

## SAPODILLA SEED BORER, *Trymalitis margarias* Meyrick: AN INVASIVE OR INDIGENOUS SPECIES?

**P. D. KAMALA JAYANTHI and ABRAHAM VERGHESE**

Division of Entomology and Nematology, Indian Institute of Horticultural Research,  
Hesseraghatta Lake PO, Bangalore 560089, India  
E-mail: jaiinsect@yahoo.co.in

**ABSTRACT:** The present study reports the pathway of the likelihood entry, establishment and spread of a micro-lepidopteran, *Trymalitis margarias* Meyrick (Lepidoptera:Tortricidae), commonly known as sapodilla seed borer, into India from Sri Lanka. It was an accidental introduction through infested fruits of sapodilla, *Manilkara achras* (Mill.). The historical data on species description along with environmental compatibility, host plant availability of origin and destination habitats, survivability of larvae of *T. margarias* during transport were considered as criterion to evaluate the likelihood of pathway. In view of the extensive sapodilla cultivation and internal fruit shipment, the potential of this invasive species to spread within the country is discussed in detail.

**Keywords:** Invasive species, sapodilla, seed borer, *Trymalitis margarias*.

### INTRODUCTION

We investigated the establishment and spread of a microlepidopteran seed borer, *Trymalitis margarias* Meyrick (Lepidoptera: Tortricidae), an economically important pest on sapodilla [*Manilkara achras* (Mill.)], also called as chiku or sapota in India. The study assumes importance as this pest, first reported from Dahanu area of Maharashtra in 2000 (Patel, 2001), within a span of six years has dispersed to south India causing up to 35 per cent fruit damage (Jayanthi and Vergheese, 2007). Micro-Lepidoptera belongs to the groups Pterophorina, Tortricina, Tineina and Micropterygina (Powell, 1999). The larvae of almost all these are concealed feeders; leaf miners; borers in roots/stems/seeds; cause plant galls; or create shelters using silk to draw together leaves or other feeding substrates

(Clarke, 1976) and the vast majority of them are host plant specialists.

The tortricid seed borer, *T. margarias* has not been cited in the earlier reports that listed 10, 25 and 39 species of insects and mites as pests on sapodilla respectively (Sandhu *et al.*, 1974; Butani, 1979; Patil, 1986). Later citations of insects on sapodilla (that recorded 20 species of insects) also did not mention *T. margarias* (Hill, 1993). Nevertheless, it was described as 'recently introduced insect' in Konkan region of Maharashtra (Puri and Mote, 2003) and was also mentioned under 'menace of exotic pests' (Paras, 2007), perhaps implying invasiveness. This draws attention to the exact status of this pest, whether exotic or indigenous with a mere shift from obscure to apparent. Thus, a need to have a close look into the memoirs of *T. margarias* was

felt. In this paper, based on surveys conducted and literature scanned we attempt to systematically establish the zoogeographic movement of *T. margarias* and to confirm its status either as an invasive or an indigenous species.

## MATERIALS AND METHODS

Field surveys were conducted to collect the larvae of *T. margarias* in the areas of incidence and the larvae were reared to adult. Taxonomic identification of the adult moths was done to ascertain the species identity. Extensive systematic literature survey was also done starting from the year 1905 when the Type species of *T. margarias* was first described by Edward Meyrick to date. Data/information thus collected on the status and distribution of the species globally and within India were pieced together to work out the most probable pathway of introduction and spread of *T. margarias*. Data on geographical spread of sapodilla were also collected as supplementary information. Geographical coordinates of certain areas of infestation were collected to compare climatic similarities.

## RESULTS AND DISCUSSION

The detailed investigation that aided in tracking the introduction pathway model of *T. margarias* is presented below.

### **Taxonomic history of Genus *Trymalitis*:**

The super family, Tortricoidea that includes Genus *Trymalitis* (Tribe: Chlidanotini; Sub family: Chlidanotinae) is a monophyletic containing single family Tortricidae comprises about 60 species in over 20 genera from Neotropical/Oriental/ Australian regions (Horak, 1999). It has been mentioned from Australia (Common, 1965) and Africa (Meyrick, 1912). Most of the genera/species of the Chlidanotini were also reported to occur in Ceylon (=Sri Lanka) (Clarke, 1976). The Indian Chlidanotini forms a small group with

about half a dozen described Indian species, without a mention of genus *Trymalitis* (Fletcher, 1920 and 1929).

In Indian literature, the first mention of the Genus *Trymalitis* Meyrick was made in the “Journal of Bombay Natural History Society” with type-species *Trymalitis margarias* Meyrick during 1905 by monotypy under ‘Descriptions of Indian Micro-Lepidoptera’ (Meyrick, 1905). The type locality was Kandy/Puttalam in then Ceylon (=Sri Lanka). The syntypes – 2 ‘♂’s were deposited at Natural History Museum, UK, and seems to be lost at present. The other species described so far under Genus *Trymalitis* are presented in Table 1.

Study of global distribution of *Trymalitis* species clearly showed that none of the species belonging to the Genus *Trymalitis* were recorded from India, and may be, therefore considered not native to India with the exception of *T. cataracta* which was reported from Andaman Islands (Clarke, 1976) which is like ‘Sri Lanka’ an island away from the main land (Table 1). Recently the occurrence of *T. margarias* was reported for the first time in Dahanu area of Maharashtra which was identified by Dr Tuck, CABI Bioscience, UK (Patel, 2001). This is the first report of *T. margarias* in India. The larvae of *T. margarias* are concealed feeders with in the seed, and are monophagous on sapodilla, as there has been no record of other host plants as this group is known to be host specialists (Clarke, 1976).

### **ii) Sapodilla origin and distribution:**

Sapodilla (=Sapota), *M. achras*, popularly known as chiku is one of the common fruit crops of India. It is not strictly tropical and is native to Central/South America, specifically from the Yucatan Peninsula of Mexico to Costa Rica, where the largest population of native trees still exists (Gilly, 1943). Early in colonial times, it was carried to the Philippines and later was adopted everywhere in the Old World tropics. In Indian sub-continent region first entry of sapodilla was into Ceylon (=Sri Lanka) in 1802 by Portuguese. Later, it

**Table 1. Described species of *Trymalitis* (other than *T.margarias*)**

Species described	Type localities	Location	Distribution
<i>T. cataracta</i>	Ceylon (=Sri Lanka), Maskeliya	lectotype ♂ at Natural History Museum, UK	Micronesia, Eastern Australia, New Guinea, Fiji, Sri Lanka, Africa, Andaman Islands, Bismark Archepelago (Meyrick, 1907; Brown, 2005)
<i>T. escharia</i>	Guam Ritidian	holotype ♂ at Smithsonian Institution, USA	Southern Mariana Is, Micronesia Islands (Brown, 2005; Clarke, 1976)
<i>T. macarista</i>	Fiji Islands, Vunidawa	holotype ♀ at Natural History Museum, UK	Fiji, Ceylon, Java, Siam, Queensland, New Guinea, Fiji, Bismarck Is. (Meyrick, 1934; Bradley, 1957; Evenhuis, 2007)
<i>T. climacias</i>	Australia, Queensland, Cooktown	holotype ♀ at Natural History Museum, UK	Australia, Queensland (Meyrick, 1911)
<i>T. optima</i>	Fiji	lectotype ♂ at Natural History Museum, UK	Rainforests of southern Queensland and northern New Southwales (Horak, 1999; Bradley, 1957; Meyrick, 1911)
<i>T. scalifera</i>	South Africa, Natal, Zululand, Mfongosi	holotype ♂ at South African Museum, South Africa	South Africa (Common, 1965; Razowski, 2004)

entered India during 1888, as an introduction into a village Gholwad of Thane district of Maharashtra (Cheema *et al.*, 1954). This dispersal in to Indian subcontinent might have happened during colonialism, wherein the strong aggregate of Portuguese holdings (part of these holdings was later dominated by Dutch as well as British) all over western coast of India as well as north-western coast of Sri Lanka ([http://en.wikipedia.org/wiki/File:Portugal\\_Imp%C3%A9rio\\_total.png](http://en.wikipedia.org/wiki/File:Portugal_Imp%C3%A9rio_total.png)) and the frequent trade voyages (mainly through Indian Ocean). Thus, these colonial foot prints in both western coastal India as well as western coastal Sri Lanka together with their regular trade in Indian Ocean provide strong base of the possible introduction of sapodilla into Sri Lanka and later to India. Today, India is the largest producer of sapodilla (Chadha, 1992) and commercial plantations prosper in coastal areas

of Maharashtra, Gujarat, Tamil Nadu, Karnataka and Andhra Pradesh.

### iii) Economic status assessment of *T. margarias* in India

After the first report of *T. margarias* (Patel, 2001), a concurrent research report from Dapoli, Maharashtra during the year 2000 mentions the seed borer incidence as “... severe incidence of hitherto unknown seed born pest of sapota.....in Dapoli, Maharashtra” (Anonymous, 2001). Another report also from coastal districts of Thane endorses the occurrence of *T. margarias*, causing upto 21% yield loss since the year 2000 ([http://www.kvkkosbadhill.com/AnnualProgressReport\\_04-05.doc](http://www.kvkkosbadhill.com/AnnualProgressReport_04-05.doc)) and explained the incidence as “.....Severe attack of chiku seed borer came in 2001, before the pest was identified and measures could be undertaken the season was

over". This further confirms that till the year 2000, *T. margarias* never surfaced in any reports. The regular roving/fixed plot surveys carried out under surveillance of insect pests of sapodilla in major sapodilla growing regions also did not report *T. margarias* till 2001 (AICRP,2000). Interestingly, though the seed borer was reported in the year 2000, an exhaustive insect pest list of sapodilla by Somdutt (2001) also did not mention *T. margarias*. This shows that the incidence of seed borer *T. margarias* till then was limited to only Dahanu and surroundings. Later, during 2001 and 2003-04, 21% and 40% incidence of *T. margarias* was reported in Thane and Gandevi respectively (Anonymous, 2001 and 2005; Dumbre, 2004). In southern states of India, 25 per cent incidence was reported from Bangalore during 2006-07 (Kalpana, 2003; Anonymous, 2008) and 60 per cent incidence was observed in Periyakulam during 2008-09 (Dr Kumar, Pers. comm.). This clearly showed that in the last one decade after its first report, *T. margarias* might have spreaded in to southern parts of India may be through fruit shipment and established over a period of time. An action plan for Indian agriculture for coming 25 years by a high level committee under the chairmanship of Dr Swaminathan (<http://pdkv.mahlnicl.in/research>) reports *T. margarias* as a new pest posing serious threat in some regions and recommends an urgent research to tackle seed borer on priority basis to sustain and expand horticultural revolution.

**iv) *T. margarias* movement and invasive potential :** The authors' hypothesis is that *Trymalitis margarias* is a non-native species to India and had reached India from Sri Lanka as an accidental introduction through cargo via sea route and established in Dahanu area in Maharashtra. The growing internationalization of trade and increasing movement of horticultural produce adds strength to this hypothesis. Usually, when an exotic pest is introduced to a new area, it can be expected to behave as it does in its native area, if host plants and climates are similar ([http://www.aphis.usda.gov/peer\\_review/](http://www.aphis.usda.gov/peer_review/)

[downloads/APHIS-2006-00720002%5B1%5D.pdf](http://www.aphis.usda.gov/peer_review/downloads/APHIS-2006-00720002%5B1%5D.pdf)). Comparison of eco-climatic zones of Dahanu and Puttalam, for both host availability and climate suitability also further supports this view. Dahanu (19° 58' 0"N; 72° 44' -1" E) a seaside port town in Thane district, Maharashtra from where the first report of *T. margarias* came is on western coast of India and Puttalam (8° 01' 17"; 79° 50' 27" E), is also situated on the west coast of Sri Lanka that borders Indian ocean from where the holotype of *T. margarias* was described in 1905. Both these western Sri Lanka and western India's coastal stretches have typical tropical wet weather with characteristic hot and humid with short dry season. Thus, in addition to the similar climatic conditions, the geographical proximity of these places through sea route gives clear indication that the regular sea route transports would have helped in the accidental introduction of *T. margarias* into Dahanu (Fig.1).

Secondly, the introduction of an exotic pest should be in to an area that has suitable host range, if it has to establish successfully which otherwise perishes. That means the 'risk' posed by an introduced arthropod pest to establish in a new area is assumed to be positively correlated with host range i.e., the risk of an exotic pest to establish successfully is rated as a function of host range. In the present scenario, this further supports the author's assumption that the *T. margarias* introduced into Dahanu area had plenty of scope to establish, as it is famous for its sapodilla orchards from colonial times. Thus, inspite of being host plant specific, *T. margarias* did find ample base in terms of host plants (sapodilla trees) in the new environment to survive and establish. From here, in a span of ten years, it would have spreaded through out South India.

The alternate hypothesis for introduction of *T. margarias* into India could be the much proximal route from Sri Lanka into Tamil Nadu compared to Dahanu, but surprisingly this did not happen, as the first report of the pest came

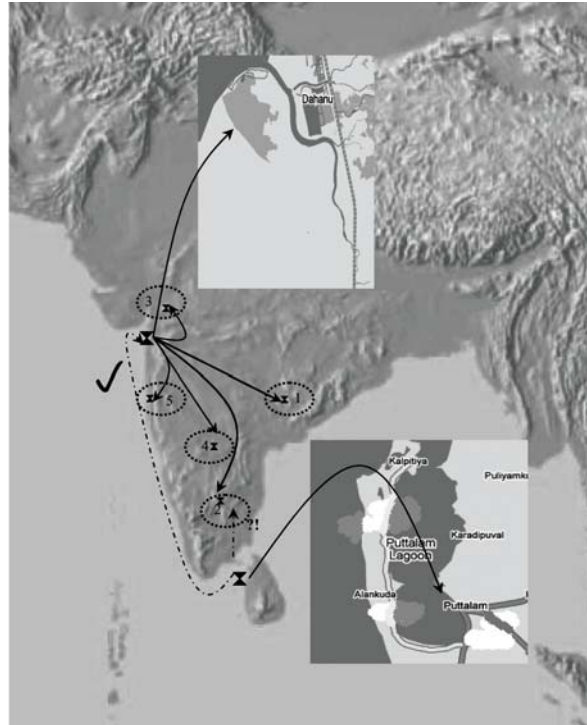


Fig. 1 : Predicted route of *T. margarias* introduction and spread in India [✓ mark shows the most probable route of introduction from Puttalam in Sri Lanka from where the holotype (X) described], to Dahanu (X), in Thane, Maharashtra, India; "?! mark shows the probable alternate proximal route of introduction to Tamil Nadu that did not happen (Later reports of seed borer incidence in 2003); X shows the spread of *T. margarias* within the country to southern territories viz., Karnataka [4], Konkan region [5], Gujarat [3] Tamil Nadu [2] and Andhra Pradesh [1].

from Dahanu. Further, it may be argued that *T. margarias* may not have got reported immediately from Tamil Nadu, but this contention does not hold well as *T. margarias* causes very significant and noticeable loss to sapodilla fruits both quantitatively as well as qualitatively that cannot go unnoticed. This limits the possibility of introduction of *T. margarias* into Tamil Nadu region as an alternate pathway. Further, report on occurrence of sapodilla pests through roving as well as fixed plot surveys in all agro-climatological regions of Tamil Nadu during 2001, did not mention occurrence of *T. margarias* (Muthukrishnan et al., 2001). Therefore, exploring all the probabilities clearly indicates that introduction of *T. margarias* into Dahanu areas of Maharashtra through sea route sounds apt

than its entry into any other region of the country.

*Trymalitis margarias*, a non-native species of India has definite potential for expanded distribution as it can get carried undetected through shipments of fruits, because of the tiny size and the ability to stay within in the fruit through harvest in larval stage. Therefore, studies on patterns in sapodilla fruit shipment, trade and domestic quarantine are particularly relevant to curtail the further spread of this pest.

## REFERENCES

- AICRP, 2000. Annual Report of All India Coordinated Project (AICRP), IIHR, Bangalore.



- Anonymous, 2001. In Annual Report, Dr. BSKK Vidyapeeth, Dapoli, Maharashtra.
- Anonymous, 2005. In Annual Report of All India Coordinated Project (AICRP), IIHR, Bangalore.
- Anonymous, 2008. In Annual Report of Indian Institute of Horticultural Research, Bangalore.
- Bradley, 1957. Nat. Hist. Rennell I. Br Solomon Is 2:97 (=cataracta Meyr)
- Brown, J. W., 2005. I World catalogue of insects, Tortricidae. vol. 5.
- Butani, D. K. 1979. Insects of fruit crops. Periodical Expert Book Agency, Delhi 31, pp. 415
- Chadha, K.L. 1992. Strategy for optimization of productivity and utilization of sapota [*Manilkara achras* (Mill.) Forsberg.]. *Indian Journal of Horticulture*, **49**(1): 1-17.
- Cheema, G.S., Bhat, S.S. and Naik, K.C. 1954. Commercial fruits of India. Ed. Macmillan & Co.
- Clarke, J.F.G. 1976a. *Insects of Micronesia, Microlepidoptera: Tortricoidea*. **9**(1):144
- Clarke, 1976b. *Trymalitis escharia* Clarke, *Insects Micronesia*, **9**(1): 142.
- Common, I. F. B. 1965. A revision of the Australian Tortricini, Schoeotenini, and Chlidanotini, (Lepidoptera: Tortricidae: Tortricinae). *Australian Journal of Zoology*, **13**(4) 613 - 726.
- Common, I.F.B., 1990. In Moths of Australia. Melbourne University Press. pp. 535.
- Dumbre, M.R., Desai, B.D., Mule, R.S., Mehendele, S.K., and Jalgaonkar, V.N. 2004. Studies on seasonal incidence and biology of sapota seed borer, *Trymalitis margarias* Meyrick in Thane district. *Pestology*, **28**(6), 50-3.
- Evenhuis, N.L. 2007. Checklist of Fijian Lepidoptera. *Bishop Museum Technical Report*, **38**(13)
- Fletcher, B.T. 1920. Life histories of Indian insects microlepidoptera (Memoirs of the department of agriculture in India). In Entomological series Vol VI, No.3 Published for The Imperial Department of Agriculture in India by Thacker, Spink & Co., Calcutta, W. Thacker & Co, London.
- Fletcher, T.B. 1929. A list of generic names used for Microlepidoptera. Mem. Depart. Agric. India. *Entomological Series*, **11**:1-244, Calcutta
- Gilly, C.L. 1943. The sapodilla-nispero complex. *Tropical Woods*, **73**:1-22.
- Hill, D.S. 1993. In "Agricultural insect pests of the tropics and their control". First Indian Edition, Foundation books, Daryanganj, New Delhi, Cambridge University press pp. 746
- Horak. M. and Brown R. L. 1991. In: *Tortricid Pests*, van der Geest LPS, Evenhuis HH (eds). Elsevier, Amsterdam, Netherlands. Pp. 23-48.
- Horak, M. 1999. The Tortricoidea. In Lepidoptera, moths and butterflies Vol I. Evolution, systematics and biogeography (Ed Niels P. Kristensen). Pp. 199
- Jayanthi, P. D. K. and Verghese. A. 2007. Record of parasitoids on sapota seed borer, *Trymalitis margarias* Meyrick. *Insect Environment*, **13**(3):131-132.
- Kalpana, B. 2003. Bioecology and management of sapota seed borer, *Trymalitis margarias* Meyrick (Lepidoptera: Tortricidae). M.Sc Thesis submitted to University of Agricultural Sciences, Bangalore

- Meyrick, E. 1905. *Trymalitis* Meyrick. *Journal of Bombay Natural History Society*, **16**: 590 (Type-species: *Trymalitis margarias* Meyrick, *ibid* [by monotypy])
- Meyrick, 1907. *Trymalitis cataracta* Meyrick. *Journal of Bombay Natural History Society*, **19**:153
- Meyrick, 1911. *Trymalitis optima* Meyrick. *Proc. Linn. Soc. N. S. W.* **36**:295
- Meyrick, E. 1912. *Trymalitis scalifer* Meyrick, South African Micro-lepidoptera. *Annals of South African Museum*, **10**: 58.
- Meyrick, E. 1934. *Trymalitis macarista* Meyrick, 1934, *Exotic Microlepid*, **4**: 489.
- Muthukrishnan, N., S. Palaniswamy, R. Bhuvaneshwari, R. Logiswaran, and T. Thangaraj. 2001. Sapota pests: survey, bionomics, varietal reaction and IPM. In 'IPM in Horticultural crops:emerging trends in new millennium'. In Proceedings of the II National symposium on integrated pest management in horticultural crops, new molecules, biopesticides and environment, October 17-19, 2001, Bangalore India. Pp. 82-83.
- Paras, N. 2007. In Entomology: Novel Approaches (ed. Jain PC and Bhargava, MC). Pp. 43-96.
- Patel, Z.P. 2001. Record of seed borer in sapota, *Manilkara achras* (Mill.) Forsberg. *Insect Environment*, **6**(4): 149
- Patil, R.H. 1986. In "Studies on insects infesting sapota (*Achras sapota* L.) with special reference to biology and chemical control of flower bud borer". M. Sc. (Agri.) thesis, submitted to U.A.S. Dharwad.
- Powell, J.A. 1999. <http://www.hastingsreserve.org/Invertebrates/Insects/MicrolepidHst.html>
- Puri, S.N. and Mote. U.N. 2003. In "Emerging pest problems of India and critical issues in their management : an overview". Proceedings of the National Symposium on Frontier Areas of Entomological research, Nov 5-7, 2003, IARI, New Delhi, India pp.13-25
- Razowski, J. 2004. Review of the genera of Afrotropical Tortricidae (Lepidoptera). *Acta zoologica cracoviensia*, **47**(3-4):167-210
- Sandhu, G.S., Singh, B., Singh, A. and Bhalla, G.S. 1974. Insect pests of sapota and their control. *Punjab Horticulture Journal*, **14**: 134-136.
- Somdutt, 2001. Fruit Crops: Sapota. In Hand Book of Horticulture, published by ICAR, New Delhi 110012, pp. 308-312.