several countries. First described from coconut leaves in India (Herst 1924), *R. indica* has also been reported in Egypt, Israel, Russia, Mauritus, Reunion, Sudan, Iran, Oman, United Arab Emirates (EPPO 2008). The first Western Hemisphere record was for the red palm mite was in 2004 for the Caribbean island of Martinique (Fletchtmann and Etienne, 2004). It has since been reported for Dominica, Dominica Republic, Guadeloupe, St.Lucia, Trinidad and Tobago Puerto Rico, and Florida (EPPO 2008). It was first identified in Jamaica in April 2007 from coconut palms.

The red palm mite is considered an important pests risk for the subtropical areas of the United States, tropical Central and South America and the Caribbean Region (Welbourn

2006). It has the potential to threaten the production of agricultural crops including coconuts, bananas, plantains and ornamentals. There is also a threat to the Tourism Industry as it may damage gardens around hotels.

In an effort to sustainably manage the pest, Jamaica initiated studies that would assist with the development of an integrated pest management progamme. The objectives of these studies were to describe the population dynamics of *R. indica* and any identified predator(s) as well as to evaluate the efficacy of selected reduced-risk pesticides against the red palm mite under nursery conditions

MATERIAL AND METHODS

Population Dynamics

The seasonal dynamics of the red palm mite and its phytoseiid predator *Amblyseius largoensis* were studied between July 2007 and March 2008. The study was conducted in a commercial orchard, Black's Farm, Nutts River, St. Thomas. No pesticide was applied to the plots.

To determine the density of *R. indica* and *A. largenosis*, bi-weekly visits were made to the orchard. At each visit, 15 coconut palms were randomly selected and sampled by removing three leaflets each from the basal, middle and apical sections of a selected fond (usually number 9-11). Samples were placed in polyethylene bags, stored in a cooler and taken to the laboratory for processing.

In the laboratory samples were washed in alcohol to release the mites and the washings concentrated in 30ml alcohol. From this volume, 10% (3 ml) were removed and the number of red palm mites and phytoseiids therein counted. The counts were extrapolated to reflect the numbers in the original volume. Special attention was paid to the presence of other natural enemies.

A simple linear regression analysis was performed in order to evaluate the relationship between *R. indica* and rainfall. Rainfall data were collected with a rain gauge installed in the orchard. Significant differences were determined at the 95% confidence level ($P>0.05$) (GenStat10th edition).

Pesticide Efficacy Trial

Twelve plots of coconut palm seedlings were established at the Coconut Industry Board's nursery in Spring Gardens, Portland and treated periodically with five reduced-risk pesticides: abamectin, soybean oil, sulphur, insecticidal soap, spiromesifen and the conventional acaricide/insecticide diafenthiuron. Each plot measured 1m x 2m and contained 55 coconut palm seedlings. Seedlings were in 5 rows with 11 plants along each row. The seedlings in the outer rows of each plot were considered guard rows leaving the inner 27 seedlings as experimental plants. In addition, plots were separated by a 1m block of seedlings.

The treatments were arranged in a randomized complete block design and replicated twice. Each treatment was mixed with water and applied at the manufacturer's recommended rates: Treatments were reapplied one week after first application. Reapplication was determined by increased mite populations.

Plots were evaluated weekly for mite infestation by randomly selecting two seedlings and removing three leaflets from leaf number 4. In the laboratory, samples were processed as for the population dynamics studies.

Data were analysed for significant treatment effect by analysis of variance (ANOVA). Means were compared by Fisher's significance test for all pairs. Significant differences were determined at the 95% confidence level (P›0.05). Analyses were done using GenStat10th edition.

The effect of treatments on the phytosieiids was measured by comparing the number of predatory mites in treated plots with those in untreated control plots, using Abbott's formula: Efficacy =100% x Number in control plot-Number in treated plot/Number in control plot.

RESULTS AND DISCUSSION

The highest population levels of *Raoiella indica* were observed between July and August while the lowest incidence occurred in the months of August through September and during December. There was a direct relationship between rainfall and red palm mite population levels (P= 0.004). Data suggested that as rainfall increased, red palm mite populations decreased (Fig 1). The seasonal pattern of *R. indica* was similar to that reported in India (Nagesha-Chandra and Channabasavanna. 1984) where population densities decreased with the start of the rainy periods.

In general, population levels of the phytoseiid mimicked that of the red palm mite. Fig1 shows population peaks and troughs at approximately the same points. Some variation was seen during the period December to February. During this time, moderate rainfall, followed by a particular dry spell and then more rains, saw the expected increase then decrease in population levels of the red palm mite. This was not the case for the phytoseiid population which increased steadily throughout this period. Phytoseiid levels only fell when that of the red palm mite got fairly low in March.

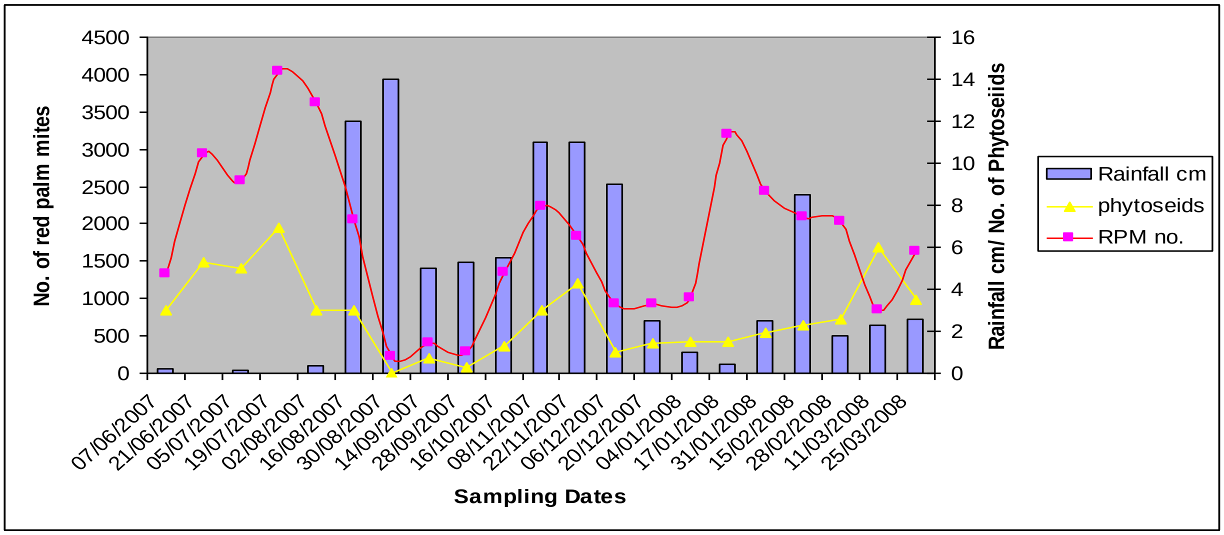

Fig 1 Average density of *R. indica* and phytoseiid predator in coconut orchard (St. Thomas, Jamaica) between Julu 2007 and May 2008

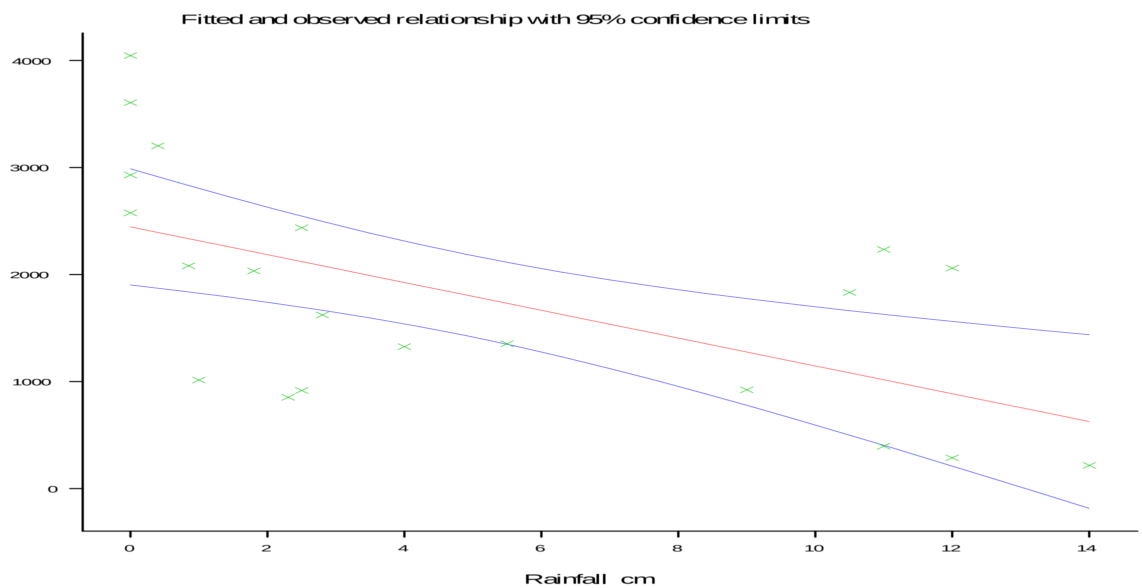

Fig 2 Rationship between average density of *R. indica* and rainfall

The search for Natural enemies

Two predators were found feeding on the red palm mite: the phytoseiid, *Amblyseius largoensis* (long haired mite) and a ladybird beetle (Coleoptera: Cocinellidae).

Amblyseius largoensis was consistently found associated with the pest and was seen actively feeding on different *R. indica* life stages. It has been consistently reported associated with *R. indica* in the Caribbean (Etienne and Flechtmann 2006 and Peña et al 2006.) *Amblyseius largoensis* is a generalist predator commonly found in Jamaica. It is predaceous on a number of mite and insect species. No appreciable control of R. *indica* by *A. largenosis* was observed.

Other phytoseiidae from the *Amblyseius* genus have been reported feeding on R. indica. *Amblyseius channabasavanni* reportedly feeds on R. indica in India (Daniel 1981) while *A. caudate* is mentioned from Mauritius (Moutia 1959).

The ladybird beetle was only observed in one coconut orchard. Larvae were observed feeding on *R. indica* eggs and larvae. Although other cocinellids have been reported feeding on R. indica, they have form the genus Stethorus (Hoy and Peña 2006).

Pesticide Efficacy Trial

All the treatments were effective in reducing red palm mite populations when compared with the untreated control (P=<0.001). There were no significant among the treatments (Table 1). Importantly, there were no significant difference between the conventional acaricide, Pegasus and the selected reduced risk pesticides (Table 1). It was noted however that the mite populations responded slowest to Safer Insecticide. (Fig 3).

Table 1 Mean number of mites/plot collected at 6 sampling times

	Sampling Times					
		Post Spray				
Treatment	Pre Spray	Week 1	Week 2	Week 3	Week 4	Week 5
Newmectin	830 a	100 a	10 a	48 a	60 a	5 a
Pegasus	1125 a	130 a	59 a	105 a	35 a	0 a
Golden Sun oil	810 a	85 a	82 a	52 a	11 a	5 a
Oberon	845 a	150 a	38 a	4 a	6 a	5 a
Safer Insecticide	885 a	260 a	422 a	41 a	165 a	15 a
Top- Cop	835a	205 a	33 a	14 a	12 a	0 a
Control	1025 a	820 b	950 b	1270 b	885 b	590 b
d.f = 41						
s.e.d = 122						

Means within times of sampling followed by the same letter are not significantly different (P=0.05)

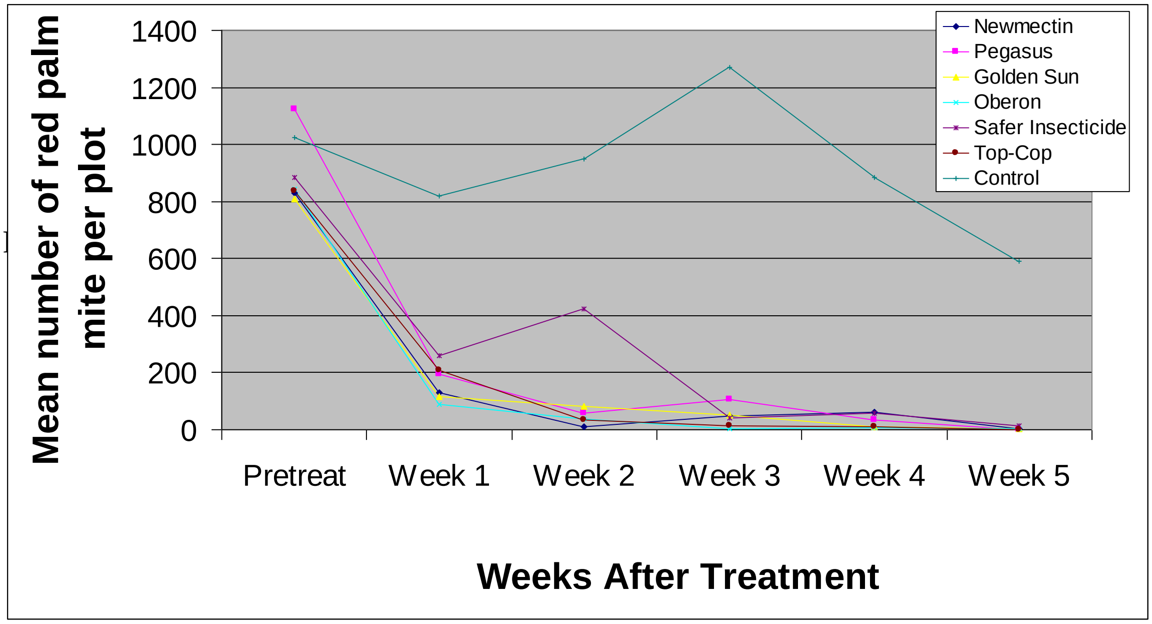

Fig 3 Mean number of *R. indica* per treatment plot recorded weekly after pesticide treatment

Treatments differed in terms of their impact on the predatory mite, *Amblyseius largoensis*. Safer insecticide had the least impact on the predators, recording an efficacy of 53%. The highest efficacy was recorded for Sulphur (96%), followed by diafenthuiron (95%) and abamectin (92%). soybean oil and spiromesifen had efficacies of 80% and 81% respectively.

CONCLUSIONS

These findings indicate *R. indica* populations are reduced by rainfall. Mite populations are therefore expected to increase during dry periods.

There are local predators feeding on the red palm mite in Jamaica

The reduced risk pesticides abamectin,, soybean oil, sulphur, insecticidal soap and spiromesifen may be used to control red palm mite under nursery conditions.

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