Paper 6.4

Coconut Eriophyid Mite, *Aceria guerreronis* Keifer

P. Rajan, Chandrika Mohan, A. Josephrajkumar
Central Plantation Crops Research Institute,
Regional Station, Kayangulam – 690 533
Email: *rajanpmenon@gmail.com*

Introduction

Coconut eriophyid mite, *Aceria guerreronis* Keifer (Eriophyidae : Acarina) is the most destructive pest among the various species of eriophyid mites affecting coconut palm in 30 countries of Tropical America, Africa and Asia. In India, coconut eriophyid mite was first reported from Amballur Panchayat in Ernakulam district of Kerala during 1998 (Sathiamma *et al.*, 1998). Within a short span of time the mite had spread rapidly to all major coconut growing regions of the country and currently its incidence is seen in entire coconut growing states of West and East Coast of India and North-East part of India (Nair, 2000; Ramaraju *et al.*, 2000; Mallik *et al.*, 2003; Khan *et al.*, 2003). The occurrence of the pest was also reported from Lakshadweep Islands (Mullakoya, 2003).

Distribution

The history of the occurrence of *A. guerreronis* on coconut starts with the first report from the Guerrero State, Mexico by Keifer in 1965. In the same year it was reported from Rio de Janeiro, Brazil. It was widely noticed in several countries from South America and neighbouring Caribean Islands by 1968. During 1970's and early 1980's, severe damage by the pest was reported from Central America and West African countries. Tanzania witnessed an outbreak of the pest during 1980. In Sri Lanka, the pest occurrence almost coincided with that of India when the incidence was recorded in the later part of 1997 at Kalpitia Peninsula in the North-West province (Fernando *et al.*, 2000).

Hosts

Coconut palm is the primary host of *A. guerreronis*. It has also been recorded from cocosoid palm *Lytocaryum weddelliana* in Brazil (Flechtmann, 1989), palmyrah palm (*Borassus flabellifer*) in India (Ramaraju and Rabindra, 2001).

Biology

Coconut mite is a microscopic creamy white, vermiform organism measuring 200-250 microns in length and 36-52 microns in breadth. The body is elongated, cylindrical, finely ringed and bears two pairs of legs at the anterior end. Mites attain sexual maturity

within a week's time and start laying eggs. An adult mite lays about 100-150 eggs. The eggs hatch into protonymphs, deutronymphs and finally to adults. The total life cycle is completed in 7-10 days.

Nature of Damage and Symptoms

In coconut, mites infest the developing young buttons after pollination and are seen in the floral bracts (tepals) and the soft meristematic portions beneath the perianth. Entry of the mite into the developing nuts takes place during the early phase of the development immediately after fertilization. The mite thus gaining entry into the nuts multiply and form active colonies containing various stages of development *viz.*, eggs, nymphs and adults. Usually in a developing nut, the coconut mite colonies are seen as 2 or 3 congregations on the meristematic regions of the buttons below the perianth. Under favourable conditions, the high reproductive potential and shorter life cycle of the mite result in the enormous multiplication of the colonies. When colony size becomes substantially increased, mite comes out of the interspaces between the tepals of the developing nut for dispersal. The dispersal of the pest takes place mainly through wind. Honeybees and other insects visiting inflorescence of coconut also act as agents for dispersal.

The mite infestation symptoms are observed approximately one month after the initial colonization of the mite inside the fertilized buttons. Appearance of elongated white streaks below the perianth is the first external visual symptom on young buttons. In many cases, an yellow halo develops around the perianth. Within a few days this halo develops into yellow triangular patch pointing towards the distal end of the button. This can be clearly seen in 2-3 month old buttons. In a short time the yellow patch turns into brown and show necrotic patches on the periphery of the perianth. As the nut grows the injuries form warting and longitudinal fissures on the nut surface. In severe infestation the husk develops cracks, cuts and gummosis. Shedding of buttons and young nuts and malformation of nuts as a result of retarded growth are the other indications associated with severe attack of the pest.

Population Dynamics

In India, the pest activity has been observed through out the year with the population peak during the summer months. Studies undertaken 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). Investigations on population dynamics in Tamil Nadu revealed that maximum population existed during November and May. Mathew *et al.* (2000) observed monthly variations in total population of mite with a peak in February-March and a sharp decline in subsequent rainy months indicating a negative relationship between mite population and rainfall. Observations on the population of the mite within various age groups of the nuts showed that third and fourth bunches harbour maximum mite population.

Crop Loss

Yield loss to various levels has been reported world wide as a result of infestation by

the pest. In general, pest incidence and extent of loss are comparatively high during the initial few years of pest occurrence in a particular locality. Yield loss depends on the cultivar, health and general maintenance of the crop as well as intensity of infestation. Feeding by few mites causes only cosmetic damage to the husk without affecting the quality and quantity of copra and coconut water.

In India during 1998 when the pest outbreak was reported almost 70% of nuts were affected showing malformation and reduction of nut size (Nair, 2000). But observations recorded during subsequent years revealed overall reduction in incidence and intensity of pest in areas of its initial occurrence (Nair *et al.*, 2004). In Kerala though pest damage has been reported initially ranging from 50-70%, later surveys carried out in Alappuzha district during 2000 has shown significant reduction in crop loss indicating an average loss of 30.94% in terms of copra and 41.74% in husk production (Muralidharan *et al.*, 2001).

Similar studies undertaken in Tamil Nadu during 2000 revealed an average loss of copra yield to the tune of 27.5% (Ramaraju *et al.*, 2000). A reduction in copra yield ranging from 18-42% was observed in Karnataka when severe infestation symptoms were seen on more than 50% of surface area of infested nuts (Mallik *et al.*, 2003). Mite damage caused significant reduction in quality of fibres in terms of fibre length and tensile strength. Studies undertaken at Kerala Agriculture University (KAU) during 2003 revealed that fibres from moderately to severely infested nuts suffered 26-53% reduction in length (Naseema Beevi *et al.*, 2003).

Recent surveys (2004) carried out by CPCRI in Kerala register lower levels of pest incidence with comparatively less intensity of infestation. The loss in terms of copra in Southern districts of Kerala ranged from 8-12% compared to an average loss of 25% in initial years (Rajan *et al.*, 2007).

Varietal Susceptibility

The tepal traits, colour, shape and size of the nut influence the degree of damage. Among these, shape of the nut (round shape) and tepal traits (tight perianth) are important attributes for mite tolerance. A coconut variety exhibiting resistance to eriophyid mite is not reported from any country. However, varieties like Malayan Yellow Dwarf (MYD), Malayan Red Dwarf, Rennal Tall, Cameroon Red Dwarf, Equatorial Green Dwarf and Hybrid [MYD x West African Tall (WAT)] were reported to show different degrees of tolerance to mite attack in different countries of the world (Rethinam, 2003). In India work done at CPCRI revealed that Chowghat Orange Dwarf (COD) variety shows maximum tolerance to mite infestation in the field. Malayan Green Dwarf (MGD), Laccadive Micro and Spicata also recorded comparatively lower mite incidence in the field. West Coast Tall (WCT) and Laccadive Tall (LCT) recorded maximum incidence in the field. WCT with green and oblong nuts recorded higher level of mite incidence as compared to WCT with reddish bronze colour and round nuts (Nair *et al.*, 2000). Among the Hybrids DxT with COD as mother parent exhibited high level of tolerance compared to Hybrids with Chowghat Green Dwarf (CGD) as mother parent. Ramaraju *et al.* (2000) reported Kenthali variety having lower surface damage by mite while Tiptur Tall is the most susceptible variety.

Management

Over five dozen systemic and contact insecticides have been evaluated world over and recommended from time to time for management of coconut mite. In India also, a wide spectrum of pesticides have been tried by various research agencies including both Central Institutes and State Agricultural Universities (Mallik *et al.*, 2003; Nair *et al.*, 2000; Ramaraju *et al.*, 2000; Saradamma *et al.*, 2000). Though these pesticides were effective in the field when given as spray/ root feeding / stem injection, none of the chemicals has been used for larger adoption due to environmental reasons. Even wettable sulphur recommended for mite management in the initial years was withdrawn due to its deleterious effects on the natural enemies of mite particularly on the entomopathogenic fungi. The massive crown of the palm, large area to be covered in a short spell of time, need for repeated application, residual toxicity of pesticides, labour intensive mode of application etc were other factors which were unfavourable for the wider use of chemical pesticides.

Currently botanical pesticides *viz.*, neem based biopesticides are recommended for management of the pest in the field. Spraying of neemoil-garlic soap mixture at 2% or commercial botanical pesticides containing azadirachtin 10,000 ppm @ 0.004% or root feeding with neem formulations containing azadirachtin 50,000 ppm (7.5 ml) or azadirachtin 10,000 ppm (10 ml) mixed with equal volume of water is recommended for mite management (Mallik *et al.*, 2003; Nair *et al.*, 2000, 2003; Rajan *et al.*, 2009; Saradamma *et al.*, 2000).

Preparation of spray solution

To prepare one litre of 2% neem oil-garlic soap emulsion, 20 ml pure neem oil, 20 g cleared garlic pearls and 5g washing soap are required. Dissolve the soap in 500 ml of water and add neem oil to this solution and mix it well. Grind garlic pearls well, mix it well in 500 ml of water and add this to the soap-neem oil mixture by sieving through a cloth to remove debris of garlic pearls. The mixture is stirred well and can be used for spraying. The pesticide mixture shall be used on the day of preparation. To prepare one-litre of azadirachtin spray solution take 4 ml of 10000 ppm azadirachtin formulation and mix it well in one litre of water by stirring.

Method of spraying

As the mite colonies are lodged on the soft tissues of the developing nuts covered by the perianth, pesticide should be applied as fine droplets on the perianth region from top so as to provide its penetration into the perianth lobes. Pesticide solution should cover the 2 to 6 month old nuts since these bunches harbour maximum number of mites. There is no need to spray the unpollinated and mature nuts in the palm. If the pesticide is applied on the bunches using pneumatic hand sprayer 250 to 500ml spray fluid is required per palm. The neem based formulation can be applied through roots also for getting effective control of the pest.

Root feeding method

Trace an active semi hard, pencil thick and brownish coloured root without damage from about one meter away from the bole region. Make a slanting cut of 45° at the tip

portion with a sharp knife. Take either 7.5 ml of Azadirachtin 5% formulation or 10 ml Azadirachtin 1% formulation and mix it with equal volume of water in a polythene pouch. Fully immerse the cut end of the root in the pesticide solution up to the bottom of the pouch and tie the mouth of the pouch with a twine. Care should be taken to avoid any injury or spillage of the pesticide solution and cover the root gently with leaf mulch or loose soil.

Nutrient management as a component of IPM

The nutritional status of the palm plays a significant role in the management of the pest. The nutrient management package consists of balanced application of NPK fertilizers at recommended doses in two splits (Urea 1.0 kg, rock phosphate 1.5 kg, muriate of potash 2.0 kg), recycling of organic biomass in coconut ecosystem using *in situ* vermicomposting or growing of green manure crops like cow pea or sunn hemp and its incorporation in coconut basin and conservation of soil moisture by appropriate mulching methods.

IPM technology for mite

In India, adoption of integrated mite management approach with need based application of botanical pesticides either by spraying or root feeding and adequate nutrient management of the affected palm has given encouraging results in the field. An integrated strategy blending plant protection and nutrient management is currently recommended for management of the pest. Plant protection includes spraying / root feeding of neem based pesticides thrice a year during Dec-Jan, Apr-May and Sep-Oct coinciding with the population build up of the pest. Under nutritional management, balanced application of NPK fertilizers, recycling of organic biomass, raising of suitable green manure crop in coconut basin and its incorporation and soil moisture conservation measures are recommended.

IPM package was demonstrated in farmer's fields at Krishnapuram village covering 25 ha area of coconut gardens in 208 farmer holdings. Here the integrated nutrient management technology was implemented along with recommended practice of azadirachtin spraying thrice a year and the mite incidence could be brought down to 15.3% from 68% over a period of three years (Rajagopal *et al.*, 2003).

Biocontrol

Due to the limitations of pesticidal applications and the labour intensive nature of the application techniques for pesticides, biological control programmes gain major importance in managing the coconut mite. Biocontrol is most desirable as it is safe and eco-friendly. Hence, it is more vital in sustainable management of the pest. Among the biocontrol agents, predators and pathogens constitute the major groups of natural enemies. So far no parasitoid has been reported on *A. guerreronis*.

Predators

A variety of predatory mites and smaller insects are associated with *A. guerreronis* in different parts of the world. Predatory mites belonging to Phytoseiidae, Bdellidae and Tarsonemidae are encountered in various collections. In India the phytoseiid mite *Neoseiulus*

baraki is the most dominant predator in the field. Other predatory mites include *Neoseiulus paspalivorus* and *Bdella* species. The insect predators encountered with coconut mite population in the field are thrips, coccinellids and syrphid maggots. But these are found only occasionally and in very few numbers. An increasing trend of incidence and better establishment of predatory mites in the field over the years are observed. The activity of the predators is high during June to December in the field. Compared to the young developing nuts below three months, more predators are encountered in 4-6 month old nuts. The predatory mites are larger in size compared to the coconut mite and hence they gain entry only later into the nuts. This is one of the limiting factors for the wider use of the predators. However, conservation of the predatory fauna in the ecosystem is beneficial to regulate the coconut mite in nature (Nair *et al.*, 2005; Rajan *et al.*, 2009).

Pathogens

Among microbial pathogens fungi form the predominant pathogens of coconut eriophyid mite. The fungal pathogen, *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 *synnemetosa* has been more often invading *A. guerreronis*. In India the incidence of *H. thompsonii* was recorded from Kerala, Karnataka Tamil Nadu, Andhra Pradesh, Pondicherry and Lakshadweep Islands (Kumar, 2002). In Kerala, local strain of *H. thompsonii var. synnemetosa* could be isolated from field samples (Beevi *et al.*, 1999). CPCRI could collect virulent native isolates of this fungus from different locations of India. A total of 42 isolates of *H. thompsonii* were collected and maintained. Talc based formulations of the virulent strains of this fungus are being evaluated for the suppression of coconut eriophyid mite in the field (CPCRI, 2009). Other fungal species associated with eriophyid mite include species of *Poecilomyces, Beauveria, Metarhizium, Sporothrix, Verticillium, Acremonium, Aspergillus, Pencillium* and *Fusarium* (Kumar *et al.*, 2001). However, the bio-efficacy of these fungi as biocontrol agents of mite in field conditions is not fully studied.

Conclusion

Coconut eriophyid mite *A. guerreronis* is one of the potential pests of coconut in India. In a period of 12 years from its initial occurrence, the pest has spread to all major coconut growing regions of India including Lakshadweep Islands causing heavy economic loss to coconut industry. Detailed and thorough studies on various aspects of bioecology and management have been carried out by various research agencies in the country. An IPM package consisting of two components *viz.*, plant protection and nutritional care could be developed and field validated. A natural decline in the mite incidence could be observed especially in most of the pest infested tracts in the West Coast. Both biotic and abiotic factors can be attributed as probable reasons for the reduction in mite incidence. The slow and steady increase in the population of predatory fauna, natural infection of mite population by pathogenic fungi particularly *H. thompsonii* and uniform distribution of rainfall in the major coconut growing areas of West Coast of the country are considered to be the major

factors for natural regulation of the pest. However, in depth studies on biocontrol agents and role of plant nutrition for sustainable management of the pest are highly essential to chalk out a cost effective, eco-friendly and viable management technology for the pest.

References

Beevi, S.P., Beena, S., Lyla, K.R., Varma, A.S., Mathew, M.P. and Natarajan, IL. 1999. *Hirsutella thompsonii* var. *synnematosa* Samson, McCoy and O'Donnell on coconut mite, *Aceria guerreronis* (Keifer), a new report for India. *Journ. Trop. Agric.* **37**: 91-93.

CPCRI, 2009. Annual Report 2008-2009. Central Plantation Crops Research Institute, Kasaragod, Kerala, India, 145p.

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 Eriophyid Mite*, CRI, Sri Lanka, p128.

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

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

Khan, H., H., Sujatha, S., Sivapuja, 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, p 89-96.

Kumar, P.S. 2002. Development of a biopesticide for coconut eriophyid mite in India. In: *Proceedings of British Crop Protection Conference- Pests and disease* Vol 1& 2 18-21, Nov, 2002, British Crop Protection Council, Brighton, United Kingdom.

Kumar, P.S., Singh, S.P., Anuroop, C.P. and Ramachandra, C.G. 2001. Acaropathogenic fungi associated with coconut eriophyid mite, *Aceria guerreronis* in South India. Pp 99-100. In : *National Seminar on Emerging Trends of Pests and Diseases and their Management*, 11-13th October, 2001, TNAU, Coimbatore, India

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 at Entomocongress 2000*, Perspective plan for the new millennium, 5-8, November, Thiruvananthapuram. P 195.

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, p 27-34.

Mullakoya, P. 2003. Status report on the incidence of coconut mite in Union territory of Lakshadweep. 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, p 97-98.

Muralidharan, K., Jacob Mathew, Thampan, C., Amarnath, C.H., Anithakumari, P., Chandrika Mohan, Vijayakumar, K., Sairam, C.B. and Nair, C.P.R. 2001. Pilot sample survey on the incidence and yield loss due to eriophyid mite in coconut in Alappuzha district. *Indian Coconut Journal* **32:**

28-32.

Nair, C.P.R. 2000. Status of coconut eriophyid mite, *Aceria guerreronic* K. In India. In: *Proceedings International Workshop on Coconut Eriophyid Mite*, CRI, Sri Lanka, p9-12.

Nair, C.P.R., Rajan, P. and Chandrika Mohan 2000. Distribution, ecology and management of the eriophyid mite, *Aceria guerreronis* Keifer affecting coconut. *Paper presented at Entomocongress 2000*, Perspective plan for the new millennium, 5-8, November, Thiruvananthapuram. P 180.

Nair, C.P.R., Rajan, P. and Chandrika Mohan. 2005. Coconut eriophyid mite, *Aceria guerreronis* Keifer – An overview. *Indian Journ. Plant Protec.* **33**(1): 1-10.

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

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, p 99-103.

Naseema Beevi, S., Thomas Biju Mathew, Hebsy bai, 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, p 64-75.

Rajagopal, V., Anithkumari, 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, p 22-26.

Rajan, P., Chandrika Mohan, Nair, C.P.R. 2007. *Technical folder on Coconut mite, Aceria guerreronis* Keifer, CPCRI, Regional Station, Kayangulam, Kerala

Rajan, P., Chandrika Mohan, Nair, C.P.R. and Josephrajkumar, A. 2009. *Integrated pest management in coconut*. Technical bulletin No. 55, CPCRI, Regional Station, Kayangulam, Kerala, India, p 20.

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 Eriophyid Mite*, CRI, Sri Lanka, p13-31.

Ramaraju, K. and Rabindra, R.J. 2001. Palmyrah, *Borossus falbellifer* Linn. (Palmae: a host of coconut eriophyid mite *Aceria guerreronis* Keifer. *Pest Management in Horticultural Ecosystems* **7**: 149-151.

Rethinam, P. 2003. International efforts on coconut eriophyid mite, *Aceria guerreronis* Keifer, Problem –An overview. 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, p 10-21.

Saradamma, K., Beevi, S.N., Mathew, P.B., Sreekumar, V., Jacob, A.V., and Vishalakshy, A. 2000. Management of coconut eriophyid mite in Kerala. *Paper presented at Entomocongress 2000*, Perspective plan for the new millennium, 5-8, November, 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**(2): 1-3.