Invited Article Indian Journal of Plant Protection Vol. 33. No. 1, 2005 (1-10)

Coconut Eriophyid Mite *Aceria guerreronis* Keifer – An Overview

C P R Nair, P Rajan and Chandrika Mohan,

Central Plantation Crops Research Institute, Regional Station, Kayangulam – 690 533, Kerala, India

Abstract

Coconut eriophyid mite, Aceria guerreronis *Keifer is a potential pest of coconut in India. Though its occurrence in the country was recently reported the pest had spread to all major coconut growing regions of peninsular India causing heavy economic loss to the coconut industry. A co-ordinated effort by various research agencies has helped in developing an IPM programme against the pest. However, indepth studies on biocontrol agents and role of plant nutrition for sustainable management of the pest are highly essential. An attempt has been made in the paper to review the work done on various aspects relating to bioecology and management of the pest.*

Keywords: Coconut, *Aceria guerreronis*, Peninsular India, bioecology, pest management

Introduction

Coconut palm (*Cocos nucifera* L.) known as 'Kalpavriksha' occupies a key role among the cultivated palms in India. This important oilseed crop provides food, shelter and occupation to millions of small and marginal farmers in the country especially in the vast stretches of land both in the east and west coast of the country. Among the various pests reported on coconut in India, the nut infesting eriophyid mite *Aceria (= Eriophyes) guerreronis* Keifer is the most serious one causing significant reduction in yield. As a pest first reported from Ernakulam District of Kerala, a major coconut growing state, the pest has appeared simultaneously in adjoining states of Tamil Nadu and Karnataka and within few years it has spread to almost all coconut growing states. As the sudden outbreak and spread of this mite caused serious concern throughout India, research programmes with a consortium approach were initiated by various organizations to develop suitable management technologies to tackle the pest and to create better awareness among farmers to face the situation. The Government of India constituted a steering committee for effective monitoring of the research and extension programmes on this dreaded pest. Perhaps this is one of the rarest cases of concerted research programmes in the country that have generated a clear insight on various aspects of the problem within a short period. Considering the economic importance of the pest elaborate reviews on the pest covering both national and international scenario were published (Rethinam *et al.,* 2001 and Rethinam, 2003). In the present paper an effort has been made to compile relevant information on various aspects on the bioecology and management of the pest giving more thrust in the Indian scenario.

Occurrence and distribution

In India, *A. guerreronis* was first reported on coconut palm from Ernakulam District by Sathiamma *et al.,* in 1998. An immediate survey by the scientists of Central Plantation Crops Research Institute revealed the widespread occurrence of the pest in nearby districts of Central and South Kerala (Nair, 2000). A survey in a few villages of Coimbatore District in Tamil Nadu revealed the severe incidence of the pest in the same year (Ramaraju *et al.,* 2000). The mite was also observed in almost all Districts in Karnataka during the same period (Mallik *et al.*, 2003) . In 1999 the pest incidence could be located in Chittoor area of Andhra Pradesh, in 2001 from Orissa, in 2002 from West Bengal and Maharashtra and in 2003 from Gujarat (Khan *et al.*, 2003).

The history of the occurrence of *A. guerreronis* on coconut starts with the first report from Mexico by Keifer in 1965. Further, the mite was reported from South America and neighbouring few islands by Doreste (1968). The fast spread of the pest was reported between 1977 and 1984 by Mariau (1977), Hall and Espinosa (1981) and Griffith (1984). The pest was reported from Tanzania in 1980 (Seguni ,2000). In Sri Lanka the pest occurrence almost coincided with that of India when the pest was observed in the later part of 1997 at Kalpitia peninsula in the north-west province (Fernando *et al.,* 2000). Hence the perusal of literature makes it very clear that *A. guerreronis* enjoys a wide distribution in all tropical belts of South and North America, Africa and South Asia.

Bioecology

Entry of the mite into the developing nuts takes place during the early phase of development immediately after the pollination. Active colonies of mite are formed by the egg laying female mites gaining entry into the developing nuts. Various stages of development *viz.*, eggs, nymphs and adults can be seen in the colonies (Figure1). The biology of the mite takes 7-10 days (Mariau, 1977). The average fecundity of the female mite is 80 eggs and under favourable conditions this high fecundity and the shorter life cycle result in the enormous multiplication of the colonies.

Figure 1. Various stages of development of eriophyid mite *viz.*, egg, nymphs and adults

The mites are microscopic having an average size of 200-250 microns. It has a tapering body shape with two distinct parts *viz.*, anterior cephalothorax and the posterior abdomen. The body is finely ringed with bristles arranged in rows and is pale yellowish in colour. The mite has two pairs of legs on the anterior half of the body. The well developed mouth parts are suitable for feeding the plant sap.

On coconut the mites are seen in the floral bracts and the soft meristematic portion beneath the perianth. The infestation by the mite follows immediately after pollination. Appearance of elongated white streaks below the perianth is the first external manifestation of mite infestation on young buttons. Further these white streaks form triangular yellow patches. Draining of sap by the feeding activity of the colony results in drying of the tissues causing browning of the affected portion (Figure 2).

As the nuts grow, warts and longitudinal fissures appear on the nut surface. Severe infestation causes drying and shedding of buttons (Figure 3) or malformation of nuts as a result of retarded growth. Considerable reduction in the copra content and malformation of fibre are the major

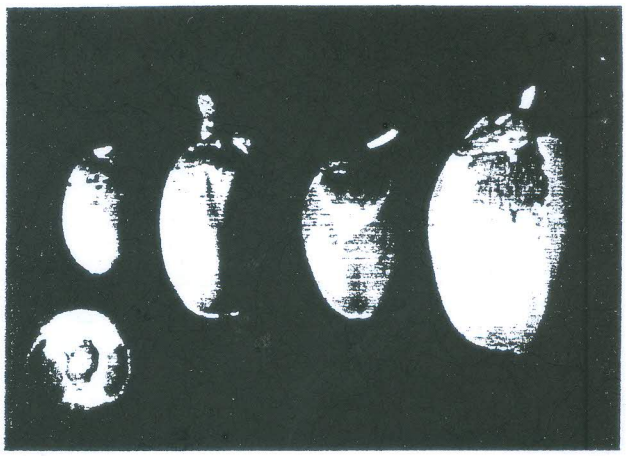

Figure 2. Coconuts showing symptoms of mite infestation

Figure 3. Coconut palm showing drying and shedding buttons due to mite infestation

economic losses due to severe infestation by the pest.

Dispersal of the mite in nature takes place mainly through the wind currents (Griffith, 1984; Moore and Howard, 1996; Ramarethinam and Marimuthu, 1998; Haq, 1999). The fast spread of the pest within a short period in a particular geographic area is mainly due to the nature of the aerial dispersal and high biotic potential. Mallik *et al.*, (2003) studied the activity of dispersal of the mites during day time and found that mites were more active during early part of the day indicating that migration of mites happens more during the cooler hours of the day. Moore and Howard (1996) reported the dispersal also by phoresy.

The population dynamics of *A. guerreronis* has been studied by various researchers. Griffith (1984) reported that mite attack was more severe during dry climate. Mariau (1977)

observed that drought situation aggregates the mite incidence. In India the pest activity has been observed throughout the year with a population peak during the summer months (Nampoothiri *et al.*, 2002). Studies in Kerala coast revealed that a period of high temperature with intermittent rains causing high humidity favoured higher multiplication and rapid spread of the mite (Nair *et al.*, 2003). Studies on population dynamics in Tamil Nadu indicated that population was maximum during November and May. Correlation analysis on the influence of weather parameters on mite population did not reveal any clear relationship (Marimuthu *et al.*, 2003). Mathew *et al.*, (2000) observed monthly variations in total population of mite with a peak in February – March and sharp decline in subsequent rainy months indicating a negative relationship between mite population and rainfall. Observations on the population of mites within various age group of nuts showed that five month old nut lodged the highest population of mites and in older age group of nuts the population showed declining tendency (Mallik *et al.*, 2003). Ranjith *et al.*, (2001) reported that maximum mite population could be observed on the third and fourth bunches from the first fully opened flower bunch of the palm.

The host range of *A. guerreronis* is very narrow. Other than coconut, an ornamental palm *Cocos weddelliana* H. Wendl. was reported as a host plant of the mite in Brazil (Flechtmann, 1989). In India, Ramaraju and Rabindra (2001) reported the pest affecting the nuts of palmyra palm, *Borassus flabellifer* Linn.

Crop loss

Yield loss to various levels has been reported as a result of infestation by the pest. In general pest incidence and the extent of loss are comparatively high during the initial few years of pest occurrence in a particular locality. In India during 1998 when the pest outbreak was reported almost 85-90 per cent of the nuts were affected showing malformation and reduction in size (Nair, 2000). But observations recorded during subsequent years revealed an overall reduction in the incidence and intensity of the pest in areas of its initial occurrence (Nampoothiri *et al.*, 2002 and Nair *et al.*, 2004).

A detailed survey on yield loss in Alappuzha District during 2000 revealed an average loss of 30.94 per cent in terms of copra and 41.74 in terms of husk production (Muralidharan *et al.*, 2001). Ramaraju *et al.*, (2000) estimated an average loss in copra yield to the tune of 27.5 per cent in Tamil Nadu. A reduction in copra yield ranging from 18-42 per cent was observed when severe infestation symptoms were seen on more than 50 per cent of the surface area of infested nuts (Mallik *et al.*, 2003). Mite damage caused significant reduction in quality of fibre in terms of fibre length and tensile strength. Fibre from moderate to severely infested nuts suffered 26 to 53 per cent reduction in length (Naseema Beevi *et al.*, 2003).

An yield loss upto 31.54 per cent was reported from St. Lucia by Moore *et al.*, (1989). Doreste (1968) in Venezuela recorded damage of crop to the tune of 70 per cent. The estimated loss of copra was 30 - 80 per cent in Mexico (Olivera Fonseca, 1986), 10 per cent in Benin and 16 per cent in Ivory Coast (Julia *et al.*, 1979).

Management methods

As in the case of any other pest several management measures have been tried and found suitable in the case of coconut mite too. However, due to the favourable biotic characters of the pest and its peculiar habitat providing almost an absolute shelter, there are many limitations in the implementation of various management methods.

Chemical pesticides

For effective and immediate management of the pest several attempts were made in various countries with pesticides. Different methods of pesticidal application like spraying of affected bunches, stem injection and root feeding methods with systemic chemicals have been tried. Hernandez (1977) reported significant control by spraying the affected bunches with dicrotophos or monocrotophos at an interval of 20-30 days and with application of acaricides at 15 days interval (Mariau and Tchibozo, 1973). Stem injection with monocrotophos at two months interval was found to be effective by Julia and Mariau (1979) on young palms.

In India a wide spectrum of pesticides have been tried by various research agencies including both Central Institutes and State Agricultural Universities (Nampoothiri *et al.*, 2002). Field trials at CPCRI during 1998-99 with root feeding of monocrotophos and triazophos showed significant reduction in mite population up to 60 days. Spraying of dicofol 0.1 per cent also showed significant reduction in mite infestation in field trial. In another co-current trial, triazophos 0.1 per cent and carbosulfan 0.05 per cent showed encouraging results (Nair *et al.*, 2000). Pesticides like profenophos 0.05 per cent and methyl demeton 0.1 per cent also gave effective control of the mite. A series of field trials were carried out by Tamil Nadu Agricultural University in farmers plots. One such trial indicated highest mortality of mites with spraying of monocrotophos @1.5 ml / l water and triazophos @ 5 ml / l (Kannaiyan *et al.*, 2002). A field trial with two rounds of spraying with carbosulfan 2 ml / l and triazophos @ 5 ml/ l reduced mite population by 68 and 70 per cent, respectively (Ramaraju *et al.*, 1999). In another field trial fenpropathrin (3 ml / l) endosulfan, chlorpyriphos,

hosalone and ethion each at 4 ml / l were found effective hen they were sprayed on infested palms (Marimuthu *et l.*, 2003).

he field experiments at Kerala Agricultural University dicated monocrotophos 0.01 per cent, dicofol 0.1 per cent, rbosulfan 0.05 per cent, triazophos 0.2 per cent and npropathrin 0.02 per cent as effective pesticides. Screening newer chemical formulations like profenophos, nazaquin and imidacloprid also gave promising results aradamma *et al.*, 2000).

udies at University of Agricultural Sciences, Bangalore owed that dicofol 0.1 per cent, triazophos 0.15 per cent, dosulfan 0.1 per cent, carbosulfan 0.05 per cent and ethion)5 per cent were effective pesticides in managing the mite. ot feeding /stem injection trials with monocrotophos 10 / palm, triazophos15-20 ml / palm and carbosulfan 15 / palm also proved effective (Mallik *et al.*, 2003).

ough the chemical pesticides were effective in the field en given as spray or root feeding / stem injection, none the above chemicals has been used for larger adoption to environmental reasons. The massive crown of the m, larger area to be covered in a short spell of time, need repeated application, residual toxicity of the pesticides were other factors which were unfavourable for the wider of chemical pesticides.

pesticides

anical pesticides *viz.*, natural oils of plants and neem ed pesticides had been widely experimented by all the ncies in India. The use of 2 per cent neem oil and garlic ture was proved effective and recommended in Kerala e for large scale adoption (Nair *et al.*, 2000). Spot ication of 3 per cent Neem oil/ pongamia oil was found tive in the management of the pest in Tamil Nadu naiyan *et al.*, 2002). Among several seed oils tested heir efficacy, a mixture of neem oil and castor oil (2:1), sesamum oil 2 per cent and pongamia oil 3 per cent found promising in trials done at College of culture, Vellayani (Naseema Beevi *et al.*, 2003)

lable neem based bio-pesticides in the market also were cted to screening and field trials in India. Azadirachtin cent at 0.003 to 0.005 per cent was found effective g various formulations tried and this was recommended eld use (Nair *et al.*, 2000; Saradamma *et al.*, 2000 and muthu *et al.*, 2003). Root feeding of neem formulations ad been reported to give promising results (Mallik *et*)03 and Nair *et al.*, 2003).

Ecofriendly chemicals

The use of wettable sulphur as spray was found very effective in various field trials carried out in India (Nair *et al.*, 2000; Saradamma *et al.*, 2000 and Marimuthu *et al.*, 2003). However, as there could be an adverse effect of this chemical on the native flora of entomopathogenic fungi, the large scale use of wettable sulphur was not promoted.

Fish oil resin soap (FOIS) was found effective in managing the pest at 0.4 per cent concentration when sprayed at an interval of 60 days (Palaniswamy *et al.*, 2000). Many eco-friendly approaches like smoking in the garden during dawn period of the day, spraying sticky substances like starch, spraying of sea water etc. have been tried by various workers with a view to combat the pest. In case of spraying with sea water and starch more than 85 per cent reduction in mite population has been reported (Naseema Beevi *et al.*, 2003). However, similar trials by other agencies did not show consistent results.

Biological control

Due to the limitations of the pesticidal applications and the labour intensive nature of application techniques for chemical pesticides the biological control programmes gain more importance in managing the coconut mite. Biocontrol is more desirable as it is safe and eco-friendly and therefore more vital in sustainable management of the pest. Among the biocontrol agents no parasitoid has been so far reported on *A. guerreronis*. Predators form a major group of biocontrol agents of coconut mite.

Predators. A variety of predatory mites and smaller insects have been found associated with *A. guerreronis* in different parts of the world. Predatory mites belonging to Phytoseidae, Bdellidae and Tarsonemidiae are predominantly encountered in various collections. Howard *et al.*, (1990) reported *Amblyseius largoensis* Muma, *Neoseiulus mumai* Denmark, *N. paspalivorus* De Leon attacking mites in Florida. *N. paspalivorus* was also reported as a natural enemy of mite in Cuba (Cabrera,1982). The Bdellidae mites *viz., Bdella indicata* and *B. distincta* Baker and Balock were reported as predators of mite in Benin by Mariau (1977) and the latter species was reported from Mexico by Octero Colima in 1986. Hall *et al.*, (1980) reported tarsonemid *Lupotarsonemus* from Ivory coast and New Guinea attacking different stages of coconut eriophyid mite.

Fernando *et al.*, (2000) had identified *N. paspalivorus* (phytoseidae) and *Bdella* sp (Bdellidae) as predatory mite fauna on eriophyid mite in Sri Lanka. Among these, *Neoseiulus* sp nr *paspalivorus* was giving encouraging results as a potential natural enemy in Sri Lanka. Mass

phosalone and ethion each at 4 ml / l were found effective when they were sprayed on infested palms (Marimuthu *et al.*, 2003).

The field experiments at Kerala Agricultural University indicated monocrotophos 0.01 per cent, dicofol 0.1 per cent, carbosulfan 0.05 per cent, triazophos 0.2 per cent and fenpropathrin 0.02 per cent as effective pesticides. Screening of newer chemical formulations like profenophos, fenazaquin and imidacloprid also gave promising results (Saradamma *et al.*, 2000).

Studies at University of Agricultural Sciences, Bangalore showed that dicofol 0.1 per cent, triazophos 0.15 per cent, endosulfan 0.1 per cent, carbosulfan 0.05 per cent and ethion 0.05 per cent were effective pesticides in managing the mite. Root feeding /stem injection trials with monocrotophos 10 ml / palm, triazophos15-20 ml / palm and carbosulfan 15 ml / palm also proved effective (Mallik *et al.*, 2003).

Though the chemical pesticides were effective in the field when given as spray or root feeding / stem injection, none of the above chemicals has been used for larger adoption due to environmental reasons. The massive crown of the palm, larger area to be covered in a short spell of time, need for repeated application, residual toxicity of the pesticides etc were other factors which were unfavourable for the wider use of chemical pesticides.

Biopesticides

Botanical pesticides *viz.*, natural oils of plants and neem based pesticides had been widely experimented by all the agencies in India. The use of 2 per cent neem oil and garlic mixture was proved effective and recommended in Kerala State for large scale adoption (Nair *et al.*, 2000). Spot application of 3 per cent Neem oil/ pongamia oil was found effective in the management of the pest in Tamil Nadu (Kannaiyan *et al.*, 2002). Among several seed oils tested for their efficacy, a mixture of neem oil and castor oil (2:1 ratio), sesamum oil 2 per cent and pongamia oil 3 per cent were found promising in trials done at College of Agriculture, Vellayani (Naseema Beevi *et al.*, 2003)

Available neem based bio-pesticides in the market also were subjected to screening and field trials in India. Azadirachtin 1 per cent at 0.003 to 0.005 per cent was found effective among various formulations tried and this was recommended for field use (Nair *et al.*, 2000; Saradamma *et al.*, 2000 and Marimuthu *et al.*, 2003). Root feeding of neem formulations also had been reported to give promising results (Mallik *et al.*, 2003 and Nair *et al.*, 2003).

Ecofriendly chemicals

The use of wettable sulphur as spray was found very effective in various field trials carried out in India (Nair *et al.*, 2000; Saradamma *et al.*, 2000 and Marimuthu *et al.*, 2003). However, as there could be an adverse effect of this chemical on the native flora of entomopathogenic fungi, the large scale use of wettable sulphur was not promoted.

Fish oil resin soap (FOIS) was found effective in managing the pest at 0.4 per cent concentration when sprayed at an interval of 60 days (Palaniswamy *et al.*, 2000). Many eco-friendly approaches like smoking in the garden during dawn period of the day, spraying sticky substances like starch, spraying of sea water etc. have been tried by various workers with a view to combat the pest. In case of spraying with sea water and starch more than 85 per cent reduction in mite population has been reported (Naseema Beevi *et al.*, 2003). However, similar trials by other agencies did not show consistent results.

Biological control

Due to the limitations of the pesticidal applications and the labour intensive nature of application techniques for chemical pesticides the biological control programmes gain more importance in managing the coconut mite. Biocontrol is more desirable as it is safe and eco-friendly and therefore more vital in sustainable management of the pest. Among the biocontrol agents no parasitoid has been so far reported on *A. guerreronis*. Predators form a major group of biocontrol agents of coconut mite.

Predators. A variety of predatory mites and smaller insects have been found associated with *A. guerreronis* in different parts of the world. Predatory mites belonging to Phytoseidae, Bdellidae and Tarsonemidiae are predominantly encountered in various collections. Howard *et al.*, (1990) reported *Amblyseius largoensis* Muma, *Neoseiulus mumai* Denmark, *N. paspalivorus* De Leon attacking mites in Florida. *N. paspalivorus* was also reported as a natural enemy of mite in Cuba (Cabrera,1982). The Bdellidae mites *viz.*, *Bdella indicata* and *B. distincta* Baker and Balock were reported as predators of mite in Benin by Mariau (1977) and the latter species was reported from Mexico by Octero Colima in 1986. Hall *et al.*, (1980) reported tarsonemid *Lupotarsonemus* from Ivory coast and New Guinea attacking different stages of coconut eriophyid mite.

Fernando *et al.*, (2000) had identified *N. paspalivorus* (phytoseidae) and *Bdella* sp (Bdellidae) as predatory mite fauna on eriophyid mite in Sri Lanka. Among these, *Neoseiulus* sp nr *paspalivorus* was giving encouraging results as a potential natural enemy in Sri Lanka. Mass

rearing of this predator on *A. guerreronis* and eggs of *Tetranychus utricae* are being carried out in Sri Lanka. Studies on bioecology and behaviour of this general predator is being intensified at Sri Lanka with a view to develop a technology sustainable for the management of erophyid mite on coconut.

Work done at CPCRI on predatory mites revealed that four species of mites are attacking mite colonies in the field. Among these, *Amblyseius* sp was the predominant species attacking eriophyid mite colonies in the field (Figure 4). *Bdella* sp was recovered from few samples only. It has been observed that the predatory mite population was registering an increasing trend of incidence and better establishment in nature over the years. On an average, 37.1% samples showed presence of predators during 2001, which increased to 62.3% during 2003. Marimuthu *et al.*, (2003) had reported three species of predatory mites *viz.*, *Amblyseius paspalivorus*, *Bdella* sp and a Tarsonemid attacking mite colonies in the field in Tamil Nadu. They found that the population level of predators is only 5-10 per nut and their predatory potential was not encouraging.

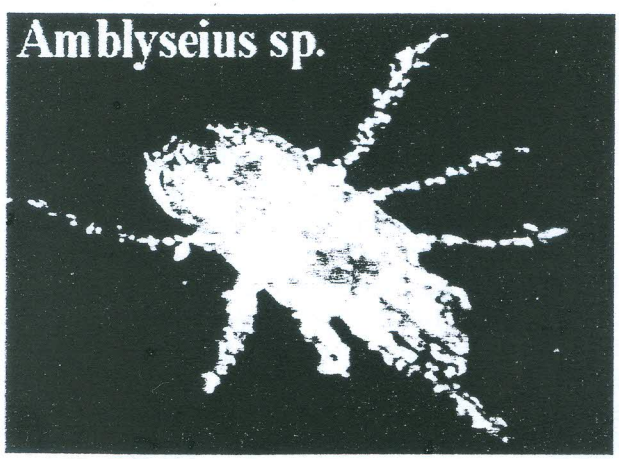

Figure 4. Predatory *Amblyseius* sp. recorded predominantly on eriophyid mite colonies

Work done at Kerala Argicultural University revealed that predatory mites belonging to Phytoseidae, Tarsonemidae and Bdellidae attack mite colonies in the field (Naseema Beevi, *et al.*, 2003). Among these, two species of phytoseid mites *viz.*, *Amblyseius* sp and *Phytoseilus* sp recorded on mite colonies (Nair, *et al.*, 2000), *Amblyseius* sp. was the predominant species. Mallik *et al.*, 2003 reported that among the phytoseid mites, *A. paspalivorus* and the tarsonemid *Lupotarsonemus* sp are the predatory mites more encountered with mite colonies in Karnataka. The tarsonemid is found attacking on egg and the phytoseid attacking on all stages of mite. Predatory insects are very seldom reported on eriophyid mite. Nair *et al.*, (2003) reported one species each of syrphid, thrips and coccinellid associated with mite colonies in the field.

The potential of predators in suppression of eriophyid mite colonies has been questioned by many markers on account of the facts that they are observed only occasionally and in very small populations on infested coconut and there is no evidence that they make a significant impact on coconut mite population (Hall *et al.*, 1980, Howard *et al.*, 1990). When compared to eriophyid mite, the phytoseid predatory mites are large and found more often in older nuts and abundant during June-July. The eriophyid mite being 200 micron in size is able to colonize on younger nuts and causes considerable damage well before the predators are able to enter the meristamatic region. Even in Sri Lanka, where *N.* sp nr *pasrpalivorus* is being evaluated as a potential predator, studies on distribution of predator on bunches of different ages revealed maximum population of predator in sixth bunch. According to Moraes and Zacarias (2002), use of predatory mites for the control of coconut mite requires detailed field studies.

Pathogens. Among microbial pathogens, fungal species contribute the predominant pathogens of coconut eriophyid mite. The fungal parasite, *Hirsutella thompsonii* has received considerable attention throughout the world as the most effective natural enemy of eriophyid mite of coconut. This fungus has three varieties of which synnematosa has been more often infesting *A. guerreronis*.

H. thompsonii has been used both in the laboratory and field for suppressing the coconut mite in different countries of the world. The fungus was associated with coconut mite in tropical America and West Africa (Moore and Howard, 1996). Hall *et al.*, (1980) had reported that the fungus could cause upto 100% mortality in *A. guerreronis* when colonies were directly exposed to 100% relative humidity. The potential of this fungus as an effective biocontrol agent against *A. guerreronis* was well documented (Julia and Mariau, 1979, Cabrera, 1982, Espinosa Becerril and Carrilo Sanchez, 1986, Cabrera and Dominguez, 1987 and Lampedro and Rosas 1989) . Cabrera (2000) had given an exhaustive account of the potential of the fungus as a biocontrol agent of coconut mite in Cuba.

Espinosa Becerril and Carrillo Sanchez (1986) evolved 'Mycar' a bio preparation of *H. thompsonii* in Mexico and concluded that 36.7% of fruits tested showed infested mites with a mortality rate varying from 25-75%. The development of a process for the commercial production of *H. thompsonii* (Gillespie, 1988) has increased the future potential of the fungus for large scale development.

Another acaropathogenic species of *Hirsutella viz. H. nodulosa* was also reported to be infective to coconut mite in cuba (Cabrera and Dominiguez, 1987), but the potential of the fungus in field condition has not been fully studied.

In India, the incidence of the pathogen (*H. thompsonii*) was recorded in Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Pondicherry and Lakshadweep islands (Kumar, 2002). In Tamil Nadu and Andhra Pradesh, average incidence of the fungus was recorded as 17.2% and 15.5 % (Kumar *et al.*, 2001 and 2002). In Kerala, local strain of *H. thompsonii var synnematosa* could be isolated from field samples (Beevi, *et al.*,1999). Field evaluation of *H. thompsonii* indicated that mortality of mites ranged from 20 - 40% (Naseema Beevi *et al.*, 2003).

A mycoacaricide called "Mycohit" based on native strains of *H. thompsonii* was developed with indigenous technology at Project Directorate of Biological Control , Bangalore (Kumar and Singh 2002). For evaluation of Mycohit in field conditions multilocational trials were conducted in different states in South India. In all the trials, pre harvest damage grade was taken as a parameter to judge the efficacy of the product. However, the results obtained so far from different centers have been variable. In most of the centers, the reduction of damage is not significant under field conditions. In the environment, various factors interact which determine the efficiency of the fungus. Hence an indepth study to identify the conditions for its effectiveness is needed for further evaluation and testing of this product.

Other fungal species associated with eriophyid mite include species of *Paecilomyces, Beauveria, Metarhizium, Sporothrix, Verticillium, Acremonium, Aspergillus, Penicillium and Fusarium* (Kumar *et al.*, 2001). However, the bio-efficacy of these fungi as a biocontrol agent of mite in field conditions was not fully studied. In a preliminary investigation, Murali Gopal *et al.*, (2002) reported *Scopulariopsis brevicaulis* as pathogenic to *A. guerreronis* giving about 27 per cent mortality of mites in treated nuts. Rabindra and Kumar (2003) indicated the importance of a comprehensive study on the natural enemies to arrive at definite conclusions to measure the impact of the bio-control agents in respective regions.

Effect of crop management practices

The role of plant nutrition in the management of pests and diseases is a well known and widely accepted fact. Moore *et al.*, (1991) suggested that modification of farm management practices by irrigation and optimum input of fertilizer could regulate mite population. Mariau (1977) indicated that well managed coconut gardens receiving balanced nutrients might suffer less due to mite attack. Experiments at Tamil Nadu Agricultural University, Coimbatore with higher levels of potassium and neem cake have shown promising trends in reducing mite population. An integrated nutrient management package consisting of application of urea (1.3 kg), super phosphate (2 kg), muriate of potash (3.5 kg) neem cake (5 kg), borax (50 g), gypsum (1 kg), magnesium sulphate (0.5 kg) and growing of green manure crops like sunnhemp and its incorporation in soil were suggested by the University (Kannaiyan *et al.*, 2002).

In gardens where balanced NPK application and recycling of organic matter are practiced, the incidence and intensity of the mite show decreasing trends. Observations on mite incidence in various ongoing manurial experiments at CPCRI also indicated that plant nutrition affected the mite incidence. In a demonstration covering 25 ha coconut garden in 208 farmers fields where integrated nutrient management was implemented along with the recommended practices of azadirachtin spraying thrice a year, the mite incidence could be brought down to 15.3 per cent from 68.0 over a period of three years (Rajagopal *et al.*, 2003).

Integrated approach recommended by National Steering Committee

In India, a National Steering Committee for the mite catalyzed the efforts for collective thinking and prompt implementation of research programmes by the participating research organizations. The Coconut Development Board, Government of India and Asian and Pacific Coconut Community, Jakarta along with the National Steering Committee organized an international workshop on coconut mite at Bangalore in 2003. In the workshop a unified recommendation was formulated with two components *viz.*, IPM and INM. The IPM recommendation consists of phytosanitary measures in coconut plantations including crown cleaning, burning of fallen mite infested nuts and spraying of azadirachtin 0.004 per cent on affected younger bunches thrice a year during December – January, April – June and September – October. Wherever spraying is difficult for adoption, root feeding with azadirachtin 5% (7.5 ml + 7.5 ml water) or azadirachtin 1 per cent (10 ml + 10 ml water) formulation thrice as in the case of spraying was recommended.

Along with the IPM package adoption of INM package including application of NPK fertilizer as per recommended levels, recycling of biomass or raising of green manure crops in coconut basins, summer irrigation and moisture conservation by appropriate measures were also recommended for the management of the pest.

Varietal susceptibility

A coconut variety exhibiting total tolerance to eriophyid

guerreronis) . Eds. Fernando, L.C.P., G.J de Moraes and Wickramananda, I.R., CRI, Sri Lanka, pp 1-8.

Flechtmann, C. H. W. 1989. *Cocos Weddelliana* H Wendl. (Palmae : Arecaceae), a new host plant for *Eriophyes guerreronis* (Keifer, 1965) (Acari : Eriophyidae) in Brazil. *International Journal of Acarology* **15** : 241.

Gillespie, A. T. 1988. Use of fungi to control pests of agricultural importance. *In: M.N. Burge (Editor), fungi in biological control systems.* Manchester Univ. Press, Manchester, UK, pp.37-60.

Griffith, R. 1984. The problem of the coconut mite, *Eriophyes guerreronis* (Keifer), in the coconut groves of Trinidad and Tobago. In: R., Webb, W. Knausenberger, and L. Yntema (Eds), Proce. 20th Ann. Meeting of the Caribbean Food Crops Soc. East Caribbean centre, College of the Virgin Islands and Carribbean Food Crops Soc., St. Croix, Virgin Islands, USA, pp 128-132.

Hall, R. A. and Espinosa, B. A. 1981. The coconut mite, *Eriophyes guerreronis* with special reference to the problem in Mexico. Proc. 1981 British Crop Protection Conf. – Pests and Diseases, British Crop Protection Council, Farnham, UK, pp 113-120.

Hall, R. A., Hussey, N. W. and Mariau, D. 1980. Results of a survey of biological control agents of the coconut mite, *Eriophyes guerreronis. Oleageneux* **35** : 395 - 400.

Haq, M. A. 1999. Distribution of *Aceria guerreronis* in peninsular India and adjacent Islands. *Entomon* **24** : 371-379.

Hernandez, R. F. 1977. Combate quimico del eriofido del cocotero *Aceria* (Eriophyes*) guerreronis* (K). *Agricultura Technica*. Mexico **4** : 23-38.

Howard, F. W., Abreu Rodriguez, E. and Denmark, H. A. 1990. Geographical and seasonal distribution of the coconut mite, *Aceria guerreronis* (Acari: Eriophyidae), in Puerto Rico and Florida, USA. *Journal of Agriculture of University Puerto Rico* **74** : 237 - 251.

Julia, J. F. and Mariau, D. 1979. Nouvelles researches en cote d'Ivoire sur *Eriophyes guerreronis* K., acarien ravageur des noix du cocotier. Congress sur la lutte contre les insectes en milieu tropical. Chambre de Commerce et d'Industrie de Marseille, 13-16 Mars. 1979. Compte rendu des travauz. Premiere partie. Cultures tropicales. Deuxieme partie. Sante humaine et animale. pp. 373 - 387.

Julia, J. F., Mariau, D. and Hall, R. 1979. Nouvelles researches en cote d'Ivoire sur *Eriophyes guerreronis* K., acarien ravageur des noix du cocotier. *Oleagineux* **34** : 181 - 189

Kannaiyan, S., Rabindra, R. J., Ramaraju, K. and Sabitha Doraiswamy. 2002. Integrated management of eriophyid mite on coconut. Tamil Nadu Agricultural University, Coimbatore, India. 82pp.

Keifer, H. H. 1965. Eriophyid studies B-14. Calif. Dept. of Agric., Bureau of Entomology 20 pp.

Khan, H. H., Sujatha, S. and Shivpuje, P. R. 2003. Regionally different strategies in Managing eriophyid mite. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International workshop on coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. pp 89-96.

Kumar, P. S. 2002. Development of a biopesticide for the coconut eriophyid mite in India, pp 335-340. *In: Proceedings of the British Crop Protection Conference – Pests & Disease*, Vol.1&2, 18-21 November 2002, British Crop Protection Council, Brighton, United Kingdom.

Kumar, P. S. and Singh S. P. 2002. Development of 'Mycohit', the first mycoacaricide based exclusively on *Hirsutella thompsonii*, for suppressing the coconut mite in India., pp 209-213. *In: Bioinoculants for sustainable Agriculture & Forestry* Reddy, S.M., Ram Reddy, S., Singarachary,M.A and Girisham,S. (Eds), Scientific Publishers (India), Jodhpur, India.

Kumar, P. S., Singh S. P. and Gopi, T. S. 2001. Natural incidence of *Hirsutella thompsonii* Fisher on the coconut eriophyid mite, *Aceria guerreronis* Keifer in certain districts of Karnataka and Tamil Nadu in India. *Journal of Biological Control* **15** : 151-156.

Kumar, P. S., Singh S. P., Anuroop, C. P. and Ramachandra, C. G. 2001. Acaropathogenic fungi associated with the coconut eriophyid mite (*Aceria guerreronis*) in south India, pp 99-100. In: *National Seminar on Emerging Trends in Pests and Diseases and Their Management*, 11-13 October, 2001, Tamil Nadu Agricultural University, Coimbatore, India.

Kumar, P. S., Singh S. P., Marulasiddesha.K. N. and Anuroop, C. P. 2002. Role of the acaropathogenic fungus *Hirsutella thompsonii* Fisher, in the natural suppression of the coconut eriophyid mite *Aceria guerreronis* Keifer in Andhra Pradesh, India. *In : Bioinoculants for sustainable Agriculture & Forestry* Reddy, S. M., Ram Reddy, S., Singarachary,M. A and Girisham, S. (Eds), Scientific Publishers (India), Jodhpur, India. pp 215-221.

Lampedro, L. and Rosas, J. L. 1989. Selection of *Hirsutella thompsonii* Fisher strains to fight the coconut mite *Eriophyes guerreronis* Keifer. I. Pathogenicity bioexperiments. *Revista Mexicanna de Micologia* **5** : 225 - 231.

Mallik , B., Chinnamade Gowda, C., Jayappa, J., Guruprasad, H. and Onkarappa, S. 2003. Coconut Eriophyid mite in India issues and strategies. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International workshop on coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. pp 27-34.

Mariau , D. Y. and Tchibozo, H. M. 1973. Essais de lutte chemique contre *Aceria guerreronis* Keifer. *Oleagineux* **28** : 133-135.

Mariau, D. 1977. *Aceria (Eriophyes) guerreronis* un important revageur des cocoteraies africaines et americaines. *Oleagineux* **32** : 101-111 .

Marimuthu, T., Palanisamy, S. and Ramaraju, K. 2003. Integrated Management of Coconut Eriophyid Mite (*Aceria*

mite is not reported from any country. However, varieties like Malayan Yellow Dwarf, Malayan Red Dwarf, Rennal Tall, Cameroon Red Dwarf, Equatorial Green Dwarf and the hybrid MYD X WAT (Malayan Yellow Dwarf X West African Tall) were reported to show different degrees of tolerance to mite attack in different countries of the world (Seguni, 2000; Moore and Alexander, 1990; Suarez, 1991; Mariau, 1977 and Julia and Mariau, 1979).

In India, work done at CPCRI revealed that COD (Chowghat Orange Dwarf) variety shows maximum tolerance to mite infestation in the field. MGD (Malayan Green Dwarf), Laccadive Micro and Spicata also recorded comparatively lower mite incidence in the field. WCT (West Coast Tall) and LCT (Laccadive Tall) recorded maximum incidence in the field. Among the hybrids DXT with COD as mother parent exhibited relatively high level of tolerance when compared to DXT with CGD (Chowghat Green Dwarf) as mother parent. The tepal traits, colour, shape and size of the nut influence the degree of damage. Among these, the shape of the nut (round shape) and tepal traits (tight perianth) are important attributes for mite tolerance. In the field WCT variety with green and oblong nuts recorded maximum level of mite incidence as compared to WCT with reddish to bronze colour and round nuts (Nair *et al.*, 2000). In Tamil Nadu, Muthiah and Bhaskaran (1999) identified Laccadive Ordinary (LO), Cochin China (CC), Andaman Ordinary (AO) and Gangabondum (GB) as less susceptible varieties. Ramaraju *et al.*, (2000) reported Kenthali having lowest surface damage while Tiptur Tall is the most susceptible followed by St. Vincent, ECT, WCT and WCT X COD. Kannaiyan *et al.*, (2002) reported that among hybrids, GB X WCT and ECT X GB were having the lowest susceptibility. In general dwarf varieties and hybrids with dwarf as mother parent exhibited relatively more tolerance to mite attack in the field.

Varietal differences in susceptibility to eriophyid mite could be exploited to develop resistant / tolerant varieties and hybrids. But an indepth knowledge of the resistance mechanism is vital in achieving the goals. Eventhough it is a long term process, work in these lines needs due priority and encouragement. Understanding of highly susceptible varieties in different geographical zones will be helpful in elimination of such varieties in the new planting / replanting / rejuvenation programmes in these areas.

Conclusion

After the first report of *A. guerreronis* as a devastating pest of coconut in 1998 from Ernakulam District and its simultaneous occurrence from nearby states showing its fast and continuous spread to the major coconut states of India, detailed and thorough studies have been carried out by various research agencies in the country. The coordinated research efforts by the researchers, the wider network of extension activities aiming at quicker transfer of technologies and sincere efforts taken up by the farming communities were helpful in developing suitable technologies and putting them to practice. This approach has helped in having a better insight about the pest problem.

An interesting phenomenon has been evident during the later part of the incidence of the pest in the country having a history of only seven years. A natural slow decline of the pest could be observed by the end of third year after the first report of the pest. Both biotic and abiotic factors can be attributed as probable reasons for this clear decline in pest incidence. The presence and slow and steady increase in the population of predatory fauna, natural infection of the mite population by pathogenic fungi, particularly *Hirsutella thompsonii* and the more or less uniform rainfall pattern in most of the major coconut areas particularly the West Coast of the country are considered to be the major factors responsible for effecting a natural regulation of the pest.

References

Beevi, S. P., Beena, S., Lyla, K. R., Varma, A. S., Mathew, M. P. and Nadarajan, L. 1999. *Hirsutella thompsoni* var. Synnematosa Samson, McCoy & O'Donnell on coconut mite *Aceria (Eriophyes) guerreronis* (Keifer) – a new report for India. *Journal of Tropical Agriculture* **37** : 91-93.

Cabrera, R. I. 1982. El hongo *Hirsutella thompsonii* y su importancia en el control del acaro del cocotero. *Eriophyes guerreronis* en cuba. Lera Jornada Cient. Inst. De Zool., A.C.C. La Habana, Resumen, 46 pp.

Cabrera, R. I. 2000. Biological control of the coconut mite, *Aceria guerreronis* (Acari : Eriophyidae) with the fungus *Hirsutella thompsonii* and its integration with other control methods. *In: Proceedings of International Workshop on coconut Mite*, CRI, Sri Lanka, pp 89 - 103.

Cabrera,R. I. and Dominiguez, D. 1987. El hongo *Hirsutella nodulsa*, nucvo parasito parael acaro del cocotero *Eriophyes guerreronis*. Ciencia y Technica en la Agricultura. *Citricos y Otros frutales* **10** : 41 - 51.

Doreste, S. E. 1968. El acaro de la flor del cocotero (*Aceria guerreronis*) en Venezuela. *Agronomia Tropical* **18** : 379-386.

Espinosa Becerril, A. and Carrillo Sanchez, J. L. 1986. The fungus *Hirsutella thompsonii* Fisher of the control of eriophyid *Eriophyes guerreronis* (Keifer). *Agricultura Technica en Mexico* **12** : 319 - 323.

Fernando, L. C. P., Wickramananda, I. R. and Aratchige, N. S. 2000. Status of coconut mite, *Aceria guerreronis* in Sri Lanka. *In. Proceedings International Workshop on Coconut Mite (Aceria*

guerreronis Keifer) in Tamil Nadu. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International Workshop on Coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. Kochi. pp 81- 86.

Mathew, T. B., Ambily Paul., Beevi, S. N. and Saradamma, K. 2000. Population dynamics of coconut mite *Aceria guerreronis* Keifer on developing nuts. *Paper presented in the international meet entomocongress 2000: perspective for the new millennium.* 5th-8th November, 2000, AAE, Trivandrum, pp195. (Abstract).

Moore, D. and Howard, F. W. 1996. Coconuts In Eriophyid Mites. Their Biology, natural enemies and control. eds Linquist, E.E.; Sabelis, M.W. and Bruin.J. Elsevier, Amsterdam, Netherlands. pp 561-570.

Moore, D. and Alexander, L. 1990. Resistance of coconut in St. Lucia to attack by the coconut mite, *Eriophyes guererronis* Keifer. *Tropical Agriculture* **67** : 33-36.

Moore, D., Alexander, L. and Hall, R. A. 1989. The coconut mite, *Eriophyes guerreronis* Keifer in St. Lucia : yield losses and attempts to control it with acaricide, polybutene and *Hirsutella* fungus. *Tropical Pest management* **35** : 83-89.

Moore, D., Ridout, M. S. and Alexander, L. 1991. Nutrition of coconuts in St. Lucia and relationship of attack by coconut mite *Aceria guerreronis* Keifer. *Tropical Agriculture* (Trinidad) **68** : 41- 44.

Moraes, G. J. and Zacarias, M. S. 2002. Use of predatory mites for the control of eriophyid mites. In. *Proceedings of the International Workshop on Coconut mite (Aceria guerreronis)* Eds.L.C.P.Fernanado; G.J-de Moraes and I.R.Wickramananda. Coconut Research Institute, Sri Lanka, 6-8 January, 2000. Coconut Research Institute, Sri Lanka. pp 78-88.

Murali Gopal., Saleena, A. and McCoy, C. W. 2002. Study of microflora associated with coconut eriophyid mite as a preliminary step towards pathogen isolation. *Current Science* **82** : 22-24.

Muralidharan, K., Jacob Mathew, Thamban, C., Amarnath, C. H., Anitha Kumari, P., Chandrika Mohan, Vijayakumar, K., Sairam, C. V., Nair, C. P. R. and Arulraj, S. 2001. Pilot sample survey on the incidence and yield loss due to Eriophyid mite on coconut in Alappuzha District. *Indian Coconut Journal* **32** : 28-32.

Muthiah, C. and Bhaskaran, R. 1999. Screening of coconut genotypes and management of Eriophyid mite *Aceria guerreonis* (Eriophyidae: Acari) in Tamil Nadu. *Indian Coconut Journal* **30** : 10-11.

Nair, C. P. R. 2000. Status of coconut eriophyid mite, *Aceria guerreronis* K. in India. In : proceedings *International Workshop on coconut Eriophyid Mite* CRI, Sri Lanka, pp 9-12.

Nair, C. P. R., Chandrika Mohan, Rajan, P., Sandhya, S. R. and Anand Gopinath. 2003. Technological advances in the management of coconut eriophyid mite, *Aceria guerreronis* Keifer. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International workshop on coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. Kochi. pp 99-103.

Nair, G. M., Mathew, T. B., Saradamma, K. and Beevi, N. 2000. Infestation of coconut mite (*Aceria guerreronis* K) in southern Indian state, Kerala. In proceedings *International Workshop on coconut Eriophyid Mite* CRI, Sri Lanka, pp 32 - 40.

Nair, C. P. R., Rajan, P. and Chandrika Mohan. 2000. Distribution, Ecology and management of the Eriophyid mite *Aceria guerreronis* Keifer affecting coconut palm. Paper presented in the International Entomology Symposium Entomocongress, 5-8 Nov 2000., Thiruvananthapuram. Abstract of papers pp180.

Nair, C. P. R., Rajan, P., Chandramohanan, R. and Anithakumari, P. 2004. Current status in management if root(wilt) disease and eriophyid mite affecting coconut. In *Abstracts of First Indian Horticulture Congress 2004.* 6-9th November, 2004. Horticultural Society of India, New Delhi. pp 70.

Nampoothiri, K. U. K., Nair, C. P. R., Kannaiyan, S., Sabitha Doraiswamy, Saradamma, K., Naseema Beevi, S. and Sreerama Kumar. 2002. Coconut Eriophyid mite (*Aceria guerreronis* Keifer)- an update. In *Placrosym XV.* Edited by Sreedharan.K; Vinod kumar, P.K.; Jayarama and Basavaraj M. Chulaki. Central Coffee Research Institute, Mysore. pp 487 - 496.

Naseema Beevi, S., Thomas Biju Mathew, Hebsy Bai and Saradamma, K. 2003. Status of Eriophyid mite in Kerala – Resume of work done. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International workshop on coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. Kochi, pp 64 - 75.

Olivera Fonseca, S. 1986. El acaro causante de la rona del cocotero en Veracruz, Mexico. (Acarina, Eriophyiae). *Folia Entoniologica Mexicana* 67: 45-51.

Octero Colina, G. 1986. Acaros colectados sobre plantas cultivadas en el Estado de Tabasco, Mexico y su importancia. *Folia Entomologica Mexicana* **69** : 127-147.

Palanisamy, S., Karuppuchamy, P., Ramaraju. K., Philip Sridhar, R., Kempraj, T., Bhaskaran, V. and Rabindra, R. J. 2000. Evaluation of ecofriendly agents and insecticides against coconut eriophyid mite *Aceria guerreonis* K. Paper presented in group meeting on coconut eriophyid mite, *Aceria guerreronis* K. on 15th May 2000 at Tamil Nadu Agricultural University, Coimbatore -3.

Rabindra, R. J. and Kumar, S. P. 2003. Prospects of Biological control of coconut mite. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International workshop on coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. Kochi, pp 35 - 42.

Rajagopal, V., Anithakumari, P., Rohini Iyer and Nair, C. P. R. **2003.** Strategic approaches of management in coconut. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the*

International Workshop on Coconut Mite held at Bangalore. Eds. H.P. Singh and P. Rethinam. Coconut Development Board. Kochi. pp 22-26.

Ramaraju, K. and Rabindra, R. J. 2001. Palmyra, *Borassus flabelliferLinn.* (Palmae): a host of the coconut eriophyid mite *Aceria guerreronis* Keifer. *Pest Management in Horticultural Ecosystems* **7** : 149-151.

Ramaraju, K., Natarajan, K., Sundarababu, P. C. and Murali Ragini, G. T. 1999. Management of coconut eriophyid mite, *Aceria guerreronis* K. Tamil Nadu *Journal of Acarology* **14** : 82 - 83.

Ramaraju, K., Natarajan. K., Sundara Babu, P. C., Palanisamy, S. and Rabindra, R. J. 2000. Studies on coconut eriophyid mite, *Aceria guerreronis* Keifer in Tamil Nadu, India. In: Proceedings International Workshop on coconut mite, CRI. Sri Lanka. pp 13-31.

Ramarethinam, S. and Marimuthu, S. 1998. Role of IPM in the control of eriophyid mite, *Aceria (Eriophyes) guerreronis* (K). an emerging menace in the coconut palms in Southern India. *Pestology* XXII : 39 - 47.

Ranjit, A. M., Vidya, C. Y. and Nadarajan, L. 2001. Population distribution of the perianth mite *Aceria guerreronis* Keifer on coconut bunches. *Insect-Environment* **7** : 31-33.

Rethinam, P. 2003. International efforts on coconut eriophyid mite, (*Aceria guerreronis*, Keifer) problem – An over view. *In: Coconut Eriophyid Mite - Issues and Strategies Proceedings of the International workshop on coconut Mite held at Bangalore.* Eds. H.P. Singh and P. Rethinam. Coconut Development Board. Kochi, pp 10-21

Rethinam, P., Singh, H. P. and Vijayakumar Hallikeri. 2001. Eriophyid mite attack on coconut –state of art report. Pub. Coconut Development Board. Kochi, pp 1-35.

Saradamma, K., Beevi, S. N., Mathew, T. B., Sreekumar, V., Jacob, A. V. and Visalakshi, A. 2000. Management of coconut eriophyid mite in Kerala. Paper presented at Entomocongress 2000 – Perspective plan for the new millennium. 5 - 8 November, 2000. Thiruvananthapuram.

Sathiamma, B., Nair, C. P. R. and Koshy, P. K. 1998. Outbreak of a nut infesting eriophyid mite *Eriophyes guerreronis* (K) in coconut plantations in India. *Indian Coconut Journal* **29** : 1-3.

Seguni, Z. 2000. Incidence, distribution and economic importance of the coconut Eriophyid mite, *Aceria guerreronis*, Keifer, in Tanzanian coconut based cropping systems. *In Proceedings of International workshop on coconut mite*. Eds. Fernando *et al.*, 2000. pp 54 - 57.

Suarez, A. 1991. Distribucion y evalacion de danos del acaro *Eriophyes guerreronis* en plantaciones de cocotero de la region de Baracoa. *Protecion de plantas* **1** : 75-81.

Received : 25-04-2004 Accepted : 20-05-2005