

Integrated management of Eriophyid mite, *Aceria guerreronis* Keifer on coconut in Tamil Nadu, India

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Abstract

A field experiment was conducted at Vellalore from January 2002 to December 2004 to evaluate the influence of organic and inorganic nutrients and the effect of botanicals and insecticide against coconut eriophyid mite. Soil application of nutrients along with spraying of Triazophos 40 EC (5 ml/lit.), azadirachtin 1% (5 ml/lit.) and neem oil (30 ml/lit.) as first, second and third round of sprayings, respectively were evaluated. The results revealed that there was a significant reduction in mite population (65%) after two years in the Integrated Management (IM) treated trees (application of organic and inorganic nutrients, basin cultivation of sunnhemp and three rounds of spraying) followed by trees treated with Nitrogen: Phosphorus: Potash (1.3:2.0:3.5 kg/palm/year) + Farm Yard Manure 50 kg/palm/year + neem cake 5 kg /palm/year + micronutrients + three rounds of sprayings (52.8%). Similarly, there was also a significant reduction in the per cent damaged green nuts after two years. After second year, the per cent damaged nut was lowest (41.9) in the IM treated trees which was statistically on par with treatment 6 (42.9) as against control (71.8). A similar trend was also recorded after third year. IM package treated trees recorded the lowest nut damage grade of 2.8, 2.4 and 2.1 at harvest followed by IM package without sunnhemp as basin crop 3.0, 2.6 and 2.2 as against 4.3, 4.3 and 4.5 in the check after first, second and third year, respectively.

Key words: Coconut, Eriophyid mite, Integrated Management, *A. guerreronis*, Vermicompost, Neem cake.

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Introduction

Coconut is extensively grown in about 93 countries of the world with the total production of over 56,360 million nuts annually. The productivity of the crop is highest in India with 7,572 nuts /ha. In Tamil Nadu coconut is grown in an area of 3.2 lakh with a total production of 3,816 million nuts. Although 9 species of eriophyid mites have been reported to attack coconut leaves and nuts (Amrine, Jr. and Stasny, 1994) *Aceria guerreronis* Keifer (Acari:Eriophyidae) feeding on tender nuts cause heavy damage. In India, the outbreak of this nut infesting eriophyid mite was first reported from Kerala State during 1998 (Sathiamma *et al.*, 1998). The estimated yield loss in copra ranged between 25 and 30 per cent in Tamil Nadu, India (Ramaraju *et al.*, 2002). Currently, the damage is widespread and many coconut gardens show moderate to heavy nut damage. Dicrotophos, monocrotophos or chinomethionate sprayed on bunches of developing fruits every 20 or 30 days reduced the damage due to *A. guerreronis* (Julia and Mariau, 1979). Mariau (1977) and Hernandez (1977) reported that it was possible to control this mite with cyhexatin or fenbutatinoxide, if repeated sprays were given. However, such an approach would hasten the development of resistance. Spraying of either dicofol 6 ml/l of water or 2% neem oil + 25g garlic extract in one litre of water at monthly intervals recorded satisfactory control of coconut eriophyid mite (Madhavan Nair *et al.*, 2000). Even though the application of acaricide/insecticides reduced the mite population substantially, the ill effects caused by the continuous use of chemicals necessitated to seek for alternative integrated management method which are economically viable and environmentally safe (Ramaraju *et al.*, 2002).

Though a large number of predacious mites have been found associated with *A. guerreronis* under the perianth (Fernando *et al.*, 2002; Marimuthu *et al.*, 2003) but none of them is

found effective in reducing the mite population under field conditions (Moore *et al.*, 1991). This may be due to the poor predatory potential and most of the predators do not gain entry into the underside of the perianth during the early stage of button development when the eriophyid mite is high. By the time the predatory mites gain entry into the perianth, the damage caused by eriophyid mite is mostly completed. In addition field application of fungal pathogens *Hirsutella thompsonii* against this mite gave variable results (Moore and Howard, 1996) and it was not promising under Indian condition (Marimuthu *et al.*, 2003). Hence, it was planned to explore the possibility of Integrated Management package against this mite.

The role of plant nutrition in the management of pests and diseases is a well known and widely accepted fact. Moore *et al.* (1991) analyzed the nutritional levels present in the coconut leaves affected by eriophyid mite at St. Lucia and suggested that modification of farm management practices by irrigation and optimum input of fertilizers could regulate mite population. Balanced fertilizer application could improve the poor nutrient status of coconut (Wilkie, 1980). It is a well known fact that application of higher level of potash reduces the damage caused by insects and mites. Moore *et al.* (1991) also reported that the coconut mite damage increased with increased levels of nitrogen and potash was responsible for decreased mite damage. Rajaram and Ramamurthy (2001) reported that potash had significant effect on reducing the incidence of *Polyphagotarsonemus latus* (Banks). Hence, application of recommended nutrients will play an important role in improving the vigor of the trees and the spraying of botanicals/chemicals may reduce the mite attack significantly. With this view, the present study was conducted to manage the pest through integrated management i.e. the application of different plant nutrients and ecofriendly agents.

Materials and methods

A field experiment was conducted at Vellalore near Coimbatore from January 2002 to December 2004 to evaluate the Integrated Management (IM) Package recommended by Tamil Nadu Agricultural University, Coimbatore against coconut eriophyid mite in Tamil Nadu, India. The experiment was laid out in Randomized Block Design with eight treatments and three replications. Each replication consists of four East Coast tall coconut trees. The trees were nine years old and the treatments include:

- T1 - Soil application of vermicompost 5 kg/ tree / year
- T2 - Neem cake 5 kg/tree/year
- T3 - Nitrogen: Phosphorus: Potash (N:P:K) (1.3 kg as urea; 2 kg as super phosphate and 2 kg as muriate of potash /tree/year) + well decomposed Farm yard manure (FYM) 50 kg/tree/year + neem cake 5 kg/tree/year
- T4 - N:P:K (1.3 kg, 2 kg, 3.5 kg/tree/year) + FYM 50 kg/tree/year + neem cake 5 kg / tree/year
- T5 - FYM 50 kg/tree/year
- T6 - T4 + micro nutrients (Boron 50g; gypsum 2kg; magnesium sulphate 0.5 Kg/tree/year)
- T7 - IM package (T6 + sunnhemp basin cultivation - 2 crops / year)
- T8 - Control

The organic and inorganic fertilizers were applied in the soil at yearly interval. The package was applied during 2002, 2003 and 2004. Three rounds of spot application (spraying) per year were given at 45 days interval coinciding with nut harvests in all treatments except control. Continuous use of same chemical may cause resurgence and residue problem. Hence, alternative sprays with insecticide and botanicals were preferred for ecofriendly mite management. Triazophos 40

EC (5 ml/lit.), azadirachtin 1 % (5 ml/lit.) and neem oil (30 ml/lit.) were applied as first, second and third round of sprayings, respectively, during summer months i.e. from January - May. The insecticide / botanical pesticides were applied by using one litre hand sprayer. At the time of harvest the climbers carried the spray fluid and applied topically on the young bunches (i.e. 1 - 6 bunches) after harvesting the nuts.

Observation on mite population was made on two numbers of four or five months old green buttons per tree. On each button the live mite population was assessed in an area of 4 sq. mm. on the inner most bracts (i.e. 4, 5 and 6 tepals or bracts) and on the nut surface covered by perianth. The percent reduction in mite population was worked out by using the formula:

$$\text{Per cent reduction} = \frac{\text{No. of mites in control} - \text{No. of mites in treatment}}{\text{No. of mites in control}} \times 100$$

Bunch damage assessment on green nuts of 4, 5 and 6th bunches were recorded at the end of each year. The mean per cent infestation in each bunch was worked out based on the following formula:

$$\% \text{ Infestation} = \frac{\text{Number of infested buttons}}{\text{Total number of buttons}} \times 100$$

One month old bunches (after fertilization) were marked with yellow coloured paint before first spraying (as an identification mark for taking further observations) for taking nut damage grading at the time of harvest. Nut damage grading was done at the time of harvest on the marked bunches on 0 and 360 DAT in each year based on 1 - 5 scale damage adopted by Julia and Mariau (1979). The nuts were graded based on the following symptoms and the mean grade index (MGI) was worked out:

Grade	Level of Damage	Damage symptoms
1	0%	Nuts with no mite damage
2	1 – 10%	Nuts with superficial damage
3	11– 25%	Nuts with significant mite damage, but not greatly reduced in size
4	26– 50%	Nuts with significant mite damage showing reduction in size and distortion in shape
5	> 50%	Nuts very heavily attacked, very much reduced in size and often greatly distorted

Pre and post treatment yield data were also recorded. The yield in the treatments trees were compared with pretreatment and control treatment trees and the benefit cost ratio was worked out.

Statistical Analyses

The analysis of variance was carried out by randomised block design using AGRES. The data on the population were transformed into $\sqrt{(X + 0.5)}$ (Snedecor and Cochran, 1967). The mean values of the treatments were compared by LSD either at 5 per cent or at 1 per cent level (Least significant difference). The data obtained in percentages were transformed to corresponding angles (arcsine percentage). The mean values of treatments were then separated using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1976).

Results and discussion

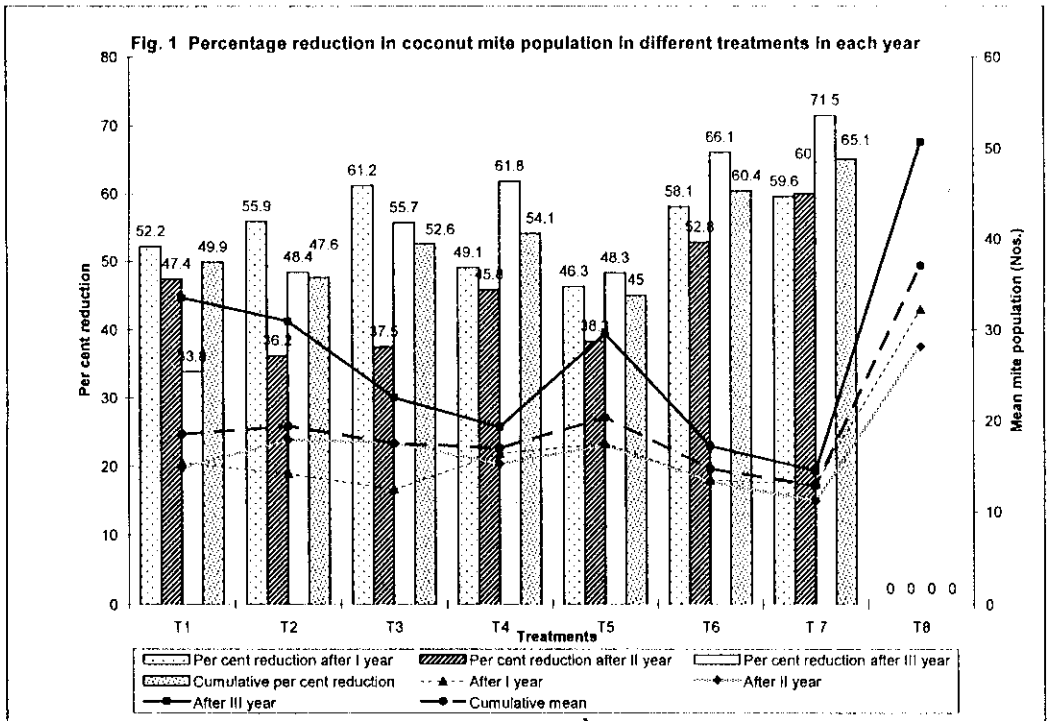
The results revealed that the percent reduction of mite population one year after application of treatment ranged between 46.3 and 61.2 per cent. The lowest mite population was recorded in Integrated Management Package (T 7) (11.2 mites/ 4 mm) followed by T6 (13.3 mites/ 4 mm) after two years as against the

control (28.1 mites/ 4 mm). There was a significant reduction in mite population after three years (65.1%) in the IM treated trees (T 7) followed by T6 trees (60.4%). Application of organic manures *viz.*, vermicompost @ 5 kg/tree + sprayings and FYM @ 50 kg/tree + sprayings recorded a cumulative population reduction of 49.9 and 45.0 per cent, respectively after three years. The population reduction in other treatments varied from 47.6 and 54.1 per cent (Fig. 1).

The data on green nut damage on 4, 5 and 6^h bunches revealed that there was no significant reduction in the damage level up to one year after treatment. However, there was a significant reduction in the per cent damaged green nuts after second year. The percent damaged nuts was the lowest (41.9) in IM treated trees (T7) which was statistically on par with T6 (42.9) as against control (71.8). IM treated trees recorded the lowest green nut damage of 38.6 per cent followed by IM without sunnhemp as basin crop (39.1 %) as against the check (73.3 %) after third year (Table 1).

The mean damage grade recorded at the time of harvest revealed that the IM package treated trees recorded the lowest nut damage grade of 2.8, 2.4 and 2.1 followed by T6 and T4 as against 4.3, 4.3 and 4.4 in the untreated check after first, second and third year, respectively. Further, more numbers of nut was also recorded in grade 1 in these treatments at the end of third year. The number of nuts in grade 5 was also reduced significantly in three years from 18 to 2 in T7 (Table 2).

Hence, it is clearly evidenced from the results that application of increased dose of muriate of potash, increases the plant resistance to mite attack. Moore *et al.* (1991) also reported that application of potash was associated with decrease in mite damage in St. Lucia. The importance of K in pest



T1 – T8 as given in Materials and methods

	I year			II year			III year		
	SED	CD(0.05)	CD(0.01)	SED	CD(0.05)	CD(0.01)	SED	CD(0.05)	CD(0.01)
Treatments	0.0059	0.0118	0.0157	0.0072	0.0145	0.0193	0.0080	0.0162	0.0211
Days	0.0041	0.0083	0.0111	0.0044	0.0088	0.0118	0.0045	0.0092	0.0119
Treatments x Days	0.0118	0.0236	0.0314	0.0124	0.0251	0.0335	0.0131	0.0266	0.0347

Table 1. Per cent green nut damage caused by coconut eriophyid mite

Treatments	Per cent nuts damage in green nuts		
	After first year	After second year	After third year
T1	56.9 ^{ab}	57.5 ^c	62.1 ^{cd}
T2	59.2 ^{ab}	48.6 ^b	54.6 ^{bc}
T3	55.6 ^{ab}	55.0 ^c	52.2 ^b
T4	54.8 ^a	46.6 ^{ab}	47.5 ^b
T5	53.2 ^{ab}	68.2 ^d	63.6 ^d
T6	56.3 ^{ab}	42.9 ^a	39.1 ^a
T7	60.6 ^{ab}	41.9 ^a	38.6 ^a
T8	67.8 ^b	71.8 ^d	73.3 ^c

Means followed by the same letter(s) are not significantly different at 5% level by DMRT
T1 – T8 as given in Materials and methods

Table 2. Per cent nut damage grading at harvest

Treatment	Per cent nuts in each damage category					MGI	Infested nuts %	
		G1	G2	G3	G4			G5
T1	pretreatment	0.0 (0)	0.0 (0)	20.4 (10)	30.6 (15)	49.0 (24)	4.3	100.0
	I year	6.6 (4)	9.8 (6)	47.5 (29)	21.3 (13)	14.8 (9)	3.3	93.4
	II year	6.8 (5)	16.4 (12)	34.2 (25)	27.4 (20)	15.1 (1)	3.3	93.2
	III year	18.7 (14)	13.3 (10)	12.0 (9)	22.7 (17)	33.3 (25)	3.4 ^c	81.3
T2	pretreatment	0.0 (0)	8.5 (5)	15.3 (9)	27.1 (16)	49.2 (29)	4.2	100.0
	I year	12.3 (8)	29.2 (19)	27.7 (18)	15.4 (10)	15.4 (10)	2.9	87.7
	II year	16.5 (13)	26.6 (21)	24.1 (19)	16.5 (13)	16.5 (13)	2.9	83.5
	III year	42.5 (34)	2.5 (2)	5.0 (4)	26.3 (21)	23.8 (19)	2.9 ^b	57.5
T3	pretreatment	0.0 (0)	0.0 (0)	21.7 (15)	39.1 (27)	39.1 (27)	4.2	100.0
	I year	11.1 (9)	27.2 (22)	27.2 (22)	22.2 (18)	12.3 (10)	3.0	88.9
	II year	5.8 (5)	24.4 (21)	41.9 (36)	11.6 (10)	16.3 (14)	3.1	94.2
	III year	12.8 (11)	15.1 (13)	34.9 (30)	18.6 (16)	18.6 (16)	3.1 ^{bc}	86.2
T4	pretreatment	0.0 (0)	0.0 (0)	14.5 (10)	24.6 (17)	60.9 (42)	4.5	100.0
	I year	10.5 (10)	12.6 (12)	33.7 (32)	21.1 (20)	22.1 (21)	3.3	89.5
	II year	15.1 (14)	34.4 (32)	26.9 (25)	9.7 (9)	14.0 (13)	2.7	84.9
	III year	56.0 (61)	2.8 (3)	1.8 (2)	11.9 (13)	27.5 (30)	2.4 ^a	42.1
T5	pretreatment	1.8 (1)	0.0 (0)	14.5 (8)	52.7 (29)	30.9 (17)	4.1	98.2
	I year	0.0 (0)	30.0 (18)	31.7 (19)	20.0 (12)	18.3 (11)	3.3	100.0
	II year	8.1 (5)	19.4 (12)	22.6 (14)	33.9 (21)	16.1 (10)	3.3	91.9
	III year	11.5 (7)	9.8 (6)	13.1 (8)	39.3 (24)	26.2 (16)	3.5 ^c	85.7
T6	pretreatment	0.0 (0)	0.0 (0)	23.1 (15)	38.5 (25)	38.5 (25)	4.2	100
	I year	15.2 (14)	19.6 (18)	33.7 (31)	17.4 (16)	14.1 (13)	3.0	84.8
	II year	17.2 (17)	32.3 (32)	30.3 (30)	11.1 (11)	9.1 (9)	2.6	82.8
	III year	58.0 (69)	3.4 (4)	10.1 (12)	21.8 (26)	6.7 (8)	2.2 ^a	42.0
T7	pretreatment	0.0 (0)	5.0 (2)	7.5 (3)	42.5 (17)	45.0 (18)	4.3	100.0
	I year	17.2 (16)	25.8 (24)	30.1 (28)	16.1 (15)	10.8 (10)	2.8	82.8
	II year	23.9 (26)	32.1 (35)	26.6 (29)	15.6 (17)	1.8 (2)	2.4	76.1
	III year	38.1 (51)	26.1 (35)	21.6 (29)	12.7 (17)	1.5 (2)	2.1 ^a	40.3
T8	pretreatment	3.8 (2)	9.4 (5)	3.8 (2)	15.1 (8)	67.9 (36)	4.3	96.2
	I year	4.3 (2)	6.5 (3)	4.3 (2)	28.3 (13)	56.5 (26)	4.3	95.7
	II year	1.9 (1)	1.9 (1)	3.8 (2)	46.2 (24)	46.2 (24)	4.3	98.1
	III year	5.1 (3)	1.7 (1)	1.7 (1)	42.4 (25)	49.2 (29)	4.4 ^d	94.9

Means followed by the same letter(s) are not significantly different at 5% level by DMRT

Figures in the parentheses are number of harvested nuts in each damage category; T1 - T8 as in Materials and methods

Table 3. Influence of Integrated Management on nut yield

Trt.	Yield (nut/palm/year)				Second year % increase in yield over		Third year % increase in yield over	
	Pre	I year	II year	III year	Pre	ctrl	Pre	ctrl
T1	49	61 ^{bc}	73 ^c	75 ^d	49.0	14.1	53.1	27.1
T2	56	65 ^b	79 ^d	80 ^{cd}	41.1	23.4	42.9	35.6
T3	69	81 ^{ab}	86 ^c	87 ^c	24.6	34.4	26.1	47.5
T4	69	95 ^a	93 ^b	114 ^b	34.8	45.3	65.2	93.2
T5	55	60 ^{bc}	62 ^f	63 ^e	12.7	-3.1	14.5	6.8
T6	65	92 ^a	99 ^b	119 ^b	52.3	54.7	83.1	101.7
T7	62	93 ^a	109 ^a	134 ^a	75.8	70.3	116.1	127.1
T8	53	46 ^a	64 ^f	59 ^e	20.8	-	11.3	-

Means followed by the same letter(s) are not significantly different at 5% level by DMRT

Trt. - Treatment Pre. - Pretreatment Ctrl. - Control

T1 - T8 as given in Materials and methods

Table 4. Effect of Integrated Management Package on Benefit Cost Ratio

Trt.	Cost * (Rs.)	Yield Nuts/12trees/year			Net additional profit (Rs).over				Benefit Cost ratio			
		Pre	II	III	Pre II	Pre III	Ctrl II	Ctrl III	Pre II	Ctrl II	Pre III	Ctrl III
T1	420	588	876	900	1440	1560	540	960	3.4	1.3	3.7	2.3
T2	270	672	948	960	1380	1440	900	1260	5.1	3.3	5.3	4.7
T3	757	838	1032	1044	970	1030	1320	1680	1.3	1.7	1.4	2.2
T4	837	830	1116	1368	1430	2690	1740	3300	1.7	2.1	3.2	3.9
T5	240	664	744	756	400	460	-120	240	1.7	-0.5	1.9	1.0
T6	900	780	1188	1428	2040	3240	2100	3600	2.3	2.3	3.6	4.0
T7	930	482	1308	1608	4130	5630	2700	4500	4.4	2.9	6.1	4.8
T8	-	640	768	708	-	-	-	-	-	-	-	-

*Cost includes cost of nutrients, chemicals and spraying cost.

management has been well documented by Panda and Khush (1995). In addition the spot application of spray fluids also contributed for the drastic reduction of mite damage.

The application of recommended dose of inorganic and organic fertilizers along with basin cultivation of sunnhemp twice a year increased the nut yield and enhanced the retention of more number of buttons/nuts when compared to all other treatments. The IM treated palms recorded 109 and 134 nuts/tree after second and third year, respectively with an increase of 70.3 and 127.1 per cent yield over control (Table 3). The third year yield of T6 and T7 treatments were 83.1 and 116.1% higher than the pretreatment yield. Similar results were also reported by Arthur Jacob *et al.* (2003) under Kerala condition in India. Moore *et al.* (1991) also suggested that though addition of N fertilizer could worsen the mite problem, the increased yield from correct/ balance fertilizer input could be greater than any increased loss due to worsened mite attack. The Benefit cost ratio (BC) was calculated based on pretreatment and control yield (Table 4). Though it was 4.4 and 2.9 for the IM trees after two years, the BC ratio increased to 6.1 and 4.8 after three years over pretreatment and control, respectively.

Coconut palm produces fronds and nuts throughout the year, demanding a continuous supply of nutrients from soil in the form of N, P, K and a mixture of micronutrients besides organic manures. Mariau (1977) reported that well managed coconut gardens receiving balanced nutrients might suffer less due to mite attack. Among the micronutrients boron is quite essential for preventing the shedding of buttons in coconut palm. Based on present results, it is presumed that the regular application of recommended dose of micro and macro nutrients with increased dose of K may definitely enhance the production and retention of more buttons in the palms and spot application of botanical / insecticides minimize the mite damage significantly. This package may be adopted

widely to counter the mite problem and to sustain the yield.

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