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Incidence of *Aleurocanthus* spp. (Aleyrodidae: Hemiptera) on betelvine (*Piper betle* L.) and their interaction with host plants

Bijan Kumar Das

All India Net-Working Research Project on Betelvine, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani - 741 235, Nadia, West Bengal, E mail: bkdas1963@rediffmail.com

A B S T R A C T

Betelvine (*Piper betle* L.) is a perennial evergreen shade loving creeper belonging to the family Piperaceae. In India, it is commercially cultivated over an area of 50,000 ha as an important and potential cash crop. In spite of the tremendous potentially of the crop, cultivation of betelvine is highly risky and returns are uncertain because of its susceptibility to several pests and diseases, aggravated by the nature of the plantation. A good number of hemipteran insect pests occur in betelvine ecosystem which dwindle betelvine yield potentiality. Among these, the polyphagous betelvine blackfly, *Aleurocanthus rugosa* Singh (Aleyrodidae: Hemiptera) is a major pest causing severe damage to the foliage in the conservatories (*borojas*) of West Bengal. The seasonal incidence of *A. rugosa* in *boroja* was recorded during 2003-2004. *A. rugosa* adults were active in the *boroja* through out the year with two peaks, one in pre-monsoon and another in post-monsoon i.e., period prior initiation of winter season. During the faunastic survey in betelvine, a new species of *Aleurocanthus* (description under process) was recorded from West Bengal. This had also been found to occur on *Piper longum* L. Another species, *A. nubilance* (Buckton) which was recorded on betelvine in Bangladesh during 1900, was not recorded in this area. Detection of host resistance against insect pests is very relevant for genetic improvement programmes. Till date, scanty information is available on the source of tolerance, if any, against betelvine blackfly. The reaction of some betelvine cultivars to *A. rugosa* was evaluated in the *boroja* with different varietal collections from different parts of India. None of the entries under the purview was completely free from infestation. A few cultivars [CARI- 2 (AN), CARI-6(AN) and Bilhari] exhibited moderate resistant reaction against *A. rugosa*. Awani Pan (*Piper hamiltonii*) exhibited resistance against *A. rugosa*.

***Keywords*:** Betelvine, *Piper betle*, *Aleurocanthus*, insect plant interaction

Introduction

India has a long ancient history of betelvine culture as mentioned in *Atharva Veda* (Bhattacharya 1976). The betel leaf occupies a significant place in everyday life of Indian people as it is used in rituals and in Indian system of medicine as cure for many diseases and disorders (Dutt 1877; Chopra *et al*. 1956). Researches in recent past explore the scientific basis of the traditional uses of this plant as well as discovering new molecules in betelvine which can be used as medicine. It is known that extract of betel leaves has antioxidant property due to presence of chevibetol (CHV), allylpyrocatechol (APC) etc. (Choudhary & Kale 2002; Rathee *et al.* 2006), anti-carcinogenic properties due to presence of hydroxy-chavicol (Amonkar *et al.* 1986; Bhide *et al.* 1991) and also has hypolipidemic activity (Gramza & Korczak 2005), antibacterial activity (Nalina & Rahim 2007; Bissa *et al.* 2007; Ramji *et al.* 2002).

Betelvine is commercially cultivated in the moist, tropical and sub-tropical regions of India, Bangladesh, Sri Lanka and to limited extent in some other Asian countries (Maiti & Saikia 2002). It is an important cash crop, and grown in about 50,000 ha in India (Maity & Shivashankara 1998). This crop has great market value both inside and outside India with a trade worth of Rs.7000 million every year (Balasubrahmanyam *et al.* 1994) and leaves are exported to countries like Pakistan, Indonesia, Malaysia, Myanmar and Thailand (Maiti & Saikia 2002).

More than 150 types/cultivars/landraces are grown by the cultivators and recognized by traders in India (Maiti & Saikia 2002). Five major cultivar groups, viz. *Bangla, Meetha, Sanchi, Kapoori* and *Desawari* are recognized in India based on morphological and bio-chemical characteristics (Rawat *et al.* 1989; Balasubhramanyam & Rawat 1990; Balasubhramanyam *et al.* 1994).

Betelvine blackfly, *Aleurocanthus rugosa* Singh (Aleyrodidae: Hemiptera) is one of the important pests of betelvine ecosystem causing severe damage to the foliage in West Bengal (Anonymous 2002; Raut & Nandi 1984; Raut & Bhattacharya 1999). *A. rugosa* is a polyphagous insect having a wide range of host plant species belonging to many unrelated families (Singh 1931; Evans 2007). Another species, *Aleurocanthus nubilans* (Buckton) was recorded on betelvine from Bangladesh (Buckton, 1900).

The insecticides like malathion (0.05%), endosulfan (0.05%) and dichlorvos (0.05%) are extensively sprayed on the leaves to manage the pest (Maity 1989; Anonymous 1992). But, due to masticatory nature of the consumption, control of insect pests by synthetic chemical pesticides may cause health hazard (Bhattacharya *et al.* 1992). The high cost of pesticides and a great demand for residue free produce in domestic and international markets necessitates the avoidance of chemical pesticides. Moreover, the pest scenario is also changing day by day due to rapid change in management practices (Anonymous 2006; Das & Mallick 2009). Till date, there is no information on the source of resistance, if any, against betelvine blackfly, *A. rugosa.*

In view of the above, screening of betelvine cultivars for resistance against *A. rugosa* was evaluated in a closed conservatory (*boroja*) where varietal collections from different parts of India were being maintained. The seasonal abundance of this pest species was recorded in two consecutive years. During the faunastic survey, a new species of *Aleurocanthus* (description under process) was recorded for the first time on betelvine and *Piper longum* L. from West Bengal.

Materials and Methods

Incidence of A. rugosa in boroja

The incidence and habits of *A. rugosa* was observed in a betelvine boroja at Kalyani, Nadia, West Bengal. The study on the seasonal abundance of *A. rugosa* was made in a fixed plot of a one year old *boroja* where one *Bangla* cultivar namely, *Simurali Bhabna* was planted in rows of 5 m length with 10cm x 70cm spacing, thus 50 vines in each row. Ten rows from the middle of the boroja were chosen to enumerate the populations of blackfly. Two vines were taken randomly from each row, totaling 20 vines from ten rows. Adult fly population from top four leaves of each vine was recorded by visual observation. The adult fly populations were recorded at monthly interval during 2004-2005. The *boroja* was kept free from application of any insecticides during the study period.

Incidence of other species of Aleurocanthus

During the faunastic survey in the farmers' *borojas* in Nadia district of West Bengal, one uncommon species of *Aleurocanthus* was found to occur on betelvine. Preliminary observations on external morphology were taken and compared with other species of *Aleurocanthus* which were previously recorded on betelvine. To

know the identity of this species, specimens were sent to a whitefly taxonomist in India.

Screening of betelvine cultivars

The screening of betelvine cultivars against blackfly, *A. rugosa* in the field level was carried out in a closed conservatory (*boroja*) where a rich collection of betelvine cultivars was maintained. The experiment was carried out at Research Farm of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal in 2003. Each betelvine cultivar was planted in a single row of 5 m length with 10cm x 70cm spacing and each row contained 50 vines.

Three cultivar groups, namely *Bangla* (15 cultivars), *Deshwari* (one cultivar) and *Sanchi* (two cultivars), and two cultivars of undetermined type were brought under purview of the study. In addition, *Piper hamiltonii* (Awani Pan) was also taken in to consideration to record its reaction against *A. rugosa*.

Natural incidence of betelvine blackfly on different cultivars of betelvine was observed at *boroja*. Populations of adult betelvine blackfly occurring on different cultivars were taken as the parameter of assessment for the degree of resistance/ susceptibility. Ten vines were taken randomly from each row. Each vine was treated as one replication. Adult blackfly population data were transformed into square root values before statistical computation.

Results and Discussion

Incidence of A. rugosa

In betelvine boroja, *Aleurocanthus rugosa* Singh (betelvine blackfly) (Figs.2a & 2b) occurs sympatrically with betelvine whitefly, *Singhiella pallida* (Singh). Eggs are laid on the lower surface of the tender apical leaves in a concentric ring fashion; when crowded, eggs are scattered on the under surface of leaves without any design. Fresh eggs are pale white, turn brownish with striated lines on the surface. The late instar nymphs /puparia are orange red to scarlet red in colour. Both the adults and nymphs/puparia cause damage by sucking the sap from the under surface of the leaves adversely affecting the vitality of the vine, and the leaves become shorter in size. Due to heavy infestation by adults, curling and crinkling of leaf lamina may occur. After the emergence of the adult flies from the puparia, the exuvae are attached to the under surface of the leaves, making it unsuitable for consumption vis-à-vis marketing.

Data on relative seasonal abundance of adult blackfly, *A. rugosa* in the betelvine *boroja* in different months of 2003 and 2004 have been presented in Fig.1. It can be seen from the Figure that *A. rugosa* adults were active in the *boroja* through out the year. When population fluctuation of adults is considered, it is found that the population of blackfly in 2003 was higher during April - June (20 – 25 adults/ vine) and again in September-October (17 – 40 adults/ vine); population was low during January – March (3 – 8.5 adults/ vine), July- August (7 – 10 adults/ vine) and November – December (5 – 9 adults/ vine). In 2004, higher populations were also recorded in two spells, one during May –June (15- 19 adults/ vine) and another during October- November (25 – 45 adults/ vine). Rest of the year the population of blackfly was low (2.5 – 10 adults/ vine). So, generally two peaks were found, one in pre-monsoon period and another in post-monsoon period. The activity was low during rainy and winter seasons.

Other species of Aleurocanthus on betelvine

Buckton (1900) described one aleyrodid fly, *Aleurodes nubilans* from material collected from betel (*Piper betle*) leaves in Bangladesh. The

original description of the species was not adequate, moreover, that was based mainly on adult (Fig. 2c) (currently, only puparial forms are usually identifiable to the species level). Subsequently, Quaintance & Baker (1914) placed the species in the genus *Aleurocanthus* Quaintance & Baker. After its discovery in 1900, it could not be recorded from anywhere for second time. Moreover, the type materials are not present. David & Manjunatha (2003) discussed about the status of *Aleurocanthus* (*Aleurodes*) *nubilans* (Buckton) and considered it as *nomen dubium*. Recently, during faunastic survey in betelvine orchards, an uncommon species of *Aleurocanthus* was found infesting betelvine (Fig. 2d) in some farmers' borojas at Nadia, West Bengal. Perfect black colour nymphs and puparia having long spines on dorsum (Fig. 2e) were found attached to the under surface of the betel leaves adversely affecting the vitality of the vine. The adults (Figs. 2e & 2f) were reared from these affected leaves. Immediately it was thought that this might be the Buckton's species, *A. nubilans*. But after careful observation and comparison with Buckton's original description and illustrations of adults, it was confirmed that they were not conspecific. These two species distinctly differed from each other in the colour pattern of wings (see Figs 2c & 2f). Now, this species has been confirmed as a new one by R. Sundararaj, of Wood Biodegradation Division, Institute of Wood Science & Technology, Bangalore. Its description is under process. This new *Aleurocanthus* species has also been recorded here on *Piper longum* L.

Screening of betelvine cultivars

The mean adult populations of *A. rugosa* on different cultivars are presented in Table 1. The results showed that there were great differences among the adult fly populations on different cultivars and the differences were statistically significant at 1% level. None of the entries under observation was completely free from infestation.

The blackfly populations on 20 cultivars of betelvine and *P. hamiltonii* varied from 3.1 to 65.6 adults /vine. Low levels of populations were found on the cultivars CARI- 2 (AN), CARI-6(AN) and Bilhari (*Deshwari* type) (10.5 – 15.1 adults /vine). Medium level of populations were found on the cultivars namely, Harishpur Bangla, Jabalpur Bangla, Bankura Bangla, Kadwa, Ramtake Bangla (Bangla type), Kalipatti and

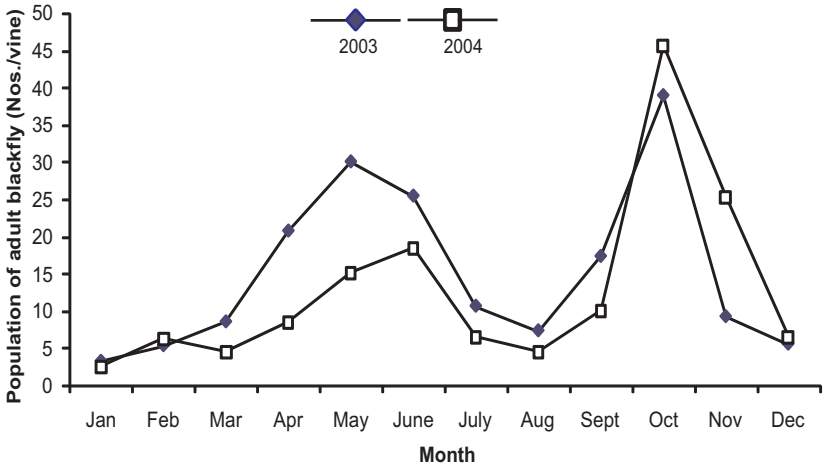

Fig 1. Population of adult blackfly, *A. rugosa* in betelvine boroja at Kalyani, Nadia, West Bengal during 2003 and 2004.

Simurali Sanchi (*Sanchi* type) (21.6 – 35.5 adult fly/vine). Rest ten cultivars (all belong to *Bangla* type) are highly susceptible having population of blackfly more than 40 per vine. Awani Pan, *Piper hamiltonii* showed extreme resistance (3.1 adults/vine).

Adults of *A. rugosa* congregate at the top of the vine (young tip with three or four leaves) for food and oviposition. Two cultivars, CARI- 2 (AN), CARI-6(AN) [unknown type] and Bilhari [*Deshwari* type] harboured comparatively low population of whitefly. It might be due to low preference for food and oviposition. These cultivars may have some adverse physical and chemical characters for which betelvine blackfly preferred these cultivars less, which can be a subject of future investigation. *Bangla* type cultivars showed either moderately susceptible or highly susceptible reaction against the betelvine blackfly. Two *Sanchi* type cultivars (Simurali Sanchi and Kalipatti) did not show resistant reaction against *A. rugosa* unlike that against another aleyrodid fly, *Singhiella pallida* (Singh) (Das BK unpublished data). Awani Pan, (*P. hamiltonii*) showed extreme resistance (3.1 adults/vine); probably it is not a suitable host of *A. rugosa*. However, Awani Pan was found susceptible to *S. pallida* (Das BK unpublished data). Thus, two aleurodid flies reacted differently to their common hosts.

A. rugosa is a poplyphagous insect having a wide range of host plant species belonging to many unrelated families (Singh 1931; Evans 2007), whereas, *S. pallida* is a stenophagous species having a narrow diet breadth which includes only a few species of *Piper* (Das BK unpublished data). Probably the specialist and generalist reacted differently to their common host plant, betelvine for different reasons.

From the above studies, it can be concluded that betelvine blackfly, *Aleurocanthus rugosa* adults were active in the orchard through out the year with two peaks, one in pre-monsoon and another in post-monsoon period, i.e., prior initiation of winter season. The activity was low during rainy season and winter season periods. A new species of *Aleurocanthus* (description under process) occurred on *Piper betle* L. as well as on *P. longum* L. in West Bengal. Another species, *A. nubilance* (Buckton) which was recorded on betelvine in

Table 1.
Population of adult blackfly, *Aleurocanthus rugosa* on different betelvine cultivars

Cultivar	Cultivar Group	No. of adult blackfly /vine*	Cultivar	Cultivar Group	No. of adult blackfly/vine
Awani Pan	*Piper hamiltonii*	3.1 (1.74) **	Godi Bangla	Bangla	42.2 (6. 42)
CARI -2 (AN)	Unknown	10.5 (3.22)	Ghanagete	Bangla	42.5 (6.49)
CARI - 6(AN)	Unknown	12.6 (3.53)	Kotki Bangla	Bangla	43.5 (6.53)
Bilhari	Deshwari	15.1 (3.87)	Boichigodi	Bangla	45.1 (6.64)
Simurali Sanchi	Sanchi	21.6 (4.61)	Simurali Chamurduli	Bangla	47.3 (6.81)
Jabalpur Bangla	Bangla	26.5 (5.11)	Bagerhat	Bangla	50.2 (7.04)
Harishpur Bangla	Bangla	27.2 (5.17)	Simurali Bhabna	Bangla	52.9 (7.22)
Bankura Bangla	Bangla	30.6 (5.47)	Simurali Deshi	Bangla	57.5 (7.41)
Ramtake Bangla	Bangla	32.8 (5.65)	Simurali Gole Bhabna	Bangla	58.3 (7.53)
Kadwa	Bangla	33.5 (5.67)	Kalibangla	Bangla	65.6 (8.01)
Kalipatti	Sanchi	35.1 (5.81)			
CD at 1%			1.21		

*Average of ten vines **Figures in the parentheses are square root transformed values*

Bangladesh during 1900, was not found in this area. From the screening trial, it was evident that none of the betelvine cultivars tested here was completely free from infestation, however, only a few cultivars [CARI- 2 (AN), CARI-6(AN) and Bilhari] exhibited moderate resistance reaction against *A. rugosa*. Awani Pan (*Piper hamiltonii*) may not be a normal host for *A. rugosa*.

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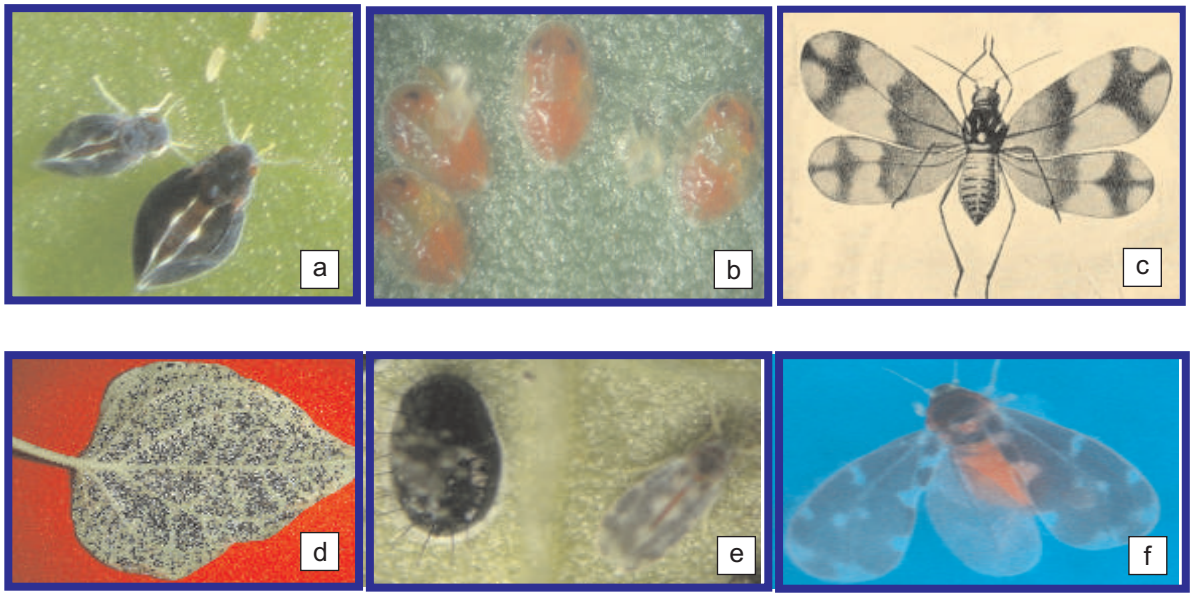

Fig 2. *Aleurocanthus* spp. on betelvine. a. adults & eggs of *A. rugosa,* b. nymphs of *A. rugosa*, c. adult, *A. nubilans* (from Buckton, 1900), d. betel leaf infested by *Aleurocanthus* sp., e. nymph and adult of *Aleurocanthus* sp., f. wing colour pattern of *Aleurocanthus* sp.

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