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(HOMOPTERA: ALEYRODIDIAE) WITH REFERENCE TO
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RESEARCH ARTICLE

DISTRIBUTION OF *ALEURODICUS DISPERSUS* RUSSELL (HOMOPTERA : ALEYRODIDIAE) WITH REFERENCE TO HOST PLANTS AND NATURAL ENEMIES FROM NASHIK DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT

Studies were undertaken regarding host plant, infestation level and natural enemies of *Aleurodicus dispersus* Russell (Spiralling whitefly) from Nasik district, Maharashtra, India. Spiralling whitefly stated as a quarantine pest have vast distribution in many tropical and subtropical regions of the world including India. This sucking pest is also observed and recorded in many states of India such as Kerala, Tamilnadu, Karnataka and Maharashtra. As Maharashtra is a state with large diversity of ornamental plants along with many important crop plants which are affected by sucking pest leading to massive loss, there is a need for survey and record of these pest from all important agricultural regions. The distribution of this sucking pest from Nasik district was found on nine plant species including some horticultural and ornamental plants. Infestation level of this pest was graded in four scales and interpreted as percent of damage caused in different seasons for period from October 2013 to December 2014. Natural enemies including predators and parasitoids from insect family Coccinellidae and Aphelinidae were recorded feeding on various developmental stages of spiraling whitefly during summer and rainy seasons. Thus, a survey of present whitefly *Aleurodicus dispersus* Russell (Spiraling whitefly) from Nasik district will significantly add to the present knowledge of this pest.

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INTRODUCTION

White flies (Aleyrodidae) are composed of tiny insects and consisting of more than 1625 species in 166 genera (Martin.J.H *et al.*, 2007). Initially the whiteflies were described as moths by Linnaeus (1758), but later Latrielle (1975) named them under bugs. Most of described whiteflies are native of tropical and sub-tropical regions, but some have also been found in Nearctic and Palearctic region (Martin and Mound, 2007). Recently it has been observed that their population has increased throughout the world becoming major problem for agriculture. Whiteflies being polyphagous and known to feed on 481 host plants (295 genera from 90 families) hence posing threat to several vegetable, fruits and ornamental plants such as guava, grapes, mulberry, papaya, banana, chillies, brinjal, okra, tomato, groundnut, cassava, gerbera, rosa pubicaulis, hibiscus (Srinivasa, 2000; Anon, 2006). There are 290 species and 57 genera of whiteflies found on various host plant from India (Gopi *et al.*, 2001). Some economically important whiteflies among these prevailing species are *Aleurodicus dispersus*, *Aleurocathus arecae*, *Aleurocathus rugose*, *Singhiella pallida*, *Aleuroclava cardamom*, *Dialeurodes citriwhitch*, *Bemisia*

tabacci, *Trialeurodes vaporariorum*, *Aleurolobus barodensis*, identified in India

Among all listed species of whiteflies, *Aleurodicus dispersus* commonly called as spiraling whitefly due to its eggs laid in spiraling pattern, is one of the important sucking pest distributed worldwide (Kumashiro *et al.*, 1983). *Aleurodicus dispersus* is a native of Caribbean island and central America, it was first observed on coconut in Florida (Russell, 1965). Spiralling whiteflies was further spread and observed in several regions of Africa (Akinlosotu *et al.*, 1993). Later in Asia the infestation of spirally whitefly was seen in many countries including India where it was first recorded at Thiruvantpuram, Kerala on tapioca (Palaniswami *et al.*, 1995). Later spirally whiteflies was also reported in five different states of India including Tamil nadu, Karnataka, Andhra Pradesh, Maharashtra and Lakshadweep islands (Pratapam, 1996; M. Mani *et al.*, 2000; S. Ramani *et al.*, 2002). Sathe.T.V *et al.*, 2015 enlisted various host plants of *Aleurodicus dispersus* Russell from Kolhapur district, Maharashtra.

They are pest of several host plants including 38 genera from 27 families (P. Neuenschwander, 1994). Their feeding

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decreases plant viability and the secretion of honey dew result in secondary infection by sooty moulds, which in turn blocks the photosynthetic activity of the leaf. Other than this, several researchers observed *Aleurodicus dispersus* Russell as vectors of numerous plant pathogens for transmitting disease such as tobacco leaf curl, cassava mosaic virus and cotton leaf curl (Costa, 1969). Due to such large extend of damage caused by this white fly species many control measures including chemical insecticides are used but, being a notorious pest they resisted majority of them (Cahill et al., 1995). An alternative to chemical based pest control is used of natural enemies of spiraling whitefly, to have a ecofriendly and maximum control over the damage caused by them. Thus, the present study of distribution, host range, level of infestation and natural enemies will add to the important knowledge to control *Aleurodicus dispersus* Russell and some related species.

MATERIALS AND METHODS

Study Area

Studies on whiteflies were done from Nasik district (Maharashtra), India for the period from October 2013 to December 2014. Nasik situated at the north-west part of Maharashtra lies 19°59'0" North and 73°48'0" East with an average area of 15,530 Sq.Km. The average recorded temperature is 25.3°C, relative humidity is 63.66 % and rainfall is 2600-3000 mm.

Collection and Rearing

Specimens of whiteflies were collected from leaves of different plants randomly from the areas of Nasik city .Collection was done at morning 9:00-11:00 am and evening 5:00-7:00 pm in zip lock covers. In leaves bearing whiteflies were kept in plastic containers of one kilogram capacity and covered with muslin cloth for mass rearing. Culture were maintained and acclimatized at °C temperature and 24±1°C and 60±1 % Relative humidity with 12 hour photoperiod. Whiteflies adults, nymphs, pupae and the predators found from every sample were recorded for infestation level, isolated and preserved in 70% alcohol for identification.

Specimens Identification

Preserved specimens were send to ZSI, Calcutta for identification of whiteflie species .Also permanent slides of whiteflies pupal stages were made by dehydration method followed by eosin staining and observed under 10X dissecting microscope. These specimens were compared with the taxonomical key provided by Gregory A. Evans (USDA/Animal Plant Health Inspection Service, Aphis, June 11, 2007).

Level of infestation

Assessment of incidence of infestation by *Aleurodicus dispersus* on various host plants were done according to the grades provided by Vennila.et.al., 2010 (National Centre for Integrated Pest Management, New Delhi).

0 Grade: No insect / incidence seen

I Grade (1-25%): Scattered appearance of few insect pest on the plant

II Grade (30-55%): Severe incidence of pest on only one branch

III Grade (60-85%): Severe incidence of insect pest on more than one branch

IV Grade (85-100%): Severe incidence of insects pest on whole plants was recorded

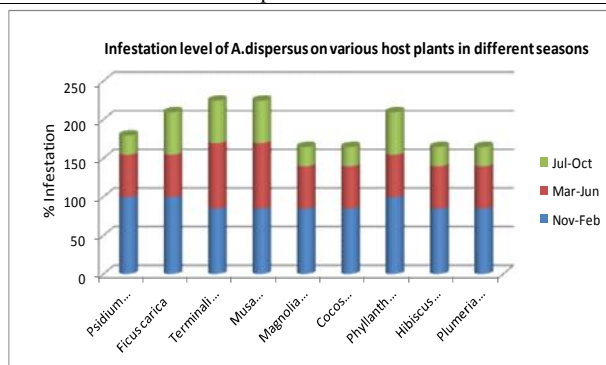
RESULT AND OBSERVATIONS

Host plants of *Aleurodicus dispersus* Russell

Infestation of *Aleurodicus dispersus* on various host plants was observed and recorded for the period of thirteen months extending from October 2013 to December 2014. Infestation of *Aleurodicus dispersus* was observed and recorded on nine host plants (table 1). During the winter season extending from October to February, heavy infestation of *Aleurodicus dispersus* was observed on major host plants along with its predators .Maximum infestation was observed in the month of December and January and there was less and negligible infestation seen during rainy season extending from June to September. During summer seasons from march to may there was minimum infestation seen in March and population of whiteflies declined and vanished till the month of May which is recorded in table.1 and represented in graph.1 .

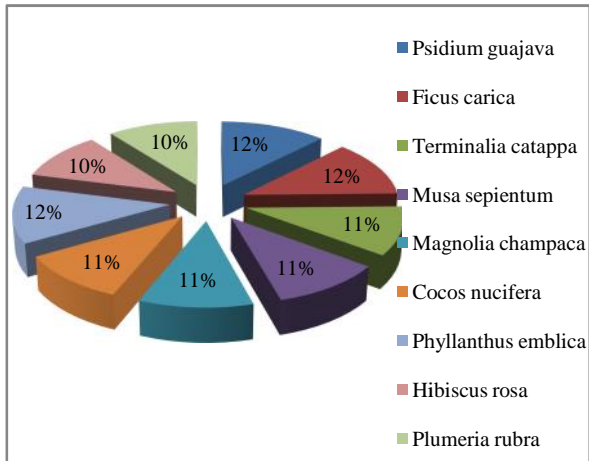
Table no 1 Grade of infestation of *Aleurodicus dispersus* on various host plant in different Seasons (from November 2012 to October 2013)

Sr.no	Host plant	Common name	Family	Grade of infestation		
				Nov-Feb	Mar-june	July-Oct
1	Psidium guajava	Guava	Myrtaceae	IV	II	I
2	Ficus arica	Fig	Moraceae	IV	II	II
3	Terminaliacatappa	Indian almond	Combretaceae	III	III	II
4	Musa sepientum	Banana	Musaceae	III	II	II
5	Magnolia champaca	Champak	Magnoliaceae	III	II	I
6	Cocosnucifera	Coconut	Arecaceae	III	II	I
7	Phyllanthus emblica	Indian gooseberry	Phyllanthaceae	IV	II	II
8	Hibiscus rosa	China rose	Malvaceae	III	II	I
9	Plumeria rubra	Frngipani/c hampa	Apocynaceae	III	II	I



Graph 1 Infestation of *Aleurodicus dispersus* Russell on different host plants in different seasons

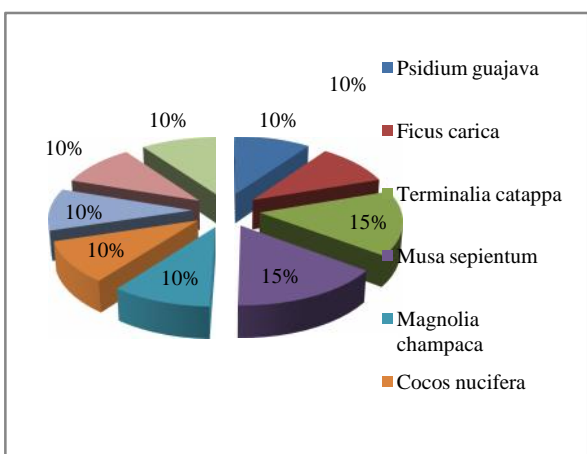
In natural climatic condition with temperature and Relative humidity, maximum infestation was observed in *Psidium guajava*, *Ficus carica*, *Phyllanthus emblica* with fourth grade of infestation and at about 85-100 % of the plants were affected . In other plants such as *Terminalia catappa*, *Plumeria rubra*, *Magnolia champaca*, *Cocos nucifera*, *Hibiscus rosa*, *Musa sepientum* third level of infestation was observed with 60-85% of plants were infected during nov 2013 to feb 2014 (Graph - 2).



Graph no 2 Percent infestation by *Aleurodicus dispersus* on various host plants during winter season (November 2012 to February 2013)

Infestation level of *Aleurodicus dispersus* Russell in various seasons

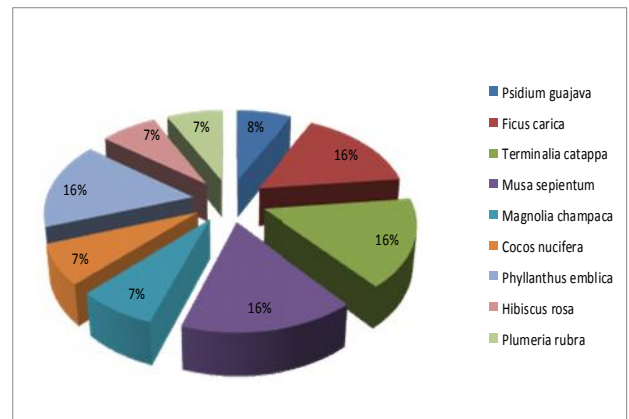
At temperature and relative humidity ,maximum infestation were observed in *Terminalia catappa* with third grade of infestation and 60-85 % of plant affected with *Aleurodicus dispersus* .Remaining all listed host plants including *Psidium guajava*, *Ficus carica*, *Musa sepientum*, *Magnolia champaca*, *Cocos nucifera*, *Phyllanthus emblica*, *Hibiscus rosa*, *Plumeria rubra* were observed with second grade of infestation and 30-55% of the plants were affected during during march to june 2014 (Graph - 3) .



Graph no .3 Percent infestation by *Aleurodicus dispersus* Russell on various host plants during summer season (March 2012 to June 2013)

At temperature and Relative humidity, maximum infestation was observed in *Ficus carica*, *Terminalia catappa*, *Musa sepientum*, *Phyllanthus emblica* with second grade of

infestation and 30-55 % of host plant affected by *Aleurodicus dispersus*. All other listed host plants such as *Psidium guajava*, *Magnolia champaca*, *Cocos nucifera*, *Hibiscus rosa*, *Plumeria rubra* with grade one infestation and 1-25 % of plant were affected for the period july-oct 2014 (Graph - 4).



Graph no 4 Percent infestation by *Aleurodicus dispersus* on various host plants during rainy season (July 2012 to October 2013)

Natural enemies of *Aleurodicus dispersus* Russell on guava plant

Four types of predators were found to attack on spiraling whitefly of infested leaves of all recorded host plants in the field. All recorded natural enemies have a large range of host insect and also found feeding on other sucking pest such as mealy bugs and aphids. Insects with different developmental stages were feeding on adults as well as nymphal stages of spralling whitefly. Predators are found in more numbers during morning and evening hours. Natural enemies included insects from order Coleopetra as predators and Hymenoptera as parasitoids.

Parasitic wasp *Encarsia erimicus* attacks the nymphal stages of spiraling whitefly either by laying eggs or direct feeding on its fluids. The parasitized nymphs turn amber brown in color and later the pupae appear black with further emergence of the adult wasp. Adult *Encarsia formosa* is observed throughout the infestation period of spiraling whitefly during morning and evening hours. Different life stages of Lady bird beetles, *Nephaspis oculata*, *Delphastus pusillus* and *Coccinella septempunctata* are found to predate on the egg, nymphs of spiraling whitefly. They are observed in abundant in warm climate between March to May and then from September to December. Later, due to low population of whiteflies it reduced the presence of larve & adult of lady bird beetle in the field. Larval stage of *Nephaspis oculata* was found to voraciously feed the eggs and nymphal stages of *Aleurodicus dispersus* Russell during evening hours. Adults of *Delphastus pusillus* and *Coccinella septempunctata* feeds on all life stages of white flies, among which *Coccinella septempunctata* was comparatively more effective feeder of spiraling whitefly.

DISCUSSION

Spiralling whitefly distributed in almost all part of the world is one of the destructive sucking pest of many agricultural and horticultural plants. Listed among one of the quarantine pest it

posses threat to many developing countries like India leading to trade implications and economical losses (N Sathyarayanan *et al.*, 2013). They are widely distributed among the tropical and subtropical regions of the world including India. Among some economically important whitefly, *Aleurodicus dispersus* Russell is considered as a notorious sucking pest found on major cultivated crops and ornamental plants in India (N.K.Krishna Kumar, 2010). However, India being a tropical country there could be more number of species of whiteflies on various host plants as compared to the cooler regions of the world. This evolve a need to observe and study the aleurodid fauna from India, which will add more information in the ecological and geographical distribution of whiteflies. Chemical control of the whiteflies are merely possibly due to their increasing resistance which becomes impractical because of its vast host range and wide spread distribution. Thus, some alternative measures should be involved which would be ecofriendly, host specific, higher effective for eradication of sap sucking pest. In classical biological control showed resulted in controlling whiteflies (Kumashirao *et al.*, 1983). By introducing the natural enemies, it is possible to control *Aleurodicus dispersus* as biocontrol measure.

An effort to elucidate and evaluate infestation of the present pest *Aleurodicus dispersus* Russell we studied its distribution on various host plants along with their natural enemies. Among nine host plants of spiraling whitefly, maximum infestation was recorded in winter season and minimal infestation in rainy season. Similar observations of high infestation level of whitefly in winter season were made by Palaniswami *et al* (1995) and Geetha (2000) in Kerala and Tamilnadu on various host plants. Low level of infestation in June during rainy season was also observed in Lakshadweep is land by Ramani, 2000. Heavy infestation is observed on fruiting trees such as *Psidium guajava*, *Ficus carica* and *Phyllanthus emblica* followed by *Terminalia catappa*, *Musa sepientum*, *Magnolia champaca*, *Cocos nucifera*, *Hibiscus rosa* and *Plumeria rubra*. All mentioned host plants of *Aleurodicus dispersus* Russell were also recorded from Tamilnadu by (Geetha and Swamiappan, 2001). Russell, 1965 recorded infestation of *Aleurodicus dispersus* Russell on *Hibiscus sps*, *Ficus sps*, *Plumeria sps* in America and Philippines. Heavy infestation of spiralling whitefly was also observed on *Psidium guajava* in Taiwan, leading to heavy losses fruit yield (Wen *et al.*, 1995). On all observed host plants, natural predators of spiraling whitelfy was found feeding on different developmental stages including insects predators from order Coleoptera like *Nephaspis oculata*, *Delphastus pusillus*, *Coccinella septempunctata* and parasitoid, *Encarsia erimicus* from order Hymenoptera.

Encarsia formosa along with some other species of *Encarsia formosa* sps were found to parasitize many species of whiteflies including, *Bemisia argentifolii*, *Trialetrodes vaporariorum* and *Aleurodicus dispersus* (M.S.Hodde *et al.*, 2000). In a classical biological approach to control spiraling whitefly in India, Pacific islands, Hawaii and countries in West Africa, 53 predators along with 8 parasitoids were used including *Nephaspis oculata*, *Coccinella septempunctata* and *Encarsia species* (M.Mani *et al.*, 2002). Tong-Xian Liu and

Philip A.Stansly (1999) observed and recorded the feeding behavior of Coccinellid beetles such as *Nephaspis oculata* and *Delphastus catalinae* on developmental stages of *Aleurodicus dispersus* Russell. As an alternative to chemical pesticides, classical biological method including use of natural enemies can lead to satisfactory control of sucking pest. Heinz and Parrella (1994) also suggested application of insect predators along with parasitoids will enhance their ability to reduce population of agricultural pest like whiteflies.

CONCLUSION

In summary, the present study makes a contribution to the knowledge of whiteflies around the world. Present study deals with distribution and infestation level of a sucking pest, *Aleurodicus dispersus* Russell on various host plants from Nasik district of Maharashtra, it will help to understand the spread of these notorious pests. Additionally, observations on natural enemies of spiraling whitefly feeding on their various developmental stages, may lead to develop some strategies to control agricultural sucking pest.

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