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A study on scale insects (Hemiptera: Coccoidea) found in Tumakuru, India

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ABSTRACT

Scale insects are the serious sap sucking pests of many agricultural and horticultural plants. A study was conducted to record the presence of scale insects in Tumkur University campus, Tumakuru, Karnataka, India. The study includes the visual observation, photography and identification of scale insects and their host plants. In the study area a total of 31 species of scale insects belong to 20 genera of 6 families were found infesting 20 different host plants and associated with 12 species of ants from 6 genera of 3 subfamilies of Formicidae. The family Coccidae was found to be predominant pest with 12 species followed by Pseudococcidae with 10 species and 5 species from Diaspididae. From the study it has also been recorded the species from Monophlebidae (two), Asterolecanidae and Ortheziidae (one species from each). The ecological factors of the study area and lack of much more predators have attributed to the occurrence of wide variety of scale insects. The study provides a base line data for future research work on integrated pest management and its further implication to agricultural crops.

Key words: Scale insects, Sap suckers, Agricultural crops, Formicidae, Tumakuru

INTRODUCTION

Scale insects have been reported as serious pests attacking a large number of host plants around the world (Miller et al. 2002, Miller, 2005, Kondo et al. 2008, Franco et al. 2009). They are polyphagous sap sucking pests of many agricultural and ornamental plants. They suck the sap from various parts of the host plant body which cause direct damage, but they can also cause indirect damage by the secretion of honey dew and by transmitting or promoting the attack of plant pathogens (Ross et al. 2010). But the species which belongs to the family Diaspididae feed on the parenchyma tissue by directly feeding on the contents of parenchyma cells and they donot secrete honeydew (Kondo et al. 2008). Ants are often associated with scale insects as honey dew consumers. It is a kind of mutualistic relationship in which scale insects provide

honeydew, a sugary excreta to numerous ant species as a stable source of energy in turn, they are attended by ants and protected from natural enemies (Way and Khoo, 1992, Gullan, 1997, Schneider et al. 2013).

Hemipteran-tending ants are mostly species of the subfamilies Myrmicinae, Dolichoderinae and Formicinae (Gullan, 1997, Schneider et al. 2013).

The Indian diversity accounts to 409 species from 166 genera, spread over 14 families and 14 subfamilies (Varshney, 2002). About 117 scales of 61 genera belonging to 9 families were recorded from Karnataka (Scalenet, 2017). Much information is available on the pest management of this insect at the world wide level as well as at the subcontinent level (Mani and Shivaraju, 2016). But the sources are scanty to provide enough of information on their taxonomical, cytological, molecular and ecological diversity aspects (Mani, 2016; Ramakrishna et al. 2016; Rebijith et al. 2016). However, no investigations have been undertaken to record the number of scale insects present in Tumakuru district. With this background of information a study on diversity of scale insects, species composition and their host plants was undertaken in Tumkur University campus of Tumakuru district, with the intension of providing a base line data for future research work in the field of scale insects biology.

MATERIALS AND METHODS

Study area

The study was conducted at Tumkur University campus, Tumakuru, Karnataka, India. It is located in the heart of the Tumkur city. The University campus has thick vegetation with diverse flora and fauna in about 90 acres with infrastructure building of about 98,800 sq. ft. Tumkur belongs to the group of districts called the maidan (plains) districts of South Eastern Karnataka, India. It is situated at a distance of 70 km (43 miles) northwest of Bengaluru, a state capital at 13◦ 20'16" N and 77◦ 7'13" E in the plains of Deccan plateau of peninsular India. The temperature throughout the year varies between average 36◦ C - 38◦ C. Annual rain fall between 500mm to 900mm (Tumkur District Gazetteeer-2017). Agriculture is one of the major occupations of the people of Tumkur district. The major crops grown in the district are raagi, paddy, maize, millets, coconut, ground nut, sunflower etc.

Methods

The study was conducted in all the vegetative areas of Tumkur University campus, Tumakuru regularly from January 2018 to June 2018. During this period the coccoid's infested plants particularly woody, ornamental and fruit plants were studied from their ground level to aerial level. The survey includes the visual observation by using hand lens, dissection needles and painting brushes. The infested host parts were photographed by using digital camera Olympus of 12 mega pixels. During the survey, a special care was given to collect the samples of the ants attending the colonies of scale insects in separate carry bags with minute perforations. The collected samples with their host leaves/twigs were brought into the laboratory and were examined, identified up to their genus level and photographed by using Lawrence and Mayo Stereomicroscopes for further studies. The species level identification of collected scale insects and ants were done with the help of experts from National Bureau of Agricultural Insect Resources (NBAIR), Hebbal, Bengaluru, literature survey, Scale Net Database and Ant web, Ant wiki Net sources.

RESULTS AND DISCUSSION

From the present study it has revealed that a total 31 species of scale insects belonging to 20 genera of 6 families of the super family Coccoidea were found infesting 37 different host plants in the study area. A total of 12 species belong to 5 genera were recorded from the family Coccidae, 10 species of 8 genera from Pseudococcidae, 5 species from Diaspididae, 2 from Monophlebidae and one species each from Asterolecanidae and Ortheziidae (Table 1). The most abundant species were *Orthezia insignis* (Ortheziidae), *Ferrisia virgata* (Pseudococcidae), *Icerya aegyptiaca* (Monophlebidae), and *Ceroplastes cirripediformes* (Coccidae).

Of which a total of 18 species of scale insects belonging to 5 families were associated with 12 species of ants belong to 6 genera of 3 sub families of Formicidae. Ants belong to 3 subfamilies namely the Dolichoderinae, Formicinae and Myrmicinae were recorded (Table 2). Among all the 6 families of scale insects noticed,, the family Coccidae was more diversified with 12 species belonging to 5 genera, of which the genus; Ceroplastes was more diversified with 6 species on different host plants. As they feed on 8 different host plants, they were polyphagous in nature, since the availability of food and host plants were more in this

area, their diversity and population was noticed to be high. The less diversified genera were *Coccus* and *Pulvinaria* with 2 species each and they were feeding on less number of host plants when compared to *Ceroplastes* sp. The genera *Parasaissetia* and *Saissetia* were represented by only one species each and infesting to *Hibiscus moscheutos* and *Tabernaemontana divertica* respectively. These two were most frequent pest of coffee and pomegranate plants (Svetlana et al. 2014), since these host plants were absent in the study area, the abundance of the above genera seems to be less with one host plant each. The family Pseudococcidae was represented by 10 species. The Present investigations were in confirmation with the studies of Tanwar et al. (2008) who reported that, mealy bugs were polyphagous, feeding on variety of plants belonging to Malvaceae, Solanaceae and Leguminosae families. Certainly, the observed mealy bug species were feeding on various host plants (Table 1).

Table 1: List of scale insects and their distribution in host plants recorded from Tumkur University campus, Tumakuru.

Sl. No.	Family	Species	Host Plants
1	**Asterolecaniidae**	***1.*** *Bambusapsis bambusae*	*Phyllostachys acuta*
2	**Coccidae**	**2.** *Ceroplastes ceriferus*	*Azadirachta indica*
		3. *Ceroplastes cirripediformis*	*Duranta erecta*
			Psidium guajava
			Manilkara zapota
			Ipomoea purpurea
		4. Ceroplastes destructor	*Syzygium cumini*
		5. Ceroplastes floridensis	*Duranta repens*
		6. Ceroplastes rusci	*Palmeira areca*
		7. Ceroplastes stellifer	*Syzygium cumini*
		8. Coccus hesperidum	*Syzygium cumini*
			Acasia auricularis
			Ixora coccinea
		9. Coccus longulus	*Psidium guajava*
			Acasia auricularis
		10. Parasaissetia nigra	*Hibiscus moscheutos*
		11. Pulvinaria psidi	*Syzygium cumini*
			Ixora coccinea
		12. Pulvinaria vitis	*Phyllostachys acuta*
		13. Saissetia coffeae	*Tabernaemontana divertica*
3	**Diaspididae**	*14. Aspidiotus destructor*	*Syzygium cumini*
			Dypsis lutescens
		15. Aspidiotus nerii	*Dypsis lutescens*
		16. Chrysomphalus aonidium	*Chamaedorea seifrizii*
			Nerium oleander
			Citrus limon
			Euphorbia milii
		17. Diaspis boisduvalii	*Dypsis lutescens*
		18. Pinnaspis aspidistrae	*Polyalthia longigolia*
			Nerium oleander
			Durantha repens
			Mangifera indica
4	**Monophlebidae**	*19. Icerya aegyptiaca*	*Psidium guajava*
			Magnolia champaca
5	**Ortheziidae**	*20. Orthezia insignis*	*Duranta repens*
			Ixora coccinea
			Millingtonia hortensis

Table 1: continued…

Sl. No.	Family	Species	Host Plants
6	**Pseudococcidae**	*21. Antonina graminis*	*Phyllostachys acuta*
		22. Ferrisia virgata	*Casia mountana*
			Adathoda vasika
			Santalum album
			Cassia occidantalis
			Psidium guajava
			Tamarindus indica
			Pongamia pinnata
			Hemelia petens
			Polyalthia longifolia
			Phanera purpurea
		23. Maconellicoccus hirsutus	*Hibiscus rosasinensis*
		24. Paracoccus marginatus	*Carica papaya*
		25. Phenococcus parvus	*Solanum diphyllum*
		26. Phenococcus solenopsis	*Codiaeum variegatum*
			Hibiscus moscheutos
			Pongamia pinnata
		27. Planococcus citri	*Ixora coccinea*
			Codiaeum variegatum
		28. Planococcus lilacinus	*Psidium guajava*
		29. Pseudococcus longispinus	*Hibiscus moscheutos*
			Hibiscus syriacus
		30. Rastrococcus iceryoides	*Ficus bengalensis*

The genera *Phenococcus* and *Planococcus* were diversified with 2 species each and were infesting on different host plants. It was observed that *Phenococcus solenopsis* survived on more than 28 species of plants, including okra, guava and some ornamental plants (Saini et al. 2009). The present study showed that *Phenococcus solenopsis* was survived on 3 host plants namely *Codiaeum, Hibiscus* and *Pongamia. Planococcus citri* was noticed on *Ixora* and *Codiaeum.*

Ferrisia virgata was noticed to be available abundantly in the study area, it was highly polyphagous and cosmopolitan species, which attacks the wide variety of plants. The favourable environmental conditions namely moderate to high temperature and more food source in the study area might have contributed in increasing the abundance of *Ferrisia virgata*, as these factors favours the breeding period of the species.

The next diversified family was Diaspididae due to lack of dispersal adaptations and the fecundity of females in producing eggs might be the reason for the less diversity of the family Diaspididae when compared to Coccidae and Pseudococcidae (Belguendouz and Biche, 2015).

There was a positive and significant correlation between the population of *I. aegyptiaca* and the temperature (Hughes-Schrader, 1930). From the present study the temperature and relative humidity of the study area have significantly affected the populations of *I. aegyptiaca*.

Ortheziidae has more abundance with only one species *Orthezia insignis* which was found to be more abundant in Duranta plants and less abundant in other hosts. The seasonal variations occurred during study period might have favoured the multiplication of the species through asexual mode of reproduction (parthenogenesis).

Nixon (1951) has shown that the survival and reproductive capacity of the coccoids might have enhanced by the association of ants. As the ants scavenges the colonies of coccoids and protect them from their predators and fungal infection increases the infestation of coccoids. During the study, it was found that all the species of ants listed in Table 2 were visiting the young females, adult females and their first and second instars of most of the species of coccoids.

Table 2: List of scale insects associated with ants

Family/ Species name	Host plant	Ant species
Family: Asterolecaniidae		
1. *Bambusaspis bambusae*	*Phyllostachys acuta*	*Camponatus vagus*
		Tapinoma melanocephalum
Family: Coccidae		
1. *Ceroplastes cirripediformis*	*Duranta erecta*	*Tapinoma melanocephalum*
	Psidium guajava	*Camponatus vagus*
2. *Ceroplastes destructor*	*Syzygium cumini*	*Crematogaster pilosa*
3. *Ceroplastes rusci*	*Palmeira areca*	*Crematogaster scutellaris*
4. *Coccus hesperidum*	*Syzygium cumini*	*Crematogaster pilosa*
	Acasia auricularis	*Crematogaster scutellaris*
		Crematogaster pilosa
	Ixora coccinea	*Tapinoma melanocephalum*
5. *Coccus longulus*	*Psidium guajava*	*Crematogaster pilosa*
	Acasia auricularis	*Crematogaster pilosa*
6. *Parasaissetia nigra*	*Hibiscus moscheutos*	*Crematogaster melanogaster*
7. *Pulvinaria psidi*	*Syzygium cumini*	*Crematogaster castanea*
	Ixora coccinea	*Crematogaster transvaalensis*
8. *Pulvinaria vitis*	*Phyllostachys acuta*	*Crematogaster pilosa*
9. *Saissetia coffeae*	*Tabernaemontana divertica*	*Tapinoma melanocephalum*
Family: Monophlebidae		
1. *Icerya aegyptiaca*	*Psidium guajava*	*Crematogaster pilosa-*
	Magnolia champaca	*Lasius niger*
	Acalypha hispida	*Oecophylla smaragdina*
Family: Ortheziidae		
1. *Orthezia insignis*	*Duranta repens*	*Tapinoma melanocephalum* *Camponatus vagus*
	Ixora coccinea	*Tapinoma melanocephalum*
	Millingtonia hortensis	*Camponatus vagus*
Family: Pseudococcidae		
1. *Antonina graminis*	*Phyllostachys acuta*	*Crematogaster castanea*
2. *Ferrisia virgata*	*Casia mountana*	*Crematogaster cerasi*
	Cassia occidantalis	*Crematogaster cerasi*
	Pongamia pinnata	*Crematogaster castanea*
	Phanera purpurea	*Camponatus vagus*
3. *Maconellicoccus hirsutus*	*Hibiscus rosasinensis*	*Solenopsis germinate*
		Camponatus vagus
4. *Phenococcus solenopsis*	*Codiaeum variegatum*	*Crematogaster cerasi*
	Pongamia pinnata	*Crematogaster pilosa*
5. *Planococcus citri*	*Ixora coccinea*	*Oecophylla smaragdina*
	Codiaeum variegatum	*Tapinoma melanocephalum*
6. *Planococcus lilacinus*	*Psidium guajava*	*Crematogaster erecta*

The present study was more focused about the number of scale insect species present in the study area and their association with ants. The study on their biology, mutual beneficial with ants and harmful aspects on hosts are yet to be of our interest in order to use them effectively in integrated pest management.

CONCLUSION:

The study area has shown wide diversity of scale insect species and their association with different species of ants. The present study implies to adapt the techniques to control the spreading of scale insects in the study area. A comprehensive study on the biology

of scale insects is needed to adapt integral pest management in preventing the infestation of coccoids.

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Conflict of interest:

The Authors declare no conflict of interest.

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