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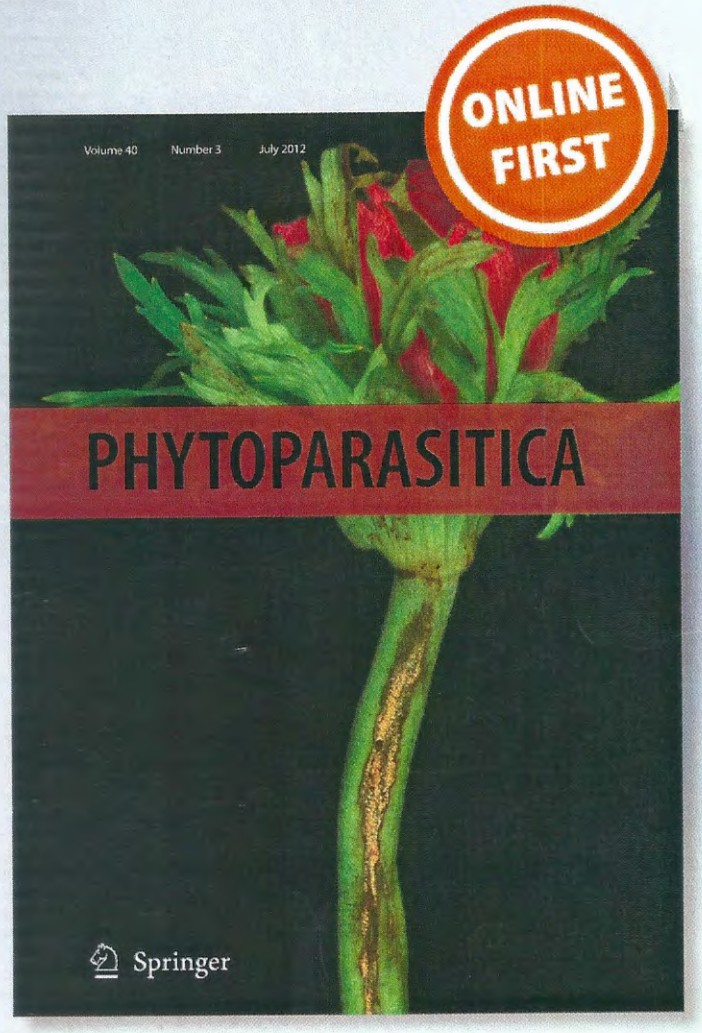

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Litchi stink bug (*Tessaratoma javanica*) outbreak in Jharkhand, India, on litchi

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Abstract The litchi stink bug *Tessaratoma javanica* (Thunberg) (Hemiptera: Tessaratomidae) is a minor insect pest of litchi (*Litchi chinensis* Sonn.) in India. Recently, an outbreak of litchi stink bug was observed in the Chotanagpur plateau of Jharkhand, India, during February–April 2011. A description of the outbreak is given in this report. Females were fonnd to be highly fecund and caused severe damage to the litchi crop (>80%) in the region. Incubation period of eggs was found to be 12.80 days. The mean nymph population was 45.66 nymphs per 30-cm shoot length, and the maximum was159 nymphs, observed during March and April 2012 on litchi trees. The outbreak of the pest may be due to the migration of bugs from wild kusum (*Schleichera oleosa* (Lour.) Oken) plants (a host plant of the litchi stink bug) to the cultivated litchi crop. During the course of the investigation, two natural enemies were found on litchi stink bug, *viz., Anastatus bangalorensis* Mani & Kurian and *Ooencyrtus* sp. However, the natural parasitization by the parasitoids was very low, 3.5%. Considering the damage caused to the litchi crop in this region, the recent outbreak created an alarming situation for the pest management researchers of the country to develop suitable integrated pest management strategies in the near future. Otherwise this will become a major problem to the litchi growers as well as to industries associated with this delicious fruit in India.

Keywords *Anastatus bangalorensis* · Chotanagpur plateau · Kusum · Migration · Natural enemies · Pest outbreak

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Introduction

Litchi (*Litchi chinensis* Sonn.) is one of the most important subtropical fruit trees of the family Sapindaceae. India is the second largest producer of litchi in the world after China, with an area and production of 77,600 ha and 497,300 t, respectively, during 2010–11 (Anon. 2012). Eastern India, comprising Bihar, Jharkhand and West Bengal, accounts for 85% of the total litchi production in the country. In Jharkhand, litchi is grown over an area of 4,300 ha with the production of 35,900 t of fruit (Anon. 2012).

Several bugs, *viz., Tessaratoma javanica* (Thunberg), *T. papillosa* (Dury), *T. quadrata* Distant, *T. nigripes* Dallas and *T. malaya* Stål are causing huge economic losses in quality and quantity of the litchi, longan and citrus fruits in Australia, China, Myanmar, and Thailand (Han *et al.* 1999; Leksawasdi & Kumchu 1991; Lu *et al.* 2006; Menzel 2002). Usually, a low incidence of *T. javanica* has been reported from different regions of India. The peak incidence of the pest was 1.21–4.09

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bugs (nymphs and adults) per shoot during 2008 in northwestern India (Kumar *et al.* 2008). In the northwestern part of India, the insect appears on litchi from the last week of April and disappears from the orchard after the last week of August and undergoes hibernation in adult stages (Kumar *et al.* 2008). In the present study, during the last week of February and March, 2012, exceptionally large numbers of eggs and egg-laying female adults along with their copulating adults were observed on litchi trees, which resulted in the outbreak of thousands of nymphs and adults during the second week of April 2012 and causing severe losses to litchi fruits (>80% fruit loss). This region is strategically important with respect to litchi production in the country due to the earliness of fruit maturity. Keeping in mind the emerging potentiality of the region on litchi production and the threat of the litchi stink bug, we describe the recent outbreak of *T. javanica* in the Jharkhand, an eastern state of India.

Materials and methods

The location for this study was Ranchi (23° 45′ N, 85° 30′ E, elevation 620 m above msl), Jharkhand, in the eastern part of India. Five locations adjacent to the main study area were selected at random within the locality for studying the incidence of bugs. Fecundity, longevity and biological parameters were studied in field cages (Fig. 1) under natural field conditions. In the field cages, one pair of adult bugs (one male and one female) per cage (n=10) was kept for recording data on fecundity and egg period. The first instar nymphs of the bug were transferred to another cage for recording observation on nymphal period. The nymphs were transferred to a new litchi twig by cutting the old twigs along with nymphs and tag with the new twig (previously uninfested) weekly. The transfer of nymphs from old twig to new twig was necessary for normal development of the bugs as they deplete food resources very quickly due to the voracious sap sucking habit of adults and nymphs. Eggs were also kept under laboratory conditions in the Entomology Laboratory at ICAR Research Complex for Eastern Region, Research Centre, Ranchi, for recording any natural mortality. The adults of litchi stink bug were sent for identification to Systematic Entomology Laboratory, Division of Entomology, Indian Agricultural Research Institute, New Delhi. The parasitoids emerged from the eggs of litchi stink bug were sent for identification to the Systematic Entomology Laboratory, Department of Zoology, University of Calicut, Kerala, India.

Fig. 1 A cloth net cage for study of stink bug biology under field conditions

Results

Aggregates of the litchi stink bug adults were found in the hibernating stage on only four out of 100 monitored plants (6–8 adults per tree) from October 2011 to January 2012. The hibernated adults became active in the last week of January 2012 and started dispersing to other litchi plants coinciding with emergence of panicles on the Shahi variety of litchi. Mating of the adults started from the first week of February 2012. The colonization of adults started on litchi plants during the first week of February 2012, and during the second week of February 2012 the first egg mass was observed on the lower surface of tender leaves. The mean density of egg masses was 11.66 egg clusters/m^2 plant canopies (range 8–15 egg clusters) from the first week of March 2012 to the third week of April 2012. A single egg cluster consisted mostly of 14 eggs but ranged between 10 and 16 eggs per cluster. Normally, the adult females were found to prefer to lay eggs on the lower surface of the young leaves but egg laying was also found on inflorescence, flowers, fruits of litchi and even on the already laid eggs. The newly laid eggs were globular in shape, pink in color (sometimes white also) but their color became slightly

blackish before hatching (Fig. 2). Under the field cages, a maximum of 16 egg batches (mean 13.40 egg batches, range10–16, n=10) were laid by the single gravid female. The eggs were hatched in 12.80±1.40 days (range 9–18 days, n=70). Only four instars of the insect were observed in the field cages. The mean developmental period of first, second, third and fourth instar nymphs was 11.69±0.58 (range 10–13 days, n=61), 7.23±0.20 (range 7–8 days, n=61), 8.63±0.55 days (range 8–10 days, n=42) and 13.04± 0.55 days (11–14 days, n=50), respectively.

The population of immature stages of stink bug increased drastically from the second week of March and the highest population (159 nymphs/ 30 cm shoot length) was recorded during the first week of April. The mean number of nymphs per 30 cm shoot length was 45.66, when recorded from the second week of March to the third week of April. Gregarious adults and nymphs were voraciously sucking sap from tender plant parts such as growing buds, leaf petioles, inflorescence, fruit stalks, fruits and tender branches of the litchi tree, which resulted in drying of growing buds, tender shoots, heavy fruit drop and ultimately total damage to the litchi crop (Figs. 3, 4, and 5). Frequent movement of the adults and nymphs of the litchi stink bug from one plant to another was recorded throughout the study period. This can be attributed to resource shortage due to exhaustive feeding by the insects.

Laboratory studies of field-collected eggs of *T. javanica* showed parasitization of two natural enemies (parasitoids), *viz. Anastatus bangalorensis* Mani & Kurian (Hymenoptera: Eupelmidae) and *Ooencyrtus* sp. (Hymenoptera: Encyrtidae). However, emergence of parasitoids from litchi stink bug eggs was very low, *i.e.,* 3.5% (n=200).

Fig. 3 Hundreds of litchi stink bug nymphs feeding gregariously and voraciously on litchi shoots

Discussion

Understanding the factors responsible for an outbreak of any insect species is a complex matter and is difficult to predict. It may be harder to identify the ecological causes of their occurrence and is even more complex for the insect species that has a longer life cycle, with migration, like litchi stink bugs. The stink bug population in litchi orchards increased drastically in a short period of time during March and April 2012. The recent outbreak of stink bug may be due to the consequences of water-stressed plant conditions or migration from different host plants present in this area. In Jharkhand, a large number of wild Kusum (*Schleichera oleosa* (Lour.) Oken) plants as an alternate host of litchi stink bug are present (Singh *et al.* 2009), which might have caused the sudden increase of the stink bug population on flowered litchi plants (Fig. 6). The water stressed woody plant favoring the pest outbreak has been reported by many researchers

Fig. 2 Egg mass of litchi stink bug on inflorescence (**a**), and on lower surface of the leaves (**b**)

Fig. 4 Total loss of litchi flower and fruit due to attack of litchi stink bug

Fig 6 Colonization of litchi stink bug nymphs on Kusum (*Schleichera oleosa*), a wild tree plant in the region

(Hunter 2002; Mattson & Haack 1987). The total rain received during January to April 2012 (Table 1) in the region is lower than normal (12 mm during 2012 as compared with an average of 86 mm during the years 2006–10). Hence, this may be one of the reasons for the outbreak of the pest. However, this needs further investigation to derive a concrete conclusion of this recent outbreak of the litchi stink bug.

The management of *T. javanica* is of great concern for entomologists as this pest will have a serious effect on the litchi cultivation in India. Practically, it was found to be very difficult to manage this insect by chemical insecticides. Since litchi is a cross-pollinated crop, it needs insect pollinators, mostly honey bees, for pollination –which takes place during the last week of February to the second week of March. The population of litchi stink bug starts rising with the emergence of inflorescences. Therefore, any insecticide application for the management of the pest affects the insect pollinator population in the field. The application of insecticides to the hibernating population of stink bugs did not produce good results. This may be due to the presence of high fat in tissues, wax layer on ventral side of the body, and hard hemielytra in hibernating adults, all of which protects them from effects of insecticides. The classical biological control of litchi stink bug utilizing *Anastatus japonicus* (Hymenoptera: Eupelmidae) and *O. phongi* Trjapitzin *et al.* (Hymenoptera: Encyrtidae) has resulted in effective management of the pest in China, Hong Kong and Thailand (Han *et al.* 1999; Leksawasdi & Kumchu 1991). Therefore, the natural enemies identified infesting eggs of *T. javanica* – *viz., A. bangalorensis* and *Ooencyrtus* sp. – in the present study would help in the development of effective integrated pest management modules of the litchi stink bug if mass reared and released in the field.

Fig. 5 Attack of litchi stink bugs on tender fruits

Table 1 Monthly rainfall (mm) from January to April (2006–2012) in Ranchi, Jharkhand

Months	2006	2007	2008	2009	2010	2011	2012
	Rainfall (mm)						
January	0	0	7.4	35	19.5	0	12
February	4.2	53	25	12	38	12	0
March	64	46	9	16	20	4	0
April	0	34.2	19.6	0	18	5	0

Considering the recent outbreak and damage to the litchi crop in this region there is a need for urgent investigation of the eco-biology, behavior, spatial and temporal distribution, and response to management practices of this species so that effective management strategies can be designed in the near future. Failing this, the litchi cultivation in Jharkhand as well as the neighboring states like Bihar and West Bengal may suffer seriously from this bug. In turn, it will be a major setback to the litchi farmer's livelihood, industries as well as the consumer of this delicious fruit in India as well as abroad.

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