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Morphological differentiation and host record of *Phenacoccus* spp. complex in Tamil Nadu

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Abstract

Phenacoccus species viz., *Phenacoccus solenopsis* (*Solenopsis mealybug*), *Phenacoccus solani* (*Solanum mealybug*), *Phenacoccus maderensis* (*Maderia mealybug*) appeared recently and has attained the status of a serious pest on a wide range of host plants. Species differentiation of *Phenacoccus* species showed in table 1. It was recorded from 140 plant species including crops, vegetables, ornamentals, weeds, bushes and trees. Most of these belong to the families Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, and Amaranthaceae economic damage was observed on cotton, brinjal, okra, tomato, sesame, sunflower, flower and medicinal crops.

Keywords: *Phenacoccus* species complex, Host range, Tamil Nadu, India

Introduction

Mealybugs (coccids) belong to the insect order homoptera and the super family coccioidea. They cause direct damage by way of feeding and in addition they also inject toxic saliva, excrete honey dew paving way for the growth of sooty mould fungus giving an ugly look resulting in poor quality of the produce. It also causes yellowing of leaves and malformation of affected portions due to salivary infection. They also cause indirect damage by way of spreading many viral diseases by acting as vector. The presence of red ants causes the nuisance while harvesting fruits/nuts in mango, coconut, citrus, Cotton, Ornamentals, flower and medicinal crops etc. The honey dew also causes the sooty mould due to capnodium growth and it reduces the photosynthesis. However, at times mealy bug infestation may occur within the vegetative shoot apex and may be extremely difficult to detect. This ability of mealybugs to form dense colonies particularly with in the shoot apex often makes chemical control of this pest quite difficult.

Among the various coccids *Phenacoccus* spp. cause a severe damage by reducing the photosynthesis of the plant due to honeydew secretion and sooty mould attack in Cotton, Sun flower Gingelly, Flower and Medicinal crops.

Farmers mainly rely chemical control and the cost of chemical is very high. Some of the chemicals cause phytotoxicity in certain plants (Dhawan, 2007) [2]. There are reports that releases of predators like coccinellids and *Chrysopa* controlled coccids effectively. Hence, under the above circumstances, it is essential to develop an eco-friendly management practices for the above pests. Despite considerable economic importance there is no systematic study on flower and medicinal crops though these are few records in different parts of India (Varshney, 1985; Shafee, 1989; Suresh, 1994) [9, 3, 4].

Materials and Methods

Extensive surveys were made in different flora in cultivated fields, Plant nurseries, range lands and waste lands of Tamil Nadu viz., Coimbatore, Dindigul, Erode, Madurai, Kanyakumari, The Nilgiris, Trichy and Theni (Fig.1). The infested plant specimens alongwith predators and parasitoids were collected from all places and brought to the laboratory for further study. During sampling, whole plants of the species under observation were examined for occurrence and infestation level as described below were followed.

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Parameters Infestation levels

- 1: Incidental i: only a few individuals of the mealy bug found
ii: No breeding of individuals observed
- 2: Low i: All stages of mealybug found in low number
ii: No adverse symptoms observed on the plant
- 3: Medium i: All stage of mealybugs found in large number
ii: Wilting and yellowing of plant leaves appeared
iii: Infested plants normally survived
- 4: High i: All stages of mealybugs found in large number
ii: Almost all plants covered with mealy wax coating
iii: Most of the plants showing stunted growth
iv: Severe cases infested plants become die

Results and Discussion

The *Phenacoccus* mealy bugs was recorded from 80 plant species of 26 families comprising 12 crops and vegetables, 20 medicinal plants, 18 ornamentals, 25 weeds and bushes and 5 fruit trees (Table 1.). Plants from Malvaceae, Solanaceae, Amaranthaceae, Asteraceae, Convolvulaceae, Euphorbiaceae, Verbenaceae and Zygophyllaceae were generally found as preferred host of this mealybug. Among these, *Hibiscus rosa sinensis*, *Hibiscus mutabilis*, *Abutilon indicum* (Malvaceae), *Lantana camara* (Verbenaceae), *Parthenium hysterophorus* (Asteraceae), *Achyranthes aspera* (Amaranthaceae), *Trianthema postrulacastrum* (Aizoaceae), *Acalypha indica*, *Amaranthus viridis* (Amaranthaceae) harboured this pest round the year and act as persistent source of spread of the mealy bug. High infestations on *Solanum melongena*, *Solanum nigrum*, *Solanum trivorum*, *Datura metel*, *Lycopersicum esculentum*, *Withania somnifera* (Solanaceae), *Hibiscus rosa sinensis*, *Hibiscus mutabilis*, *Abelmoschus esculentus*, *Abelmoschus moschata*, *Gossypium hirsutum* (Malvaceae); *Chrysanthemum morifolium*, *Helianthus annuus*, *Tagetes erecta* (Asteraceae); *Croton sparciflorum*, *Euphorbia multifida* (Euphorbiaceae); *Sesamum indicum* (Pedaliaceae) and served as preferred hosts of the mealy bug. Other plants were either preferred or the mealy bug was found incidentally in very low numbers for shorter durations. *Phenacoccus solenopsis* Tinsley was recorded on more than 40 hosts for the first time in India. This pest has been recorded earlier on *Hibiscus rosa sinensis* (Ben-Dov, 1994) [1]. The other species studied was *P. solani* (Ferris) on *H. rosa sinensis* for the first time in Tamil Nadu. Earlier it was recorded on *Chrysanthemum morifolium* (Moghaddam *et al.*, 2004). The increased incidence of the above pests in flower crops may be due to succulent nature of the plant which is more attractive and they are also surrounded by other

alternative hosts (Randhawa and Mukhopadhyay, 1998). *P. madeirensis* (Green) is also recorded for the first time on *Acalypha bicolor*, *Crotons variegatum*, *H. rosa sinensis* and *Tagetes erecta*. This pest can easily recognized by the presence of egg sac. Increased incidence/outbreak may be due to introduction of this pest either from Pakistan or from Sri Lanka and the absence of efficient natural enemies (Ben-Dov, 1994) [1], with the prevailing hot climatic conditions coupled with increase in reproductive capacity and short life cycle resulted in wider dispersal. Improper use of insecticides also resulted in increased incidence of mealybugs in cotton. This view is also in accordance with the findings of Surulivelu (2006) [8]. Accidental introduction of an insect by travelers or transport into a new area (country) absence of its natural enemies allows it to breed in an unrestricted manner.

Among different insecticides, profenophos 50%EC (@ 1250 ml / ha) was reported to be highly effective against the *Phenacoccus* spp. Though the pest has been managed by the insecticides, it can possess a threat to cotton cultivation in the future as cotton plants continue to have very low population of mealybug. Four sprays of insecticides (acephate 75% WSP @ 2000 g / ha; profenophos 50% EC @ 1250 ml / ha; monocrotophos 36% SL + DDVP 50% EC (@ 625 ml + 375 ml / ha are recommended for the management of this pest with good results (Dhawan, 2007) [2]. Saeed *et al.* (2007) [14] reported that recommended application rates of methomyl, profenofos and chlorpyrifos provided the best control of *Phenacoccus gossypiphilous* the lethal time studies proved their efficiency for better and timely control of this sporadic pest. It might be due to the good penetrative reaction of the chemical. However, main reliance on insecticides may result in resurgence, environmental hazards and discontinuation of their use (Sparks *et al.*, 1996; Mascarenhas *et al.*, 1996,1998) [12, 13]. Vast host range of *Phenacoccus* species requires alternate control measures. Information regarding biological control parameters of insects and their host preference for feeding oviposition are very important to develop alternate strategies effective for its control like other important pests (Greenberg *et al.*, 2001, 2002) [10, 11].

Diversity of hosts suggests that the *Phenacoccus* species may attack many more plants with passage of time. Therefore, effective manipulation of weeds and ornamental plants, adopting crop rotation and quarantine measures etc. will be of high significance while devising integrated management strategy for this pest

Table 1: Morphological and Taxonomic differentiation of *Phenacoccus* spp.

Characters	<i>Phenacoccus solenopsis</i> Tinsley	<i>Phenacoccus solani</i> Ferris	<i>Phenacoccus madeirensis</i> (Green)
Shape	Body oval, large some what rounded in lateral view	Body oval slightly rounded in lateral view	Body oval some what flattened dorsoventrally
Colour	Dark green almost black covered by thin white mealy wax 	Light yellow to brown covered by white mealy wax, with dark dorso submedial bare spots on intersegmental areas of thorax and abdomen 	Body gray covered by thin, white mealy wax with dark dorsosubmedial bare spots on intersegmental areas of thorax and abdomen 

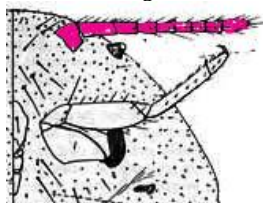
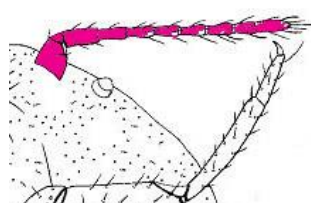
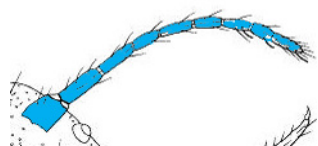
Ovisac	Well developed ventrally 	Absent 	Present covering entire dorsum 
Lateral waxy filaments	18 pairs of lateral wax filaments, posterior pairs longest, about ½ length of the body	18 pairs of lateral wax filaments, posterior pairs longest, about ½ length of the body	18 pairs of lateral wax filaments, posterior pairs longest, about - or less of length of the body
Antennae	9 segmented 	8 segmented 	9 segmented 

Table 1: Host plants of *Pheanacoccus* spp. with infestation levels in Tamil Nadu

Mealybug	Host	Family	English name	Vernacular name	Status	Infestation
<i>Pheanacoccus solenopsis</i> Tinsley	<i>Achyranthes aspera</i> Linn.	Amaranthaceae	Devils horse whip	Naiyuruvi	Weed	****
	<i>Amaranthus viridis</i> Linn.	Amaranthaceae	Pigweed	-	Weed	****
	<i>Acerva lanata</i> Linn.	Amaranthaceae	Mountain Knot Grass	Cirupulai	Weed	****
	<i>Digeria arvensis</i> Forsk	Amaranthaceae	Digeria	-	Weed	*
	<i>Nerium oleander</i> Linn.	Apocynaceae	Nerium	Arali	Ornamental	**
	<i>Chrysanthemum morifolium</i> Ramat	Asteraceae	Chrysanthemum	-	Ornamental	****
	<i>Helinthus annuus</i> Linn.	Asteraceae	Sunflower	Sooriyagandhi	Crop	****
	<i>Parthenium hyserophorus</i> Linn.	Asteraceae	Parthenium	Congress grass	weed	****
	<i>Tagetes erecta</i> Linn.	Asteraceae	Marigold	Thuluka samanthi	Ornamental	****
	<i>Artemesia nilagiria</i> Linn.	Asteraceae	Indian wormwood	Makkippu	Medicinal	*
	<i>Vernonia cineria</i> Linn.	Asteraceae	Little iron weed	Puvamkuruntal	Medicinal	*
	<i>Widelia chinensis</i> Linn.	Asteraceae	Widelia	Kayantakarai	Medicinal	**
	<i>Andrographis paniculata</i> Linn.	Acanthaceae	Kalmegh	Nilavembu	Weed	*
	<i>Rhinocanthus nasutus</i> Linn.	Acanthaceae	Snake jasmine	Nagamalli	Weed	*
	<i>Strilobanthus cilatus</i> Linn.	Acanthaceae	Karvy	Karungurinji	Weed	**
	<i>Rauvolfia serpentina</i> Linn.	Apocynaceae	Indian snake root	-	Weed	*
	<i>Gymnea sylvestris</i> Linn.	Asclepiadaceae	Gurmar	Kogilam	Medicinal	**
	<i>Trianthema postrulcastrum</i> Linn.	Aizoacaeae	Carpet weed	Saranai	Weed	****
	<i>Trianthema triquetra</i> Rott.	Aizoacaeae	Trianthema	-	Weed	***
	<i>Chenopodium album</i> Linn.	Chenopodiaceae	White goose foot	-	weed	**
	<i>Convolvulus arvensis</i> Linn.	Convolvulaceae	Bind weed	-	weed	*
	<i>Cyperus rotundus</i> Linn.	Cyperaceae	Sedge grass	-	weed	*
	<i>Cassia occidentalis</i> Linn.	Caesalpiniaceae	Senna	Payaverai	Medicinal	**
	<i>Cleome viscosa</i> Linn.	Capparaceae	Asian spider flower	Naikkadugu	Medicinal	*
	<i>Acalypha indica</i> Linn.	Euphorbiaceae	Acalypha	Kuppaimeni	Weed	****
	<i>Euphorbia multipida</i> Linn.	Euphorbiaceae	Euphorbia	-	Ornamental	**
	<i>Croton sparciflorum</i> Morong	Euphorbiaceae	Croton	-	Ornamental	**
	<i>Crotons variegatum</i> Linn.	Euphorbiaceae	Croton	-	Ornamental	**
	<i>Euphorbia hirta</i> Linn.	Euphorbiaceae	Snake weed	-	weed	*
	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	Euphorbia	Karisalanganni	Weed	*
	<i>Jatropha curcus</i> Linn.	Euphorbiaceae	Jatropha	Kattamanaku	Ornamental	**
	<i>Phyllanthus niruri</i> Linn.	Euphorbiaceae	Phyllanthus	Keelanelli	Weed	****
	<i>Abrus precatorius</i> L	Fabaceae	-	Kundrimani	Medicinal	****
	<i>Cynodan dactylon</i> Pres.	Gramineae	Bermuda grass	-	Weed	**
	<i>Echinochloa colonum</i> (Linn.)	Gramineae	Deccan grass	Nelmirati	Weed	**
	<i>Eleusine indica</i> (Linn.) Gaertn	Gramineae	Goose grass	-	-	*
	<i>Coleus forskohli</i> Linn.	Lamiaceae	Indian borage	Marunthu koorkan	Medicinal	****
	<i>Coleus aromaticus</i> L.	Lamiaceae	Indian mint	Karpuravalli	Medicinal	****
	<i>Ocimum basilicm</i> L.	Lamiaceae	Sacred basil	Black tulsi	Medicinal	****

	<i>Ocimum sanctum</i> L	Lamiaceae	Holy basil	Tulsi	Medicinal	****
	<i>Leucas aspera</i> Linn.	Lamiaceae	Common Leucas	Thumbai	Medicinal	**
	<i>Mentha longifolia</i> Linn.	Lamiaceae	Horse mint	-	Medicinal	*
	<i>Asparagus racemosus</i> Linn.	Liliaceae	Asparagus	-	Ornamental	**
	<i>Abelmoschus esculentus</i> Linn.	Malvaceae	Okra, Bhindi	Ladies finger	Vegetable	****
	<i>Abutilon indicum</i> Sweet.	Malvaceae	Indian mallow, Country mallow	Tutti	Weed	****
	<i>Gossipium arboreum</i> Linn.	Malvaceae	Desi cotton	Cotton	Crop	****
	<i>Gossipium hirsutum</i> Linn.	Malvaceae	American cotton	Cotton	Crop	****
	<i>Hibiscus mutabilis</i> Linn.	Malvaceae	Cotton rose	-	Ornamental	****
	<i>Hibiscus rosa sinensis</i> Linn.	Malvaceae	China rose	Hibiscus	Ornamental	****
	<i>Sesamum indicum</i> Linn.	Pedaliaceae	Sesame	Gingelly	Crop	****
	<i>Piper betle</i> Linn.	Piperaceae	Betel leaf	Vettilai	Crop	***
	<i>Piper longum</i> L	Piperaceae	Indian long pepper	Tippili	Medicinal	***
	<i>Punica granatum</i> Linn.	Punicaceae	Pomegranate	Mathulai	Fruit tree	*
	<i>Plumbago zeylanica</i> Linn.	Plumbaginaceae	Plumbago	Akkini	Medicinal	**
	<i>Zizyphus mauritiana</i> Lamk.	Rhamnaceae	Ber	Ilanthai	Fruit tree	**
	<i>Rosa indica</i> Linn.	Rosaceae	Rose	Rose	Flower	*
	<i>Citrus aurantium</i> Linn.	Rutaceae	Citrus	-	Fruit tree	**
	<i>Citrus sinensis</i> Osbeck.	Rutaceae	Citrus	Elumitchai	Fruit tree	***
	<i>Capsicum frutescens</i> Linn.	Solanaceae	Red chilly	Mizhgal	Vegetable	**
	<i>Datura metel</i> Linn.	Solanaceae	Thorn apple	Oomathai	Medicinal	****
	<i>Lycopersicon esculentum</i> (Linn.) Mill.	Solanaceae	Tomato	Thakkali	Vegetable	****
	<i>Nicotiana glauca</i> Viv.	Solanaceae	Wild tobacco	-	Weed	**
	<i>Nicotiana glauca</i> Linn.	Solanaceae	Tobacco	-	Weed	**
	<i>Solanum surratense</i> Burm.	Solanaceae	Thorny night shade	Karimulli	Weed	****
	<i>Solanum melongena</i> Linn.	Solanaceae	Brinjal	Katiri	Vegetable	****
	<i>Solanum nigrum</i> Linn.	Solanaceae	Black Night shade	Manatakkali	Medicinal	****
	<i>Solanum trilobatum</i> Linn.	Solanaceae	Indian Night shade	Thoothuvalai	Medicinal	****
	<i>Solanum khasianum</i> L.	Solanaceae	Night shade	Kantankairi	Weed	****
	<i>Solanum tuberosum</i> Linn.	Solanaceae	Potato	Urulai	Vegetable	****
	<i>Withania somnifera</i> Dunal	Solanaceae	Aswagandha	Amukkuram	Medicinal	****
	<i>Corchorus olitorius</i> Linn	Tiliaceae	Jute	-	Crop	**
	<i>Lantana camara</i> Linn.	Verbenaceae	Lantana	-	Ornamental	***
	<i>Clerodendron inermis</i> Gaert.	Verbenaceae	Gardenia	-	Ornamental	***
	<i>Duranta repens</i> Linn.	Verbenaceae	Duranta	-	Ornamental	****
	<i>Verbena officinalis</i> Linn.	Verbenaceae	Verbena	-	Weed	***
	<i>Vitex negundo</i> Linn.	Verbenaceae	Chaste tree	Nochi	Medicinal	**
	<i>Vitex leucoxylon</i> Linn.	Verbenaceae	-	Neer nochi	Medicinal	***
<i>Phenacoccus madeirensis</i> (Green)	<i>Hibiscus rosasinensis</i> Linn.	Malvaceae	Hibiscus	Sembaruthi	Ornamental	****
	<i>Acalypha bicolor</i> Linn.	Euphorbiaceae	Acalypha	-	Ornamental	**
	<i>Tagetes erecta</i> Linn.	Asteraceae	Marigold	Thuluka samanthi	Flower	***
	<i>Croton variegatus</i> Linn.	Euphorbiaceae	Croton	-	Ornamental	**
<i>Phenacoccus solani</i> Ferris	<i>Hibiscus rosasinensis</i> Linn.	Malvaceae	Hibiscus	Sembaruthi	Ornamental	***
	<i>Verbena officinalis</i> Linn.	Verbenaceae	Verbena	-	Weed	**

Infestation: * = Incidental ** = Low *** = Medium **** = High

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