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Association of Ants and Honeydew Producing Sucking Pests in Bangalore Provenance of Sandal (*Santalum album* Linn.)

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ABSTRACT : Mutualism between individuals of two species is increasingly recognized as a common and important ecological interaction. Interactions between ants and honeydew-producing hemipteran insects are abundant and widespread in arthropod food webs, though their ecological consequences are not well understood. Ant-hemipteran interactions have potentially broad ecological effects, because the presence of honeydew-producing hemipterans dramatically alters the abundance and predatory behaviour of ants on plants. In this paper we present an account of the ants and Hemiptera that were observed in association in Bangalore provenance of sandal. Different ants were found associated with five species of coccids viz., *Cardiococcus bivalvata* Green (*Coccidae*), *Ceroplastes actiniformis* Green (*Coccidae*), *Nipaecoccus viridis* (Newstead) (Pseudococcidae**), *Parasaissetia nigra* (Nietner) (**Coccidae**) and *Saissetia coffeae* Targioni-Tozzetti (Coccidae) and three species of membracids viz., *Leptocentrus longispinus* Dist., *Otinotus oneratus* Walk. and *Oxyrachis tarandus* Fabr. Ants were known for protecting hemipterans from predators and parasitoids, their association may accelerate the growth and impact of honeydew-producing hemipterans on sandal plants and these findings were discussed in this paper.**

Keywords : Association, ants, coccids, membracids, sandal, Bangalore.

INTRODUCTION

Beneficial interaction between individuals of two species, commonly referred as mutualism, is recognized as a common and important ecological interaction (Stachowicz, 2001). Food-for-protection mutualism between ants (Hymenoptera: Formicidae) and honeydew-producing insects in the hemipteran is one of the most familiar examples. These ant-hemipteran mutualisms are very common interactions in terrestrial communities from temperate to tropical latitudes (Buckley, 1987; Delabie, 2001). Honeydew is a sugary excretion of carbohydrates, amino acids and water derived from plant phloem upon which many hemipterans feed (Way, 1963). Ants are attracted to honeydew as a predictable, renewable food resource and, consequently, 'tend' honeydew-producing hemipterans, protecting them from predators and parasitoids (Way, 1963; Bucklery, 1987). Ants tend honeydew-producing hemipterans on an extremely wide range of plants (Way *et al.*, 1999; Moya-Raygoza and Nault, 2000; Renault *et al.*, 2005). Bluthgen *et al.* (2000) recorded ant-hemipteran associations on 20 out of 24 tree genera and on 41 out of 66 individual trees surveyed in Amazonian rainforest canopy. The interactions between ants and honeydew-producing hemipterans are also very common in managed (*e.g.* agricultural) habitats in addition to being widespread in natural habitats from grasslands to forests (Bucklery, 1987; Way and Khoo, 1992). In this paper we are reporting the association of ants and honeydew producing sucking pests in Bangalore provenance of sandal (*Santalum album* Linn.)

MATERIAL AND METHODS

The study of association ants with the honeydew secreting hemipteran insects was conducted from April 2004 to March, 2006 in Bangalore provenances of sandal which is maintained naturally without any spraying/irrigation in the campus of Institute of Wood Science and Technology, Bangalore in an area of one hectare. It is located in 12°58'N 77°38'E with 1000 m altitude. Soil type is red loam and acidic (pH 6.3 to 6.5). The annual mean maximum and minimum temperatures are 36.8°C and 12.2°C respectively with annual precipitation of 850 mm. For assessing the association, five blocks of 17 × 17 m in the size was marked. Ten sandal trees of 3 to 4 years old were selected at random in each block and on each plant the association if any was noted. The associated hemipteran insects and ants were collected and identified with the help of taxonomic experts.

RESULTS AND DISCUSSION

Different ants were found associated with five species of coccids viz., *Cardiococcus bivalvata* Green, *Ceroplastes actiniformis* Green, *Nipaecoccus viridis* (Newstead), *Parasaissetia nigra* (Nietner) and *Saissetia coffeae* Targioni-Tozzetti and three species of membracids viz., *Leptocentrus longispinus* Dist., *Otinotus oneratus* Walk. and *Oxyrachis tarandus* Fabr. (Table 1).

Table 1: Association of ants and honeydew producing sucking pests in Bangalore sandal provenance.

S. No.	*Sucking pest*	*Associated ant*	*Extent of association*
	Coccids		
1.	*Cardiococcus bivalvata* Green (Coccidae)	*Camponotus compressus*, Fabr.	Moderate
		Crematogaster sp.	More
		Meranoplus sp.	Moderate
		Myrmicaria brunnea Saunders	Moderate
2.	*Ceroplastes actiniformis* Green (Coccidae)	*Crematogaster* sp.	More
		Camponotus parius Emery	Less
3.	*Nipaecoccus viridis* (Newstead) (Pseudococcidae)	*Camponotus compressus* Fabr.	Moderate
		Crematogaster sp.	More
		Meranoplus sp.	Less
		Myrmicaria brunnea Saunders	Less
		Oecophylla smaragdina Fabr.	Less
		Technomyrmex albipes Smith	Less
		Tetraponera rufonigra Jerdon	Less
4.	*Parasaissetia nigra* (Nietner) (Coccidae)	*Camponotus* sp.	Less
		Crematogaster sp.	Less
		Oecophylla smaragdina Fabr.	More
5.	*Saissetia coffeae* Targioni-Tozzetti (Coccidae)	*Crematogaster* sp.	More
		Meranoplus sp.	Less
		Myrmicaria brunnea Saunders	Moderate
	Membracids		
6.	*Leptocentrus longispinus* Dist.	*Camponotus compressus* Fabr.	Moderate
		Myrmicaria brunnea Saunders	Moderate
7.	*Otinotus oneratus* Walk.	*Camponotus parius* Emery	Moderate
8.	*Oxyrachis tarandus* Fabr.	*Camponotus compressus* Fabr.	Low
		Oecophylla smaragdina Fabr.	More

Among the coccids *N. viridis* was found associated with maximum number of ant species (7 species) followed by *C. bivalvata* with four ant species, *P. nigra* and *S. coffeae* each with three ant species and *C. actiniformis* with 2 ant species. Among the membracids *L. longispinus* and *O. tarandus* each were associated with two species of ants and *O. oneratus* with a species of ant. Among the ant genera the genus Camponotus was found associated with maximum number of hemipteran insects. Ants were known for protecting hemipterans from predators and parasitoids, their association may accelerate the growth and impact of honeydew-producing hemipterans on sandal plants as reported by earlier workers (Holldobler and Wilson, 1990; Kaplan and Eubanks, 2002; Renault *et al.*, 2005). The ant-hemipteran interactions will have broad ecological effects, because the presence of honeydew-producing hemipterans dramatically alters the abundance and predatory behaviour of ants on plants. Hence studies focusing on the ecological factors that influence the consequences of ant-hemipteran interactions will provide greater insight into the role of positive species interactions in food web dynamics and greater predictability of the direct and indirect effects of herbivores and natural enemies on sandal plants. Such predictability could substantially benefit any attempt of biological control of sandal insect pests.

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