Original Research Article

First Report of Three Invasive Whitefly species (Aleyrodidae: Hemiptera) from West Bengal

Abstract: Invasive insect pests are alien or exotic organisms. These are introduced species to an environment outside their original or native habitat and have an immense power of dispersal and adaptation. Invasive species are responsible for reducing or minimising the productivity of the crops and thereby creating huge economic losses. Due to the small size and the ability to be attached to the host plants, the invasive white fly species have been introduced to several countries through movement of different plants during trade. Eight such species have invaded and been reported from India. But only three such species – Spiralling whitefly (*Aleurodicus dispersus* Russell), Rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin) and Bondar's nesting whitefly (*Paraleyrodes bondari* Peracchi) – have been reported from West Bengal, till date. There is no report of the other invasive species from West Bengal. Therefore, this research article is prepared to report the presence of the following three invasive whitefly species – Solanum whitefly, *Aleurothrixus trachoides* (Back), Palm infesting whitefly, *Aleurotrachelus atratus* Hempel and Woolly whitefly, *Aleurothrixus floccosus* (Maskell) – for the first time from West Bengal. Mitochondrial DNA sequencing was done for molecular characterisation of these species to confirm their identity. Regarding host plant preference, woolly whitefly and solanum whitefly showed clear affinity towards guava and chilli, respectively, whereas palm infesting whitefly preferred coconut. This report is going to be the first ever document of invasion by the above-mentioned three exotic whitefly species from West Bengal.

Keywords: First report, Invasive whitefly species, Sequencing, Host range, West Bengal

Introduction

Invasive insect pests are alien organisms that invade a non-native habitat, totally new to them, with a potential to disperse. These species result in massive economic losses as well as social disturbances. Insects that are small in size, more or less cryptic in nature, the immature stages are closely attached to the host plants and have ability to multiply and spread rapidly is the most successful invasive species. These characteristics make whiteflies one of the dreaded invasive pests (Mandal, 2011). Whiteflies are a major concern for agriculturists all over this globe. These are observed to feed on different agricultural, horticultural and forestry crops. In our country, 472 whiteflies under 68 genera have already been reported. However, the number of invasive whiteflies reported from our country is eight only. But only three such species – spiralling whitefly (*Aleurodicus dispersus* Russell), rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin) and bondar's nesting whitefly (*Paraleyrodes bondari* Peracchi) – have been reported from West Bengal, till date. Therefore, this research article is prepared to report the presence of the following three invasive whitefly species from this region. Therefore, this research article is prepared to report the presence of the following three invasive whitefly species – solanum whitefly, *Aleurothrixus trachoides* (Back), palm infesting whitefly, *Aleurotrachelus atratus* Hempel and woolly whitefly, *Aleurothrixus floccosus* (Maskell) – for the first time from West Bengal. Dubey and Sundararaj reported Solanum whitefly, native to the Neotropical region, in the year 2015 from Karnataka (Dubey and Sundararaj, 2015). Palm infesting whitefly, another Neotropical one, was reported from Karnataka by Selvaraj *et al.*, in the year 2019 (Selvaraj *et al.*, 2019). Sundararaj *et al.* reported woolly whitefly, exotic whitefly from Kerala, in the year 2020 (Sundararaj *et al.*, 2020).

Materials and Methods

The research programme was initiated to record the presence of invasive whiteflies from different districts under Sub-Himalayan region of West Bengal; i.e. Alipurduar, Darjeeling, Jalpaiguri and Coochbehar, in the year 2020. Systematic surveys were conducted in the above mentioned areas. Leaf samples were collected during survey from the host plants consisting of different stages (egg, nymph, puparium and adult) of exotic whiteflies. The fourth nymphal instars of the whitefly (or puparium), important for taxonomic identification, were found, in groups or individually, attached to the lower (sometimes upper) surface of the infested leaves. The leaves (infested with puparial cases) were collected and put into plastic zip covers. Adults were collected by aspirator. Afterwards, the samples of the puparium were kept separately for adult rearing, whereas the adults were transferred into collection tube containing 70% alcohol.The specimens were stored at the laboratory of Department of Agril. Entomology, Uttar Banga Krishi Viswavidyalaya (26° 31' N, 89° 06' E), Pundibari, Coochbehar (West Bengal) for further identification. The identification of these exotic whiteflies was confirmed on the basis of molecular characterisation. Amplification of the partial mitochondrial cytochrome c oxidase sub-unit I (COI) gene was done and then sequencing process was completed. The submission of the said sequences to National Center for Biotechnology Information (NCBI) database resulted in generation of six GenBank accession numbers. The sequences showed 98-100% match with species recorded or reported elsewhere and already submitted in NCBI database.

Results and Discussion

As stated above, systematic survey was continuously conducted in the different districts under Sub-Himalayan region of West Bengal; i.e. Alipurduar, Darjeeling, Jalpaiguri and

Coochbehar for collecting different life stages of invasive whiteflies under the family Aleyrodidae. Three invasive whitefly species – solanum whitefly, *Aleurothrixus trachoides* (Back), palm infesting whitefly, *Aleurotrachelus atratus* Hempel and woolly whitefly, *Aleurothrixus floccosus* (Maskell) were identified for the first time from West Bengal. For further confirmation, these three species were identified through molecular characterisation. The COI sequences and their respective accession numbers against each exotic whitefly has been presented in table 1.

Table 1: Molecular characterisation of Invasive Whitefly Species reported first time from West Bengal

Sl. No.	Invasive whitefly species	GenBank Accession Number	NCBI Reference Number
1.	Solanum Whitefly (*Aleurothrixus trachoides*)	OQ858378	KP032218
2.	Palm Infesting Whitefly (*Aleurotrachelus atratus*)	OQ844114	MN266486
3.	Woolly Whitefly (*Aleurothrixus floccosus*)	OQ844087	MT080466

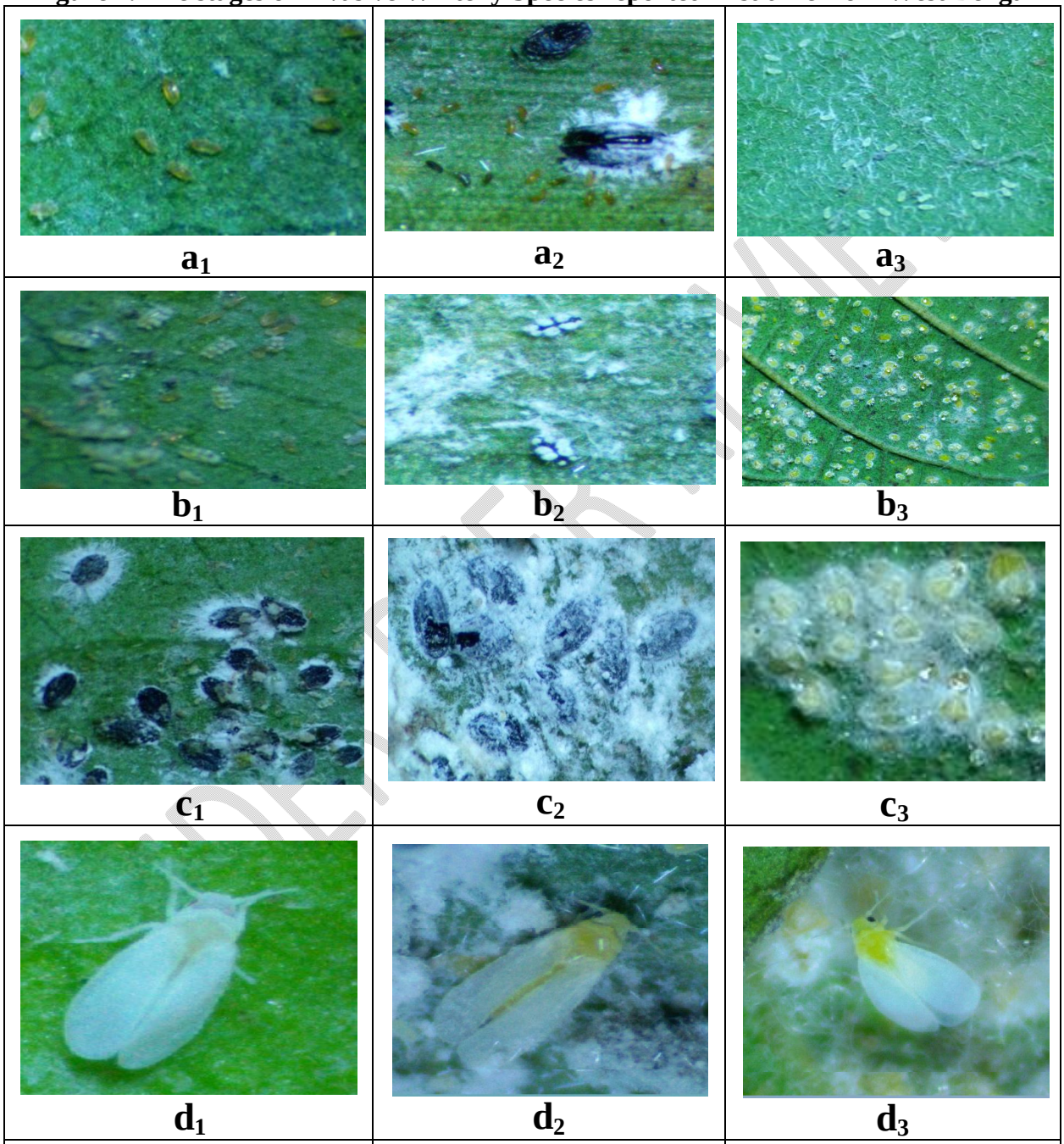
Solanum whitefly was found to prefer the host *Capsicum* belonging to the family Solanaceae. Infestation of this pest was also seen heavily in *Duranta* plants. This whitefly was found in 24 host plants in our country (Sundararaj *et al.*, 2018) including the two mentioned above. The adults were nearly same in size as that of the woolly whitefly. The eggs were more or less transparent when laid but converted towards brownish or yellowish during maturity. Nymphal instars of this invasive whitefly showed some typical characteristic features. The early ones were nearly oval and flat and converted towards convex as these proceed towards maturity. Their colour changed towards dark yellow than the lighter one in the early instars. These early nymphal instars bore patches, spherical in shape, on the dorsum. The elliptical puparium, with some characteristic features, was found to be black in colour. The margin possessed whitish waxy fringes. White wax like objects, adherent honeydew and black sooty mold were the indication of their attack. Presence of chlorotic spots as well as curling and premature shedding of chilli and duranta leaves was the symptoms of damage observed during the investigation.

Palm infesting whitefly adults were somehow different than the other two whiteflies. The wings didn't possess any specific marking. The adult laid stalked eggs in a semicircular fashion. The most important point is that, among all the invasive whitefly species, this is the only exotic whitefly in which all the nymphal instars are black in colour. The first nymphal instar possessed four pairs of wax plume like structure on dorsal surface. The shape of the puparium was found to be elliptical. The margins of the puparia were provided with white waxy layers. Several dorsal wax filaments were observed to cover the puparium. This invasive pest was seen only to attack the coconut plantation in this region. However, Malumphy and Treseder (2011) reported its colonisation on more than 110 plant species from England. Leaflets were found drying due to the attack of this pest. As usual, like the other invasive whiteflies, honeydew excreted by this pest accelerated the growth of sooty moulds.

Woolly whitefly puparia were found to be covered with loose and fluffy wool like substances and this indicates the reason for selecting the common name of this invasive whitefly. The females preferred to feed and lay on the undersides of young leaves. The short-stalked and

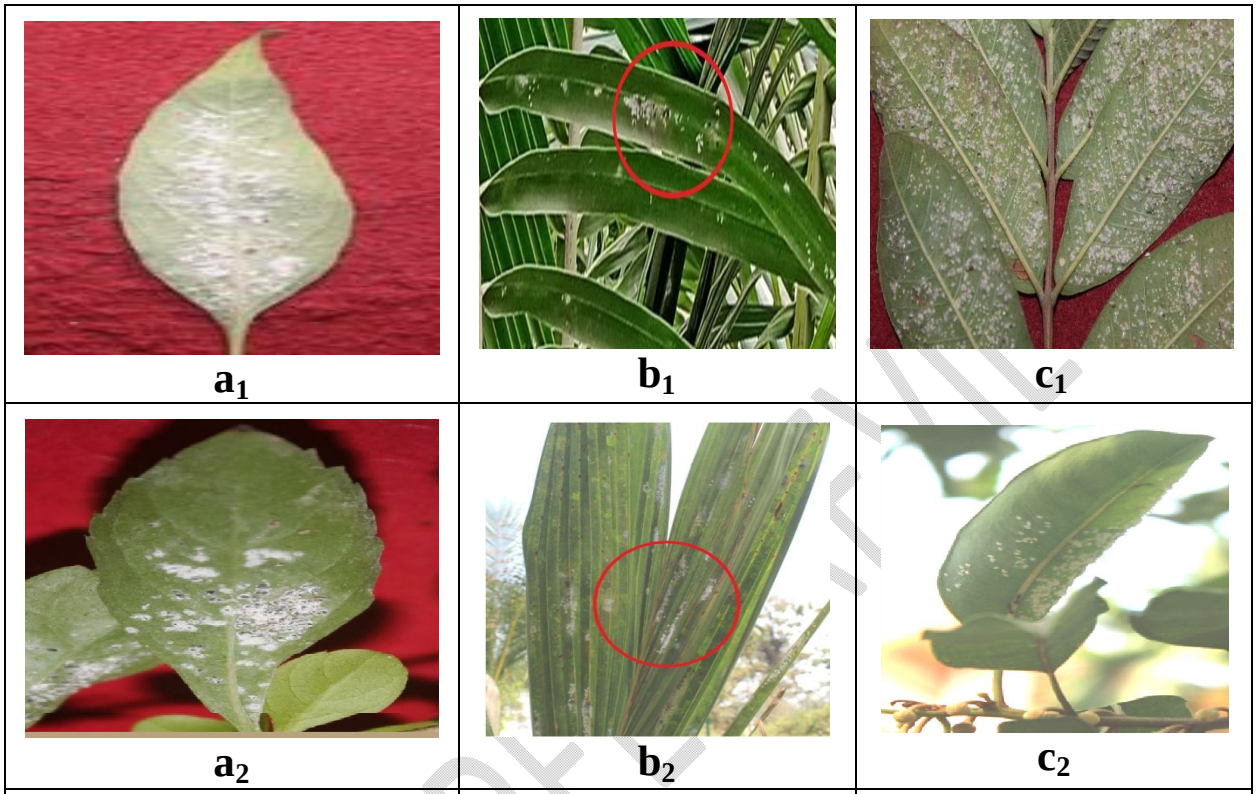
transparent eggs were found to turn brown before hatching. The nymphal instars gradually turn brown. The tiny adult possessed creamy-white body and wings. Both the body and wings were found to be covered with whitish powder like substance. Although Malumphy *et al.* (2015) reported it from Neotropical region on citrus, but in India, it has been reported to infest guava

Figure 1. Life stages of Invasive Whitefly Species reported first time from West Bengal



only, till date. However, mild attack of this pest in Bakul/Bokul (*Mimusops elengi*) plant was also recorded in this region apart from guava, infested at higher mode. Both the immature stages,

Figure 2. Symptoms of damage by the Invasive Whitefly Species reported



i.e. nymphs and adults damaged the guava leaves by their sap sucking. Honeydew secreted in a

Table 2: Host Plants of Three Invasive Whiteflies reported from West Bengal

Hosts	Invasive Whiteflies		
	Solanum Whitefly	Palm Infesting Whitefly	Woolly Whitefly
Coconut (*Cocos nucifera*)	---	***	---
Guava (*Psidium guajava*)	---	---	***
Chilli (*Capsicum annum*)	***	---	---
Duranta (*Duranta erecta*)	***	---	---
Bakul/Bokul (*Mimusops elengi*)	---	---	***

N.B. *** indicates the presence of colonies of invasive whiteflies on these hosts

profuse manner by these stages invited the situation for the development of sooty mould. Blackening of guava leaves were also seen in case of severe infestation. This not only minimised the photosynthesis of the plants, but led towards leaf fall, too. It was observed during the study, that this pest preferred to initiate their infestation on tender leaves than the matured ones.

Summary and conclusion

During the entire course of investigation, three invasive whiteflies (Aleyrodidae: Hemiptera) have been observed, identified and reported for the first time from West Bengal. These are – solanum whitefly, *Aleurothrixus trachoides* (Back) attacking chilli and duranta, palm infesting whitefly, *Aleurotrachelus atratus* Hempel attacking coconut and woolly whitefly, *Aleurothrixus floccosus* (Maskell) attacking guava and Bakul/Bokul (*Mimusops elengi*). As per available literature, Bakul/Bokul is being reported for the first time being attacked by woolly whitefly. However, this is to be noted that invasive species increase their population profusely in absence of natural enemies in the newly found environment. These species can be devastating due to their ability to create huge economic losses, at least, from the point of view of agriculture. That is why, systematic and continuous survey and surveillance as well as adoption of proper management practices are of utmost importance to fight back the invasive species.

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