Distribution of predatory arthropod communities in selected sandal provenances of south India

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ABSTRACT

Detailed study was undertaken to explore the diversity of predatory arthropods in six-sandal provenances viz., Bangalore, Thangali and Mandagadde in Karnataka, Javadis and Chitteri in Tamil Nadu and Marayoor in Kerala. The study revealed the presence of 74 species of predatory insects and 24 species of spiders and their distribution in different sandal provenances were discussed in this paper.

Key words: sandal, predators, arthropods, spiders

INTRODUCTION

Santalum album Linn., commonly known as sandalwood occupies a pre-eminent place among the forest crops which are of great economic value. Its heartwood oil, commercially known as "East Indian Sandalwood oil" is well known scented oil in the world. It alone has significantly contributed to revenue around Rs.160 million by exporting around 27 tons/year (Ananthapadmanabha, 2000). Current sandalwood and oil prices are indicated at Rs.12 lakhs/tons and Rs.22000/Kilogram respectively (Ananthapadmanabha 2002). The sandalwood prices have increased from Rs.365/ ton in 1990 to Rs.6.5 lakhs/ton in 1999-2000. The current price of Indian Sandalwood is over Rs.3500 per kilogram and that of oil is about Rs. 70,000 per kilogram, whereas the price at the international market is about 15 to 20% higher than the domestic market. Increase in price is due to large gap between demand and supply.

Of the various limiting factors, the insect pests are amongst the most important in successful establishment of sandal. During the past decade, there has been increased interest in the employment of natural enemies for the regulation of forest insect pests. Furthermore, for biocontrol of insects, there has been "a shift in emphasis from the introduction of exotic parasites and predators to the recognition of the importance of naturally occurring biological control agents and this approach is gradually becoming one of the major topics in applied entomology" (Brader, 1980). The knowledge gained from study of natural enemies may be of immense practical value in insect pest management (Kidd and Jervis, 1996). The review of insects associated with sandal by Sundararaj *et al*. (2006) includes 155 species of probable predators representing 13 families under 5 orders. Sundararaj *et al*. (2007) in their review listed 61 species of parasitoids representing 14 families under 2 orders on insects infesting sandal. In the present study extensive surveys were undertaken to document the distribution of predatory arthropods in selected provenances of sandal and the findings are presented in this communication.

MATERIAL AND METHODS

The detailed study on the distribution of predatory arthropods in sandal dominant ecostystems was conducted for two years from 2004 to 2006. For these purpose six provenances of sandal from south India viz., Bangalore, Thangali and Mandagadde in Karnataka, Marayoor in Kerala, and Javaddis and Chitteri in Tamil Nadu were selected. The details of the study sites were furnished in the Table-1. The survey was conducted two times in a year representing summer and winter season. Blocks of the size 50 x 50 ft in five replications were marked in all the selected sandal provenances for sampling. From each block five trees were selected at random and observed for the predatory insects active on the selected areas. The spiders were sampled by hand picking, sweep net and pit-fall traps and the collected specimens were preserved in 70 per cent alcohol. The representative insect and spider specimens and were identified with the help of taxonomic experts.

RESULTS AND DISCUSSION

The survey indicated the presence of 74 species of predatory insects in all the selected provenances of sandal (Table-2). It includes 22 species each of Odonata under 5 families and Coleoptera under 4 families, 15 species of Mantodea under 2 families, 7 species of Hemiptera under 3 families, 5 species of Neuroptera under 4 families and one species each of Diptera, Hymenoptera and Lepidoptera. Among the families of Coleoptera, the family Coccinellidae was dominant with 17 species. The dominance of Coccinellidae confirms the earlier report of Mani and Krishnamoorthy (1993). On the basis of number of identified species of Odonata, Libellulidae was the most

Table 1. Details of sandal provenances selected for the study

Potential provenanace	Forest Division & State	Latitude & longitude	Altitude (m)	Mean annual (mm)	Temp– Max / Min (^{0}C)	Soil Type	pH	TSS EC Mohs / Cm
Bangalore	Bangalore Karnataka	12^{0}58'N 77^{0}38'E	1000	850	36.8/12.2	Red loam	6.3-6.5 Acidic	251.1μ mohs
Thangali	Chickmagalur	13^{0}40'N 7 Karnataka	766 6^{0}00'E	1500	44.0/10.5	Red loam & alluvium	7.5-7.8 Alkaline	2.3μ mohs
Mandagadde	Shimoga, Karnataka	13^{0}9'N 75^{0}40'E	650	2000	38.1/13.0	Red loam & alluvium	5.5-5.8 Acidic	317.0μ mohs
Chitteri	Harur, Tamil Nadu	12^{0}0'N 78^{0}6'E	1050	1000	35.2 /8.2	Red sandy loam	6.0 – 6.3 Acidic	327.3μ mohs
Javadis (Kavalur)	Tirupattur, Tamil Nadu	12^{0}3'N 78^{0}7'E	930	1200	38.0/12.4	Red loam	6.6-6.7 Acidic	432.5μ mohs
Marayoor	Munnar, Kerala	10^{0}1'N 77^{0}1'E	1000	1450	36.0 / 10.0	Black clay	6.2-6.7 Acidic	362.0μ mohs

dominant family with 15 species, followed by Coenagrionidae by 4 species and Aeshnidae, Euphaeidae and Gomphidae each by 1 species. Many earlier workers reported the dominance of family Libellulidae in the Indian sub continent (Prasad, 2002; Kumar, 2002; Vashishth *et al*. 2002; Kandibane *et al*. 2005; Emiliyamma, 2005 and Emiliyamma *et al*., 2005). Under the order Mantodea 15 species belonging to 4 families were recorded with dominance of 11 species of the family Mantidae. The dominance of Mantidae is in conformity with the results of Thulsi Rao *et al*. (2005), who reported 12 species out of 26 species from Andhra Pradesh under this family. The order Hemiptera is represented by 7 species under four families with Reduvidae as dominant family with 4 species while the order Neuroptera is represented by 5 species under four families with dominance of the family Chrysopidae with 3 species. One predatory insect each represented Diptera, Lepidoptera and Hymenoptera. Among the provenances Bangalore recorded maximum number of predatory insects being 67 followed by 52 in Marayoor, 45 in Chitteri, 43 in Thangali, 38 in Mandagadde and 34 in Javaddis.

A total of 24 species of spiders belonging to 11 families viz., Araneidae, Clubionidae, Eresidae, Miturgidae, Philodromidae, Pholcidae, Oxyopidae, Salticidae, Scytodiidae, Theridiidae, and Thomisidae were recorded in different provenances of sandal (Table-3). Among them the family Salticidae was dominant with 7 species followed by Thomisidae by 5 species, Araneidae, Philodromidae and Oxyopidae each by 2 species and Clubionidae, Eresidae, Miturgidae, Pholcidae, Scytodiidae and Theridiidae by one species each. Among the sandal provenances, Bangalore recorded the maximum of 14 species of spiders followed by Thangali, which recorded 9 species. The other provenances viz, Chitteri and Javadis (8 species), Mandagadde (7 species) and Marayoor (5 species) recorded lower number of species. These differences could be attributed by several factors such as human interference, climate of the study area, deforestation, habitat destruction, fragmentation etc., (Padhye *et al*., 2006). Spiders are key components of all ecosystems as they are non-specific predators. Simmonds *et al*. (1994) studied the response of spiders to ecological disturbances and they reported maximum dominance of spiders in semi-evergreen forests. Spider species are well adapted to survive in forest ecosystem and their number increased due to presence of sufficient prey, non existent of competitors, lesser predators and non interference by humans (Sugumaran *et al*., 2005). Their potential for suppressing the pest abundance in natural ecosystem has been reported by many earlier workers (Ito *et al*., 1962; Barrion, 1980). The review of insects associated with sandal by (Sundararaj *et al*. 2006) includes 155 species of probable predators representing 13 families under 5 orders. The present study proved that the sandal provenances were rich with predatory arthropods and the non-outbreak of insect pests in natural sandal-dominated ecosystem might be due to the presence of these predators that they play a very valuable role by devouring harmful insect pests and of keeping the insect pest populations under control.

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Table 2. Predatory insects collected from different provenances of sandal

S. No.	Species name	Sandal provenances					
		1	2	3	4	5	6
	ORDER: COLEOPTERA						
(1). Family:	**Carabidae**						
1	*Abacetus* sp.	+	+	+	+	+	+
2	*Anthia sexguttata* Fabr.	+	+	+	+	+	+
(2). Family:	**Cicindelidae**						
3	*Cicindela collicia* Acciavatti & Pearson	+	+	+	+	+	+
(3). Family:	**Coccinellidae**						
4	*Anegleis cardoni* (Ws.)	+	+	+	+	+	+
5	*A. perrotti* (Mulsant)	+	+	+	+	+	+
6	*Brumus suturalis* Fabricius	+	-	+	-	-	+
7	*Cheilomenes sexmaculata* (Fabr.)	+	+	+	+	+	+
8	*Chilocorus nigrita* (Fabr.)	+	+	+	+	+	+
9	*Coccinella septumpunctata* Linn.	+	+	+	+	+	+
10	*Cryptolaemus montruizeri* Mls.	+	+	+	+	+	+
11	*Cybocephalus indicus* Tian & Ramani	+	+	+	+	+	+
12	*Harmonia octomaculata* (Fabr.)	+	-	-	-	-	-
13	*Illeis cincta* (Fabr.)	+	-	-	+	-	-
14	*Jauravia albidula* Motschulsky	-	+	-	+	-	+
15	*Nephus regularis* Sic.	+	-	-	-	-	-
16	*Pharoscymnus flexibilis* (Muls.)	-	+	-	+	-	-
17	*Pseudaspidemerus circumflexa* Motsch	+	-	-	-	-	-
18	*Pullus coccidivora* Ayyar	+	+	-	-	-	+
19	*Pullus gratiosus* Wse.	+	-	-	+	-	+
20	*Scymnus* sp.	+	+	+	+	+	+
(4). Family:	**Nitidulidae**						
21	*Cybocephalus indicus* Tian & Ramani *humeralis* (Fab.)	+	-	-	-	-	-
22	*Haptoncus? humeralis* (Fab.)	+	-	-	-	-	-
	ORDER: DIPTERA						
(1). Family:	**Syrphidae**						
23	*Ishindon scutellaris* (Fab.)	+	+	+	+	+	+
	ORDER: HEMIPTERA						
(1). Family:	**Lygaeidae**						
24	*Geocoris tricolor* Fab.	+	-	+	-	-	-
(2). Family:	**Pentatomidae**						
25	*Canthecona furcellata* (Wolff.)	+	+	+	+	+	+
26	*Erthesina fullo* Thunb.	+	-	+	+	+	-
(3). Family:	**Reduviidae**						
27	*Acanthaspis quinquespinosa* Fab.	+	+	+	+	+	+
28	*Brassivola hystrix* Dist.	+	+	+	+	+	+
29	*Epidaus sp.*	+	+	+	+	+	+
30	*Isyndus herso* (Fabr.)	+	+	+	+	+	+
	ORDER: HYMENOPTERA						
(1). Family:	**Formicidae**						
31	*Oecophylla smaragdina* Fabr.	+	+	+	+	+	+

	ORDER: LEPIDOPTERA						
(1). Family: Lycaenidae							
32	*Spalgis epius* (Westw.)	+	+	+	+	+	+
	ORDER: MANTODEA						
(1). Family: Amorphoscelidae							
33	*Amorphoscelis* sp.	+	-	-	-	-	+
(2). Family: Empusidae							
34	*Gongylus gongyloides* Linn.	+	+	-	-	-	-
(3). Family: Hymenopodidae							
35	*Creobroter* sp.	+	-	-	-	-	-
36	*Ephestiasula* near *intermedia* Werner.	+	+	-	-	-	-
(4). Family: Mantidae							
37	*Amantis sp.*	+	-	-	-	-	+
38	*Amantis biroi* Giglio-Tos	+	+	-	+	-	-
39	*Dysaules sp.*	+	-	-	-	-	-
40	*Dysaules longicollis* Stal	+	+	-	-	-	-
41	*Elmantis sp.*	+	-	+	-	+	-
42	*Euantissa pulchra* (Fabr.)	+	-	-	-	-	-
43	*Hierodula sp.*	+	-	-	+	-	+
44	*Humbertiella sp.*	-	+	-	-	-	+
45	*Humbertiella indica* Saus.	+	-	-	-	-	-
46	*Mantis religiosa* Linn.	+	+	+	+	+	+
47	*Parathespis humbertiana* Sassure	+	-	+	+	+	+
	ORDER: NEUROPTERA						
(1). Family: Chrysopidae							
48	*Chrysopa sp.*	+	+	-	+	+	+
49	*Chrysoperla cornea*	+	+	+	+	+	+
50	*Mallada boninensis* (Okamato)	+	+	+	+	+	+
(2). Family: Hemerobiidae							
51	*Micromus australis* Hagen	+	-	-	-	-	+
(3). Family: Mantispidae							
52	*Mantispa indica* Westw.	+	+	-	-	-	-
	ORDER: ODONATA						
(1). Family: Coenagrionidae							
53	*Ceriagrion cerinorubellum* (Brauer)	+	-	-	+	-	+
54	*Ceriagrion coromandelianum*(Fabricius)	+	+	+	+	+	+
55	*Pseudagrion r. rubriceps* Selys	+	+	+	+	+	+
56	*Ischnura a. aurora* (Brauer)	+	+	+	+	+	+
(2). Family: Euphaeidae							
57	*Anisopleura comes* Hagen	-	-	+	+	-	-
(3). Family: Gomphidae							
58	*Ictinogomphus rapax* (Rambur)	+	-	-	+	-	+
(4). Family: Aeshnidae							
59	*Anax immaculifrons* Rambur	+	-	-	-	-	-
(5). Family: Libellulidae							
60	*Orthetrum pruinosum neglectum* (Rambur)	+	+	+	+	+	+
61	*O. s. sabina* (Drury)	+	+	-	-	-	+
62	*O. t . triangulare* (Selys)	-	-	+	+	-	+

63	*Acisoma p. panorpoides* Rambur	+	+	-	+	-	+
64	*Brachythemis contaminata*(Fabricius)	+	-	+	-	-	+
65	*Crocothemis s. servilia* (Drury)	+	+	+	+	-	+
66	*Diplacodes trivalis* (Rambur)	+	+	-	+	+	+
67	*Neurothemis t. tullia* (Drury)	-	-	+	+	-	+
68	*Trithemis aurora* (Burmeister)	+	-	-	+	+	+
69	*T. festiva* (Rambur)	+	-	-	+	-	+
70	*T. pallidinervis* (Kirby)	-	+	-	-	-	+
71	*Palpopleura s. sexmaculata* (Fabricius)	+	+	-	-	-	+
72	*Tramea virginia* (Rambur)	+	-	-	+	-	+
73	*Pantala flavescens* (Fabricius)	+	+	+	+	+	+
74	*Tholymis tillarga* (Fabricius)	+	+	+	-	+	+
	Total	67	43	38	45	34	52

Table 3. Predatory spiders collected from different provenances of sandal

Sl.No	Species name	Family	Sandal provenance					
			1	2	3	4	5	6
1	Araneus nympha *(Simon)*	Araneidae	+	+	+	+	+	+
2	*Asemonea* sp.	Salticidae	-	-	-	-	-	+
3	*Carrhottus vidhuus* C.L. Koch	Salticidae	-	-	-	+	-	
4	*Cheiracanthium melanostomum* (Thorell)	Miturgidae	+	-	+	-	-	-
5	*Clubiona drassodes* O.P.-Cambridge	Clubionidae	-	-	-	-	+	-
6	*Crossopriza lyoni* (Blackwall)	Pholcidae	-	+	+	-	-	-
7	*Hyllus semicupreus* (Simon)	Salticidae	+	+	-	-	-	-
8	*Myrmarachne* sp.	Salticidae	+	-	-	+	-	-
9	*Neoscona vigitans* (Blackwall)	Araneidae	+	-	-	-	-	+
10	*Oxyopes* sp.	Oxyopidae	+	+	+	+	+	+
11	*Oxyopes birmanicus* Thorell	Oxyopidae	+	+	+	+	+	+
12	*Plexippus* sp.	Salticidae	-	+	-	-	-	-
13	*Rhene* sp.	Salticidae	+	-	-	+	-	-
14	*Runcinia* sp.	Thomisidae	+	-	—	-	-	-
15	*Runcinia affinis Simon*	Thomisidae	+	-	+	+	-	-
16	*Scytodes thoracica* (Latreille)	Scytodiidae	-	+	-	-	+	-
17	*Stegodyphus sarasinorum* Karsch	Eresidae	-	-	-	+	-	-
18	*Strigoplus netravati* Tikader	Thomisidae	+	-	-	-	-	-
19	*Telamonia dimidiata* (Simon)	Salticidae	-	+	+		+	-
20	*Thanatus* sp.	Philodromidae	-	+	-	-	+	-
21	*Theridion* sp .	Theridiidae	+	-	-	-	-	-
22	*Thomisus* sp.	Thomisidae	+	-	-	-	-	-
23	*Thomisus pugilis* Stoliczka	Thomisidae	-	-	-	-	+	-
24	*Tibellus* sp.	Philodromidae	+	-	-	-	-	-
	Total		14	9	7	8	8	5

1. Bangalore, 2. Thangali, 3. Mandagadde, 4. Chitteri, 5. Javadis, 6. Marayoor

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