OCCURRENCE OF THE MORACEAE-FEEDING BOMBYCID, *Trilocha varians* (Walker) (BOMBYCIDAE, LEPIDOPTERA) AS PEST OF JACKFRUIT AND SOME ORNAMENTAL SPECIES OF *FICUS* IN THE PHILIPPINES

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ABSTRACT

The occurrence of the bombycid moth, *Trilocha varians* (Walker) (Lepidoptera: Bombycidae) was observed and monitored among *Ficus benjamina* and *F. nitida* in the landscape of the National Crop Protection Center from August to December 2012. Eggs, larvae and pupae of the pest were all present on the infested shrubs. The larvae completely defoliated and eventually killed some of the *Ficus* plants. At the peak of infestation, larvae can consume all of the leaves of an individual shrub in just overnight. *T.* varians was also observed infesting jackfruit in Los Baños, Laguna and Balete, Batangas as well as on *F. nitida* in Baguio City. The nature of damage, host response and host range were discussed. This is the first record of *T. varians* as pest of *Artocarpus heterpphyllus, A. communis*, *A. kamansi* and some ornamental species of *Ficu*s in the Philippines.

Key words: damage, host range, invasive pest

INTRODUCTION

The Philippines for the last several years was affected by outbreaks and isolated serious infestations of invasive pest species - *Stenocranus pacificus* Kirkaldy on corn, *Nipaecocus nipae* (Maskell), *Brontispa longissima* Gestro, and *Aspidiotus* sp., a species of scale insect, all on coconut, as well as native species like *Spodoptera exempta* (Walker) on graminaceous crops and weeds. Recently, larvae of a species of bombycid were first observed to have totally defoliated and eventually killed several plants of *Ficus benjamina* L. and *F. nitida* L. at the National Crop Protection Center, Crop Protection Cluster, College of Agriculture, University of the Philippines Los Banos (Figure 1).

The family Bombycidae is comprised of four subfamilies: Apatelodinae, Phiditinae, Prismostictinae, and Bombycinae (Lemaire and Minet, 1998). The genus *Trilocha*, with 20 others including *Bombyx,* is a member of the subfamily Bombycinae (Lamaire and Minet, 1998; Zolotuhin and Witt, 2009; Daimon et al., 2011). *Bombyx mori* (domesticated silkworm), the lepidopteran model insect of Bombycidae and its wild species *B. mandarina* were the most studied. Recently, the third species *Trilocha varians* was studied by various workers to increase the knowledge of species related to *B. mori* (Daimon et al., 2011).

T. varians is widely distributed in Southeast Asia including India, Nepal, Thailand, Myanmar, South China, Sumatra, Java, Taiwan (Zolotuhin and Witt, 2009), Japan (Kishida, 2002) and the Philippines. The larvae feed on leaves of plants belonging to the genus *Ficus* and are known as important pests of ornamental and roadside *Ficus* trees, such as *F. benjamina* and *F. microcarpa*

(Zolotuhin and Witt, 2009; Daimon, et al., 2011). We had reported the pest earlier through a conference oral presentation and poster but only the abstracts had been published (Navasero and Navasero, 2013; Navasero et al., 2013). This paper aims, therefore to formally report the occurrence of this bombycid moth as a new pest of jackfruit and some species of *Ficus* in the Philippines. In addition, as a relatively new pest record, this also aims to describe the nature of damage, host responses and potential host plants for future research on pest management of the pest.

Fig. 1. Damage of *Trilocha varians* on *Ficus* spp. (a-d): a. Dried-up and completely defoliated trees of *F. nitida* in Baguio City, b. partially and completely defoliated *F. nitida*, c. Initial damage of larvae on *F. benjamin,* and, d. Close-up of *F. nitida* at advanced stage of infestation. Note: b-d occurred in NCPC-UPLB-College of Agriculture, Philippines.

MATERIALS AND METHODS

Collection, Preservation and Stock culture of *T. varians*

Collection of larvae and pupae from infested *Ficus* species at the National Crop Protection Center was done to start the stock culture for rearing and identification of the species. Larvae were reared on detached leaf branches of *F. nitida* until pupation in 1.5 liter plastic containers in the laboratory. Pupae from the field were placed in glass cages for adult emergence. Reference materials were preserved in alcohol for the eggs, larvae and pupae, while adults were pinned, dried and stored in insect box.

Identification and Documentation

Identification of emerged adults from laboratory stock cultures was based on published literatures. Photographs of natural field infestation, and live and preserved specimens were taken using a digital camera.

Host range, Potential Host Plants, Damage and Field Infestation

Reported host plants were inspected for possible infestation of the larvae of the bombycid moth. Infested, defoliated and dead trees were counted in relation to the total number of trees. The nature of damage was noted and described. Eggs, larvae, and pupae whenever observed were collected and brought to the laboratory for further rearing and adult emergence.

In the laboratory, potential host plants including three species of fruit trees, namely: *Artocarpus heterophyllus, A. communis, A. kamansi,* and six ornamental species of *Ficus* (*F. benjamina*, *F. elastica*, *F. mclelandii*, *F. pumila*, *F. nitida* (non-variegated), *F. nitida* (variegated), *F. septica,* two species belonging to *Broussonetia* (*B. luzonica,* and *B. papyrifera*) and *Morus alba*, all belonging to family Moraceae were evaluated to confirm their host status and as potential larval hosts for rearing *T. varians.*

Apical branches of selected plants belonging to the family Moraceae were collected from different sites in the University of the Philippines Los Baños. Detached leaves were cut at about the size of the bottom cover of a plastic plate (inside diameter of 9cm) or offered whole to the test insect. Five 3rd to 5th instar larvae of *T. varians* were allowed to feed for 24hr separately on each host plant, with *F. nitida* as standard for comparison. Extent of feeding was rated visually using the following qualitative indicators scale: - = zero feeding, + = slight feeding, ++ = moderate feeding, and +++ = extensive feeding. This was done to identify possible host range of and suitable laboratory rearing hosts for *T. varians*. Three trials were conducted for this experiment.

F. nitida and *F. benjamina* were found as the more suitable host materials but only *F. benjamina* was used in maintaining the stock culture and biological studies since the latter was more abundant.

RESULTS AND DISCUSSION

Identity, Occurrence, and Distribution

Search in the literature for similar species of bombycid feeding on plants belonging to species of Moraceae led to *Trilocha varians* (Walker) (=*Ocinara varians*), a species also native to the Philippines (Figure 2a-d) (Daimon *et al*., 2012; Konno *et al*. 2006). Adults are medium sized, dark brown to grayish brown. First to third instar larvae are dark green to grey with short, fleshy,

curved horns. Fourth to fifth instars are dull brown and the caudal horns reduced. The second to fourth instar larvae are covered with white powdery secretions. Pupation takes place in a boat-shaped cocoon, closely woven with papery silk on intact and detached leaves, leaf branches, on the walls and paper towel covers of rearing vessels. It was reported as pest of economically important species of *Ficus* and jackfruit in other countries (Huang *et al*. 2002, Ruan 2009, Udayagiri 1988, Hutson 1930). Its characteristic feeding damage was later seen also on *F. nitidas* in Baguio City, and damage and presence of larvae on jackfruit in Los Baños, Laguna and Balete, Batangas. *T. varians* is widely distributed in Southeast Asia (Thailand, Myanmar, Sumatra, Java) including India, Nepal, South China, Taiwan (Zolotuhin and Witt, 2009), and Japan (Kishida, 2002) but no report of it as pest had been encountered yet in the country (Gabriel 2000). Hence, this is the first record of *T. varians* on jackfruit in the Philippines.

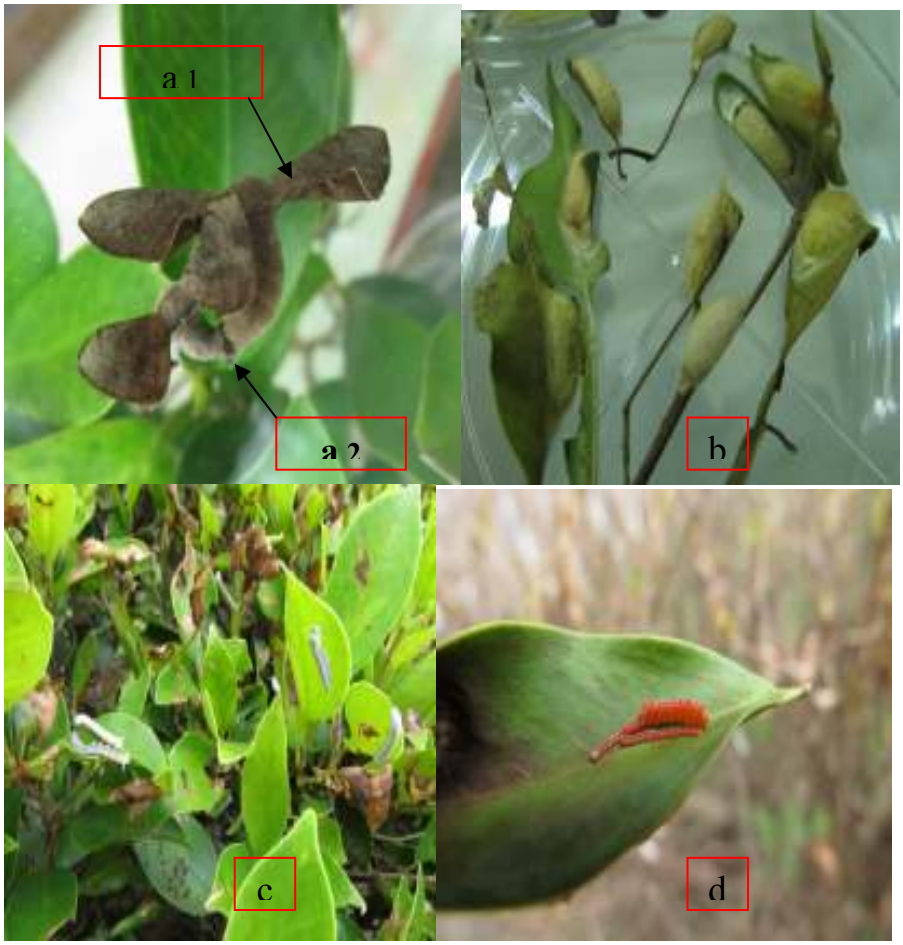

Fig. 2. Female (a.1) and male (a.2) adults in copula, pupal cocoons (b), aggregated feeding larvae (c), egg cluster laid on a leaf (d) of the bombycid moth, *Trilocha varians* (Walker) (all pictures taken at NCPC, UPLB-CA, Philippines).

Host range, Potential Host Plants and Nature of Damage

Three species of fruit trees, namely: *Artocarpus heterophyllus*, *A. communis*, *F. kamansi*, and six ornamental species of *Ficus* (*F. benjamina*, *F. elastica*, *F. mclelandii*, *F. pumila*, *F. nitida*

(non-variegated), *F. nitida* (variegated), *F. septica*) were accepted as food and fed upon by the larvae of *T. varians* (Table 1). The other two species of Moraceae, *Broussonetia luzonica*, a local traditional vegetable, and *B. papyfera*, an introduced and invasive plant species, have rough leaves that appear not suitable feeding substrates particularly for the smaller young larvae. Likewise, *Morus alba*, the sole host plant of *Bombyx mori,* was also not fed upon at all by the larvae. The larvae exhibit strong host preference for species within *Ficus* and there are major differences among species in their susceptibility to attack. The results suggest that under natural conditions the insect may able to complete its development on six species of *Ficus* and two species of *Artocarpus, A. communis* and *A. kamansi,* evaluated. Furthermore, the results also confirm the status of the two species of *Artocarpus* as new host records for *T. varians* in the Philippines. Actual feeding damage in the field by the larvae on *Ficus* are shown in Figure 1 and Figure 3 for *A. heterophyllus.*

Table 1. Plants belonging to family Moraceae tested as potential larval hosts and feeding damage of 3rd to 5th instar larvae of *Trilocha varians* (Walker) after 24h feeding access period.

HOST PLANT		EXTENT OF DAMAGE*		
Common name	**Scientific Name**	**Trial I**	**Trial II**	**Trial III**
Jackfruit	*Artocarpus heterpphyllus*	++	+++	+++
Marang	*Artocarpus communis*	++	++	++
Kamansi	*Artocarpus kamansi*	++	++	++
Himbabao	*Broussonetia luzonica*	-	-	-
Paper mulberry	*Broussonetia paperyfera*	-	-	-
Weeping fig	*Ficus benjamina*	+++	+++	+++
Rubber tree	*Ficus elastica*	++	++	++
Ficus	*Ficus mclelandi*	+	+	+
Common fig	*Ficus nitida* (non-variegated)	+++	+++	+++
Common fig	*Ficus nitida* (variegated)	+++	+++	+++
Creeping fig	*Ficus pumila*	-	-	-
Hauili	*Ficus septica*	+	++	+
Mulberry	*Morus alba*	-	-	-

*(-) = no feeding damage, (+) = slight feeding damage, (++) = moderate feeding damage, (+++) = severe feeding damage

All species of the tribe Bombycini have been reported to feed on the family Moraceae in nature (Zolotuhin and Witt 2009). *T. varians* has been reported to have special preference for fig plants (Daimon et al., 2012; Konno et al. 2006). The model species, *Bombyx mori* is known to feed solely on mulberry leaves (*Morus alba*). Mulberry leaves are toxic to insects that do not feed on them, mainly due to sugar-mimic alkaloids 1, 4-dideoxy-1, 4-imino-D-arabinitol (D-AB1) and 1-deoxynojirimycin (DNJ), which occur in mulberry latex at extremely high concentrations (Konno et al. 2006). Recent studies have demonstrated that *B. mori* has developed a unique enzymatic adaptation to these toxins (Hirayama et al. 2007; Daimon *et al*. 2008), suggesting that *T. varians* does not have mechanisms to overcome the defense chemicals of the mulberry. Thus, it would be interesting to examine in the future whether the latex of *F. benjamina* and *F. nitida* contains semio-chemicals attractive to the pest larvae that sustain their continuous feeding on said host plants. The latex contains several compounds with biological activity (da Cruz *et al,* 2012; Parveen *et al*, 2009; Yarmolinsky *et al*, 2009).

On *F. benjamina* or *F. nitida* early signs and symptoms of infestation of *T. varians* were white and papery patches on the upper surface associated with small early instar larvae which fed in cluster on the undersurface of leaves. Later, as the larvae got bigger and dispersed themselves within the canopy, they chewed-up irregular portions from the leaf margins toward the midribs consuming all the leaves of a branch. When most of the leaves were eaten-up, twigs died-back and at extreme case, the plant succumbed to death. Otherwise, the plant recovered and produced new flush. Infestation was first observed on a single plant of *F. nitida* which died shortly but infestation continued and four more died; others though unsightly without their leaves soon produced new flush and recovered.

Fig. 3. Appearance of feeding damage on *Artocarpus heterophyllus* (a-d) by *Trilocha varians*: a. Early instar larvae feeding on the underside of leaves, b. Feeding damage of bigger larvae, c. feeding mature larva with a pupal cocoon below and, d. fully recovered tree from infestation.

F. benjamina and *F. nitida* were severely infested by thrips destroying the aesthetic value of the plants. To restore probably the beauty of the landscape, these were pruned flat on the top and sides producing a square configuration and soon new flush developed. However, shortly thereafter, the beautiful landscape banished to infestation by *T. varians*, which presumably migrated from *Ficus* planted a few kilometers away. Interestingly, only those pruned plants were infested severely by the pest and this was attributed to new flush which were attractive to the migrating female moths in search for new oviposition sites and feeding hosts for the larvae. Since the infestation of *T. varians*

occurred for the first time in these plants, natural enemies were initially absent to keep the population in check.

On jackfruit, on the other hand, the larvae of *T. varians* also fed on leaves, also producing white patches attributed to feeding by early instar and irregular portions of leaves eaten up by bigger larvae. Normally, infestation maybe localized on a portion of the canopy or, occasionally, the whole canopy resulting in reduced reproductive potential of the tree. Growers do not control the pest because infestation does not last long, the crop recover and resume fruiting. This is attributed to the presence of an efficient natural enemy, a hymenopterous larval-pupal parasitoid.

CONCLUSION

Trilocha varians (Walker) (=*Ocinara varians*) devastated *Ficus benjamina* and *Ficus nitida* in the landscape of the National Crop Protection Center. *T. varians* is native to the Philippines, however; this is the first record for this species as pest of jackfruit and its related species, kamansi and marang and several species of ornamental *Ficus* in the country. Detailed studies on the confirmed host plants of *T. varians* to increase the knowledge on this pest in the country for future research are necessary.

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