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Status of whiteflies (Hemiptera: Aleyrodidae) infesting *Ficus religiosa* Linn. in India and their coexistence

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ABSTRACT

Ficus religiosa Linn. Commonly known as Peepal tree is found wild or cultivated nearly throughout India especially in vicinity of temples and is held sacred by Hindus and Buddhists. It is also planted as an avenue or road side tree and its various parts are used in traditional system of medicine. On this tree so far 12 species of whiteflies viz., *Aleurodicus dispersus* Russell, *Aleuroclava complex* Singh, *A. grewiae* Sundararaj and David, *A. louiseae* Sundararaj and David, *Aleuroplatus alcocki* (Peal), *A. quaintancei* (Peal), *A. spina* (Singh), *Bemisia religiosa* (Peal), *Dialeurolonga maculata* (Singh), *Dialeuropora decempuncta* (Quaintance & Baker), *Pealius spinosus* Jesudasan & David and *Singhiella simplex* (Singh) are known to breed in India. In our survey on whiteflies *A. dispersus*, *A. complex*, *A. alcocki*, *D. decempuncta*, and *S. simplex* were commonly found breed on *F. religiosa* in south India. Among them the infestation of *A. complex*, *A. alcocki* and *S. simplex* was severe resulting in drying and premature falling of leaves in younger plants. Further in the infestation of whiteflies coexistence of *A. complex* with *S. simplex* was commonly observed. In this context of infestation of whiteflies reaching the status of pest, the probable role of global warming is discussed.

Key words: Indian Aleyrodidae, *Ficus religiosa, Aleurodicus dispersus*

INTRODUCTION

Ficus religiosa Linn (Moraceae) commonly known as 'Peepal tree' is a large, widely branched tree with leathery, heart-shaped, long tipped leaves on long slender petioles and purple fruits growing in pairs. The tree is regarded as a sacred tree to both Hindus as well as Buddhists. It has got mythological, religious and medicinal importance in Indian culture since ancient times (GHANI, 1998; SINGH and GOEL, 2009; PRASAD *et al*., 2006). The tree grows throughout India and widely cultivated in south-east Asia especially in vicinity of temples (MAKHIJA *et al*., 2010). The tree is known to be infested by 93 species of insect pests in India (MATHUR and SINGH, 1959). On this tree so far 12 species of whiteflies *viz*., *Aleurodicus dispersus* Russell, *Aleuroclava complex* Singh, *A. grewiae* Sundararaj and David, *A. louiseae* Sundararaj and David, *Aleuroplatus alcocki* (Peal), *A. Quaintancei* (Peal), *A. spina* (Singh), *Bemisia religiosa* (Peal), *Dialeurolonga maculata* (Singh), *Dialeuropora decempuncta* (Quaintance & Baker), *Pealius spinosus* Jesudasan & David and *Singhiella simplex* (Singh) are known to breed in India. In this paper the whiteflies breeding on *F. religiosa* and their status in south India is communicated.

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Materials and Methods

The present study was largely based on the whitefly puparia collected from *F. religiosa* in various localities of south India covering the states of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu during the period of 2013-15. The whitefly infested leaves were collected from the host plants and permanent mounts of the puparia were prepared by adopting the method suggested by DAVID and SUBRAMANIAM (1976). The best mounts were obtained from puparia from which adults have emerged. Observations were made by using Nikon Optiphot T-2 EFD microscope and the identity of the whiteflies was confirmed. The studied specimens are in the collection of Institute of Wood science and Technology, Bengaluru, India (IWST). Also the whiteflies so far reported on *F. religiosa* is reviewed.

Figure-1. Leaf infested with whitefly

Figure-2. Immature whitefly

Source: Mannion et al

RESULTS & DISCUSSION

The review indicated that In India so far 12 species of whiteflies are known to breed on *F. religiosa*. The details are as follows:

1. *Aleurodicus dispersus* (Russell)

Aleurodicus dispersus Russell, 1965. *The Florida Entomologist,* **48**: 49 - 54.

Material examined: India: Karnataka: Bengaluru (Bangalore), 11 puparia, on *Ficus religiosa,* 18.i.14, D.Vimala (IWST).

Hosts: Four hundred and eighty one host plants in the world and 253 host plants from India (SRINIVASA, 2000); *Actinodaphne angustifolia, Ampelocissus latifolia, Bauhinia purpurea, Cinnamomum malabathrum, Dalbergia latifolia, Eucalyptus teriticornis, Ficus asperrima, Flemingia macrophylla, Lobelia excelsa, Polyalthia longifolia* (DUBEY and SUNDARARAJ**,** 2004a).

Distribution: Widely distributed in India (SRINIVASA, 2000); Lakshadeep Islands (RAMANI, 2000).

2. *Aleuroclava complex* (Singh)

Aleuroclava complex Singh, 1931. *Mem. Dep. Agric. India (Ent. Ser.)*, **12** (1): 91; Jesudasan & David, 1991. *Oriental Insects*., **25**: 257; Sundararaj & David, 1993a. *Oriental Insects*, **27**: 238.

Material examined: India: Karnataka: Malleswaram, 11 puparia, on *Ficus religiosa*, 21.x.15, R. Sundararaj (IWST).

Hosts: *Ficus religiosa* (SINGH, 1931); *Aegle marmelos, Madhuca latifolia* (RAO, 1958); *Streblus asper* (DAVID, 1994); *Strychnos nux-vomica, Smilax zeylanica, Clerodendrum viscosum, Hydnocarpus pentandra, Aporosa lindleyana, Vitex altissima, Flacourtia montana, Alpinia* sp., *Nothapodytes nimmoniana, Polyalthia cerasoides, Zizyphus rugosa, Cordia obliqua* (DUBEY and SUNDARARAJ, 2005b).

Distribution: India: Bihar (SINGH, 1931); Andhra Pradesh (RAO, 1958); Tamil Nadu (SUNDARARAJ and DAVID, 1993a); Goa, Karnataka (DUBEY and SUNDARARAJ, 2005b).

3. *Aleuroclava grewiae* (Sundararaj & David)

Aleuroclava grewiae Sundararaj & David, 1993a. *Oriental Insects*, **27**: 240.

Material examined: India: Palode, 5 puparia, on *Streblus asper*, 23.v.07, R. Pushpa (IWST).

Hosts: *Grewia orientalis* (SUNDARARAJ and DAVID, 1993a); *Pothos scandens*, *Flacourtia indica*, *Calycopteris floribunda*, *Macaranga peltata*, *Melastoma malabathricum, Smilax zeylanica, Glycosmis pentaphylla, Solanum sisymbrifolium, Strychnos wallichiana, Litsea* sp., *Olea dioica, Rauvolfia densiflora*, *Strychnos dalzellii*, *Zizyphus xylophyrus, Terminalia bellirica*, *Zizyphus rugosa*, *Lagerstroemia macrocarpa*, *Catunaregam spinosa, Croton gibsonianus*, *Boehmeria macrophylla*, *Streblus asper*, *Hydnocarpus pentandra, Canthium parviflorum*, *Bauhinia phoenicea, Ficus religiosa* (DUBEY and SUNDARARAJ, 2005b).

Distribution: India: Tamil Nadu (SUNDARARAJ and DAVID, 1993a); Goa, Tamil Nadu, Karnataka, Kerala (DUBEY and SUNDARARAJ, 2005b).

4. *Aleuroclava louiseae* (Sundararaj & David)

Aleuroclava louiseae Sundararaj & David, 1993a. *Oriental Insects*, **27**: 242.

Material examined: India: Goa: Kulem, 1 puparium, on *Pothos scandens*, 28.ii.2001, A.K. Dubey (IWST).

Hosts: *Ficus racemosa* (SUNDARARAJ and DAVID, 1993a); *Pothos scandens* (DUBEY and SUNDARARAJ, 2005b).

Distribution: India: Tamil Nadu (SUNDARARAJ and DAVID, 1993a); Goa (DUBEY and SUNDARARAJ, 2005b).

5. *Aleuroplatus alcocki* (Peal)

Aleurodes alcocki Peal, 1903. *J. Asiatic. Soc. Bengal.* **72**: 74 - 78.

Aleuroplatus alcocki (Peal) Quaintance & Baker, 1914. *U. S. D. A. Bur. Ent. Tech. Ser.* **27**: 98; Singh, 1931. *Mem. Dep. Agric. India,* **12** (1): 19; David & Subramaniam, 1976. *Rec. Zool. Surv. India,* **70**: 165.
Aleuroplatus ficus gibbosae Corbett, 1926. *Bull. Ent. Res.*, **16**: 267 - 284 (Synonymised by David, 1993).

Material examined: India: Karnataka, Malleswaram, 20 puparia on *Ficus religiosa*, 22.vii.15, R. Sundararaj; Tamil Nadu: Chidambaram, 11 puparia on *Ficus religiosa*, 24.ix.15, D. Vimala (IWST).

Hosts: *Ficus bengalensis* (PEAL, 1903); *Ficus religiosa* (SINGH, 1931); *Terminalia* sp. (SINGH, 1945); *Polyalthia longifolia, P. pendula* (DAVID and SUBRAMANIAM, 1976); *Terminalia bellirica, Casearia esculenta, Cinnamomum* sp., *Buchanania lanzan* (JESUDASAN and DAVID, 1991); *Morus alba* (DAVID and RAGUPATHY, 2004); *Terminalia crenulata, Gmelina arborea, Sapindus laurifolia* (DUBEY and KO, 2008); *Syzigium cumini* (DAVID and RAJA, 2008); *Acronychia pedunculata*, *Celtis tetrandra, Drypetes sepiaria*, *Terminalia elliptica* (SUNDARARAJ and PUSHPA, 2011).

Distribution: India: West Bengal (Calcutta) (PEAL, 1903); Bihar (Pusa) (SINGH, 1931); Tamil Nadu: Coimbatore, Madras (DAVID and SUBRAMANIAM, 1976); Goa: Kulem; Karnataka: Kudremukh National Park, Magod falls, Yana; Tamil Nadu: Udagamandalam (DUBEY, 2003); Karnataka: Nagarahole Rajiv Gandhi National Park; Tamil Nadu: Point Calimere, Kodaikanal (SUNDARARAJ and PUSHPA, 2011).

6. *Aleuroplatus quaintancei* (Peal)

Aleuroplatus quaintancei Peal, 1903. *J. Asiatic. Soc. Bengal*, **72**: 61- 98; Quaintance & Baker, 1914. *USDA Bureau of Entomology*, **27**: 95 - 109.

Material examined: None.

Host: *Ficus religiosa* (PEAL, 1903).

Distribution: India: West Bengal (Kolkata) (PEAL, 1903).

7. *Aleuroplatus spina* (Singh)

Dialeurodes spina Singh, 1931. *Mem. Dep. Agric. India*, **12** (1): 27.

Aleuroplatus spinus (Singh) Takahashi, 1952b. *Mushi,* **24**: 23.

Pealius spina (Singh) David & Subramaniam, 1976. *Rec. Zool. Surv. India,* **70**: 209.
Aleuroplatus spina (Singh) Martin & Mound, 2007. *Zootaxa*, **1492**: 17.

Material examined: India: Kerala: Calicut, 2 puparia, on *Ficus arnotiana,* 10.iii.2001, K. Regu (IWST).

Hosts: *Ficus religiosa* (SINGH, 1931); *F. arnotiana* (DUBEY and SUNDARARAJ, 2005d).

Distribution: India: Bihar: Mirpur Khas, Daulatpur (SINGH, 1931); Tamil Nadu: Salem (DAVID and SUBRAMANIAM, 1976); Padappai (JESUDASAN and DAVID, 1991); Kerala: Calicut (DUBEY and SUNDARARAJ, 2005d).

8. *Bemisia religiosa* (Peal)

Aleurodes religiosa Peal, 1903. J. *Asiatic. Soc. Bengal*, **72**: 67.
Bemisa religiosa (Peal) Quaintance & Baker, 1914. *U.S.D.A. Bur. Ent. Tech. Ser*., **27**: 100.

Material examined: None.

Host: *Ficus bengalensis* (PEAL, 1903).

Distribution: India: West Bengal (Calcutta) (PEAL, 1903).

9. *Dialeurolonga maculata* (Singh)

Aleurotulus maculata Singh, 1931. *Mem. Dep. Agric. India,* **12**: 89.
Dialeurolonga maculata David & Jesudasan, 1989a. *Entomon*, 14: 371.

Material examined. India: Tamil Nadu: Chennai, 1 puparium, on *Ficus religiosa*, 3.vii.1971, B.V. David (IDAV).

Host: *Ficus religiosa* (SINGH, 1931).

Distribution: India: Bihar: Pusa (SINGH, 1931); Tamil Nadu: Chennai (JESUDASAN and DAVID, 1991).

10. *Dialeuropora decempuncta* (Quaintance & Baker)

Dialeurodes (*Dialeuropora decempuncta* Quaintance & Baker, 1917. *Proc. U. S. Natn. Mus.*, **51**: 434.
Dialeuropora decempuncta (Quaintance & Baker) Takahashi, 1934. *Rep. Dep. Agric. Govt. Res. Inst. Formosa*, **63**: 46; David & Subramaniam, 1976. *Rec. Zool. Surv. India*, **70**: 196 - 197.

Material examined: India: Karnataka: Bangalore, 2 puparia, on *Ficus religiosa*, 10.v.2014, R. Sundararaj (IWST).

Hosts: *Annona squamosa*, *Dalbergia sissoo*, *Ficus religiosa*, *Prunus* sp., *Streblus asper* (SINGH, 1931); *Annona cherimoli*, *Cordia myxa*, *Euphorbia pilulifera*, *Rosa* sp., (RAO, 1958); *Annona reticulata*, *Polyalthia longifolia* (DAVID and SUBRAMANIAM, 1976); *Cinnamomum malabathrum*, *Homonoia riparia, Macaranga peltata*, *Persea macrantha*, *Psidium guajava*, *Zizyphus* sp., *Ficus* sp., *Connarus wightii*, *Hemidesmus indicus* (SUNDARARAJ, 1989); *Morus alba* (DAVID and RAGUPATHY, 2004); *Calycopteris flouribunda, Semicarpus anacardium, Moullava spicata, Actinodaphne* sp., *Ampelocissus latifolia, Litsea* sp., *Stereospermum* sp. (SUNDARARAJ and DUBEY, 2007); *Alangium salvifolium*, *Cassia fistula*, *Chionanthus* sp., *Cinnamomum sulphuratum*, *Crotalaria laburnifolia*, *Desmos lawii*, *Desmodium pulchellum*, *Lobelia nicotianiifolia*, *Polyalthia cerasoides*, *Pterospermum xylocarpum* (SUNDARARAJ and PUSHPA, 2011).

Distribution: India: Bihar: Pusa; Uttar Pradesh: Lucknow (SINGH, 1931); Andhra Pradesh: Hyderabad (RAO, 1958); Throughout Tamil Nadu (David and SUBRAMANIAM, 1976); Maharashtra: Kandla, Chembur, Karnala and Mahableshwar; Karnataka: Bangalore; Kerala: Ambalamedu (SUNDARARAJ, 1989); Karnataka: Kudremukh National Park, Jog falls, Subrahmanya, Agumbe, Devimani, Magod falls, Kumargiri; Goa: Kulem, Volpoi, Kerala: Calicut (SUNDARARAJ and DUBEY, 2007).

11. *Pealius spinosus* (Jesudasan & David)

Pealius spinosus Jesudasan & David, 1991. *Oriental Ins.,* **25**: 322 - 323.

Material examined: India: Tamil Nadu: Velangadu, 10 puparia, on *Ficus bengalensis*, 15.i.15, D. Vimala.

Host: Unidentified tree (JESUDASAN and DAVID, 1991).

Distribution: India: Tamil Nadu: Erode (JESUDASAN and DAVID, 1991); Karnataka: Yellapur (DUBEY and SUNDARARAJ, 2005d).

12. *Singhiella simplex* (Singh)

Aleurocanthus simplex Singh, 1931. *Mem. Dep. Agric. India,* **12** (1): 69.

Dialeurodes glomerata Singh, 1931. *Mem. Dep. Agric. India,* **12** (1): 39. (Synonymised by Jesudasan & David, 1991).

Pealius indicus David & Subramaniam, 1976. *Rec. Zool. Surv. India*, **70**: 206. (Synonymised by Jesudasan & David, 1991).

Singhiella simplex (Singh) Martin & Mound, 2007. *Zootaxa*, **1492**: 43.

Material examined: India: Karnataka: Forest guest house (IWST), 18 puparia, on *Ficus religiosa*, 18.viii.15, D. Vimala; (IWST).

Hosts: *Ficus bengalensis, F. glomerata* (SINGH, 1931); *Azalea indica*, *Ficus racemosa* (DAVID and SUBRAMANIAM, 1976); *Breynia vitisidaea, Ficus benjamina*, *F. microcarpa*, *F. tsjahela* (SUNDARARAJ and PUSHPA, 2011).

Distribution: India: Bihar (Pusa) (SINGH, 1931); Tamil Nadu: Coimbatore, Udagamandalam (Nilgiris) (DAVID and SUBRAMANIAM, 1976); Padappai (JESUDASAN and DAVID, 1991); Karnataka: Sakleshpura, Bangalore; Tamil Nadu: Azhakarkoil, Nammakkal (SUNDARARAJ and PUSHPA, 2011).

Whiteflies are small inconspicuous phytophagous bugs, often overlooked despite their abundance on the lower surface of leaves. They are emerging as major pest species in agriculture, horticulture and forestry in all warmer parts of the world (SUNDARARAJ and MURUGESAN, 1996; SINGH *et al*., 2014). Both nymphs and adults suck the plant sap, and production of honey-dew leading to the development of mould on leaves, adversely affecting photosynthesis. Severe infestation results in death of seedlings and young plants. In our survey on whiteflies among the 12 species of whiteflies so far reported on *F. religiosa A. dispersus*, *A. complex*, *A. alcocki*, *D. decempuncta*, and *S. simplex* were commonly found in south India. Among them the infestation of *A. complex*, *A. alcocki* and *S. simplex* was severe resulting in drying and premature falling of leaves in younger plants. Further in the infestation of whiteflies coexistence of *A. complex* with *S. simplex* was commonly observed.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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