Occurrence of *Conopomorpha sinensis* Bradley, 1986 (Lepidoptera: Gracillariidae) on litchi (*Litchi chinensis*) in India

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Scientific Note

Occurrence of *Conopomorpha sinensis* Bradley, 1986 (Lepidoptera: Gracillariidae) on litchi (*Litchi chinensis*) in India

Conopomorpha cramerella (Snellen, 1904) (originally *Acrocercops cramerella*) is an important pest of cocoa, *Theobroma cacao* L. (Malvaceae), in south Asia (Bradley 1986) but has also been cited as a pest of litchi, *Nephelium litchi* Cambess (Sapindaceae), in India (Singh 1975, Kumar et al. 2011). Bradley (1986), however, in his redescription of *C. cramerella* with descriptions of several related new species (*C. oceanica*, *C. sinensis*, and *C. litchiella*) concluded that *C. cramerella* is restricted to cocoa and rambutan, *Nephelium lappaceum* L., and does not feed on litchi, while *C. sinensis* and *C. litchiella* both do attack litchi. Bradley (1986) further clarified that the male paratype of litchi fruit borer found boring into the top shoots of litchi in Pusa, India, was identified as *A. cramerella* by E. Meyrick (1916). Until now, there have been no reports from India mentioning the occurrence of *C. sinensis*.

A review of the literature indicates that *C. cramerella* was first reported mining the leaves of litchi in Bihar, India (Singh 1975). More recently, litchi fruit borer damage was estimated at 48–74% in West Bengal, India (Chakraborti et al. 2005). Similarly, several independent reports widely reported *C. cramerella* as the fruit borer occurring on litchi in India (Butani 1977, Lall & Sharma 1978, Kumar et al. 2011). As Bradley (1986) discussed, however, the identification of this economically important pest as *C. cramerella* is incorrect, but Indian workers continue to refer to the litchi fruit borer as *C. cramerella*. Taking all of this into consideration, it is clear that the fruit borer occurring on litchi in India may, in fact, be *C. sinensis* rather than *C. cramerella*. The present study was undertaken to generate taxonomic, molecular and pheromonal response data sets for confirmation of the litchi fruit borer species occurring in India.

An infestation of litchi fruit borer was observed during October to November, 2015 in the experimental fields of the Central Horticultural Experiment Station (CHES), Chettalli, Kodagu (12.38°N, 75.64°E, 609 AMSL), regional station of ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka State, India. Fallen fruits (n = 3018) of different litchi varieties (i.e., Green, Early Seedless, Dehradun, Shahi, and Dehra Rose) were brought to the laboratory and opened to confirm infestation by *Conopomorpha* spp. We estimated the economic loss caused by litchi fruit borer using correlation and regression analysis. Additionally, visual, fortnightly observations were taken on the number of fruits infested per bunch for each tree. Infested fruits were placed inside wooden cages (46 cm × 46 cm × 46 cm) for rearing through to adult moths. The larvae were whitish in color and pupated within the cages, spinning thin, transparent cocoons. In the field, it was observed that pupation takes place in the leaves. The adult moths are 5 mm in length with a long filiform antenna and narrow, fringed forewings (Fig. 1). Additionally, during active litchi fruit borer incidence, we placed sex pheromone traps with lure ((E,E,Z)-4,6,10-hexadecatrienyl acetate) specific for *C. cramerella* (Pest Control India, Ltd., Bengaluru).

The adult moths were identified morphologically as *C. sinensis* using Bradley (1986) and following the genitalic dissection procedure described in Shashank et al. (2015).

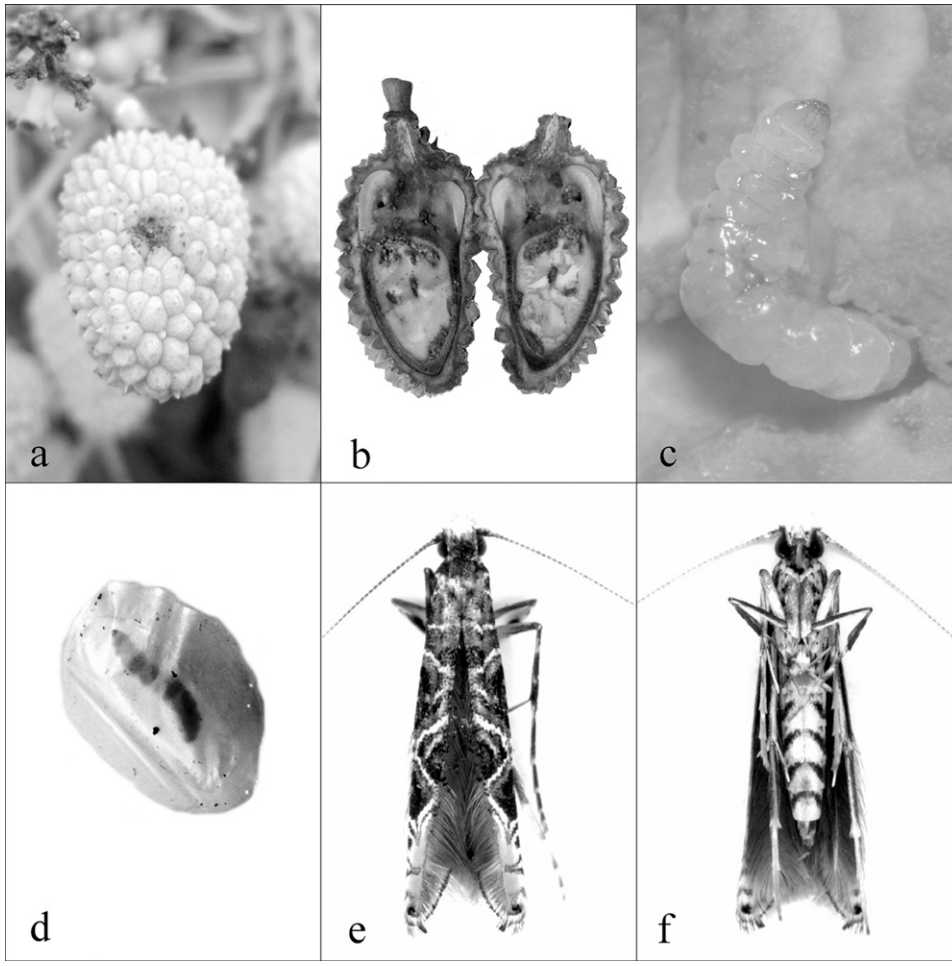

Figure 1. Litchi fruit borer, *C. sinensis* damaged fruit (a); damaged fruit cut open to show feeding within the fruit 5mm (b); larva (c); creamy transparent thin layered cocoon (d); dorsal view of adult female 5mm (e); ventral view of adult female (f).

Female genitalia of *C. sinensis* are shown in Fig. 2. The ostium is narrow, with the margin of lamella anteraginalis concave and smooth edged. The signum forms an elongate dentate patch. In the male genitalia, the vulva is moderately broad basally, costa arched, cucullus somewhat narrowed distally, distal part of sacculus studded with 12–15 stout setae, with a dense field of heavy setae in costal area immediately costad. The aedeagus bears a pair of heavy cornuti, each cornutus bifurcate or trifurcate at the tip (Bradley 1986).

Another set of adults was retained for molecular identification using the nucleospin tissue kit method (MACHEREY-NAGEL). Molecular identification was performed using the mitochondrial cytochrome oxidase I (COI) and nuclear elongation factor 1 alpha (Ef1α) genes. The COI gene was amplified through initial denaturation at 94°C for 5 min, followed by 36 cycles of denaturation 94°C for 45 sec, annealing 52°C for 45 sec, extension 72°C for 1 min, and final extension at 72°C for 12 min. The nuclear

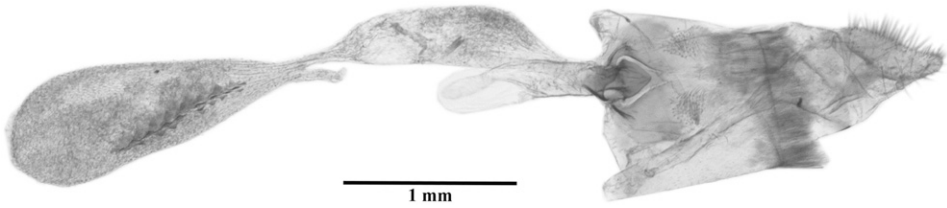

Figure 2. Female genitalia of *C. sinensis*.

elongation factor 1 alpha (Ef1α) gene was amplified through initial denaturation at 85°C for 5 min, followed by 40 cycles of denaturation 94°C for 30 sec, annealing 50°C for 1 min, extension 72°C for 90 sec, and final extension at 72°C for 10 min.

Molecular analyses confirmed the species as *C. sinensis* Bradley, and voucher specimens were deposited in the Division of Entomology, Indian Agricultural Research Institute, Pusa, New Delhi. The COI and Ef1α sequences obtained were annotated and submitted to the NCBI gene bank (Accession no.: BankIt1888613 *Conopomorpha_sinensis*_L16 KU578041 and Accession no.: BankIt1891569 *Conopomorpha_sinensis* KU687325). Our samples showed 99% (COI) and 100% (Ef1α) similarity to *C. sinensis*. Both of the gene sequences were submitted to the BOLD (Barcode Of Life Data systems) database and generated barcode BIN (Barcode Index Number) ACD5201. The COI and Ef1α gene data support the morphological identification and establishes that the litchi fruit borer occurring in India is *C. sinensis* rather than *C. cramerella* as published in earlier studies.

Samples of fallen fruit revealed 48.4% incidence of infestation by *C. sinensis*, and the infestation decreased as the fruit matured, after which the pest began infesting the tender shoots of litchi trees. The total number of fallen fruits showed a significant positive correlation ($P = 0.01$) with number of fruits infested with *C. sinensis* ($r = 0.72$). A linear relationship was observed between *C. sinensis* infested fruits and total number of fallen fruits, suggesting the borer incidence led to heavy fruit drop ($y = 0.61x - 8.13$; $R^2 = 0.90$). Comparison of *C. sinensis* infestation in fallen fruits and fruits remaining on trees revealed that fallen fruits had a higher infestation rate; this suggests that observation of fruits after harvesting will not yield accurate estimates of losses caused by *C. sinensis.*Instead, the fallen fruits during fruiting season need to be sampled to get actual estimates of fruit loss by *C. sinensis*. Further, the borer damage usually observed at the base of the fruit stalk and the bored hole is not usually visible externally; therefore, it is necessary to cut open fruits to determine infestation rates by *C. sinensis*. In opened fruits, borer damage is evident within the seed showing frass-packed feeding tunnels, and the stalk of the infested fruits dried ultimately leading to fruit drop. Of different varieties observed, the maximum fruit infestation was found in the variety Dehradun (53.27%) and the minimum in the variety Green (23.37%). Sex pheromone traps with specific lure for *C. cramerella* did not catch any *C. cramerella* moths at either the Bengaluru or the Chettalli locations where litchi fruit borer incidence was noted. The absence of moths in sex pheromone traps specific to *C. cramerella* further indicates that the litchi fruit borer in these areas is not *C. cramerella*.

The present study has clearly established that the fruit borer occurring on litchi in India is *C. sinensis* and not *C. cramerella* as reported earlier and contradicting earlier

studies revealing that the host range of *C. cramerella* does not include litchi. Hence, this study clears up the confusion and establishes *C. sinensis* as litchi fruit borer based on taxonomic, molecular and sex pheromone trap data. The present report is crucial for devising management strategies, as erecting *C. cramerella* traps will not reduce infestation rates of the litchi fruit borer (*C. sinensis*). In particular, species-specific sex pheromones need to be deployed, based on species identity; current farming practices of erecting *C. cramerella* sex pheromone traps to curb the fruit borer damage (*C. sinensis*) in litchi growing belts is ineffective. This study further emphasizes the need to initiate semiochemical studies on the Indian litchi fruit borer *C. sinensis* population to identify its specific sex pheromone components.

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Literature Cited

Bradley, J. D. 1986. Identity of the South-East Asian cocoa moth, *C. cramerella* (Snellen) (Lepidoptera: Gracillariidae), with descriptions of three allied new species. *Bulletin of Entomological Research* 76(1):41–51.

Butani, D. K.1977. Pests of litchi in India and their control. *Fruits* 32:269–273.

Chakraborti, K. & A. Samanta. 2005. Evaluation of litchi germplasm based on biochemical parameters along with incidence of leaf roller (*Platypepla aprobola* Meyr) and fruit borer (*C.cramerella* Snellen). *Annals of Plant Protection Sciences* 13:338–342.

Kumar, V., A. Kumar & V. Nath. 2011. Emerging pests and diseases of litchi (*L. chinensis* Sonn.). *Pest Management in Horticultural Ecosystems*, 17(1):11–1.

Lall, B. S. & D. D. Sharma. 1978. Studies on the bionomics and control of the cocoa moth *A. cramerella* Snellen (Lepidoptera: Gracillaridae). *Pesticides* 12(12):40–42.

Meyrick, E. 1916. Exotic Microlepidoptera. *Exotic Microlepidoptera (Marlborough)* 2(1):1–32.

Singh, H. 1975. *Acrocercops cramerella* Snell (Gracillariidae: Lepidoptera) as a pest of litchi in Uttar Pradesh and its control. *Indian Journal of Horticulture* 32:152–153.

Shashank, P. R., L. Saravanan, P. Kalidas, T. Phanikumar, V. V. Ramamurthy & N. C. Bose. 2015. A new species of the genus *Acria Stephens*, 1834 (Lepidoptera: Depressariidae: Acriinae) from India. *Zootaxa* 3957(2):226–230.

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