

## The Species Composition of Thrips (Insecta: Thysanoptera) Inhabiting Mango Orchards in Pulau Pinang, Malaysia

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**Abstrak:** Satu kajian lapangan telah dijalankan di dua tempat di Pulau Pinang, Malaysia semasa dua musim pembungaan mangga yang berturut-turut pada tahun 2009 untuk memastikan perubahan komposisi spesies thrips yang menyerang bunga mangga (*Mangifera indica* L.) di ladang yang dirawat dan tidak dirawat dengan racun serangga. Kaedah halang gerak CO<sub>2</sub> dan pemotongan jambak bunga digunakan untuk mendapatkan spesies thrips yang berlainan dari jambak bunga mangga dan perumah rumpai masing-masing. Jambak bunga mangga dan pelbagai jenis spesies rumpai dalam dusun yang dirawat didiami oleh empat spesies thrips dari famili Thripidae; *Thrips hawaiiensis* (Morgan), *Scirtothrips dorsalis* (Hood), *Frankliniella schultzei* (Trybom) and *Megalurothrips usitatus* (Bagnall). Spesies rumpai, *Mimosa pudica*, *Cleome rutidosperma*, *Echinochloa colonum*, *Borreria laevicaulis*, *Veronia cinerea* and *Asystasia coromandeliana* menjadi perumah tambahan kepada thrips ini. Enam spesies thrips ditemui di dusun yang tidak dirawat. Antaranya ialah *Thrips palmi* (Karny), *Haplothrips* sp. (Amyot and Serville) serta empat spesies yang ditemui di dusun yang dirawat. Hurain ringkas tentang larva untuk setiap genus disediakan.

**Kata kunci:** Thrips, *Mangifera indica*, Rumpai, Malaysia

**Abstract:** A field study was conducted at two localities on Pulau Pinang, Malaysia, during two consecutive mango flowering seasons in 2009 to identify variations in the species composition of thrips infesting treated and untreated mango (*Mangifera indica* L.) orchards. The CO<sub>2</sub> immobilisation technique and the cutting method were used to recover different thrips species from mango panicles and weed host plants, respectively. The mango panicles and various weed species within the treated orchard were found to harbour four thrips species from the family Thripidae. These species were identified as *Thrips hawaiiensis* (Morgan), *Scirtothrips dorsalis* (Hood), *Frankliniella schultzei* (Trybom) and *Megalurothrips usitatus* (Bagnall). The weed species *Mimosa pudica*, *Cleome rutidosperma*, *Echinochloa colonum*, *Borreria laevicaulis*, *Veronia cinerea* and *Asystasia coromandeliana* served as additional hosts to these thrips. Six thrips species were found in the untreated orchard. These species included *Thrips palmi* (Karny), *Haplothrips* sp. (Amyot and Serville) and the four thrips species found in the treated orchard. A brief description of the larvae for each genus is provided.

**Keywords:** Thrips, *Mangifera indica*, Weed, Malaysia

## INTRODUCTION

Thrips of the order Thysanoptera are an increasing threat to the production of mango, *Mangifera indica* L. In Malaysia, mango is a significant commercial crop

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(Kostermans & Bompard 1993; Kwee & Chong 1994). Mango flower thrips feed on petals, anthers, pollen and floral nectaries, resulting in the discolouration and malformation of panicles (Higgins 1992; Pena *et al.* 2002). Apart from weakening the inflorescence and reducing fruit sets, thrips cause serious bronzing of the fruit surface due to the presence of air in emptied cell cavities. This effect is very pronounced in mature fruits (Lewis 1973) and renders these fruits unsuitable for fresh marketing (Dennill & Erasmus 1992; Grove *et al.* 2000; Nault *et al.* 2003). Flower thrips have a broad range of hosts, including weeds that provide refuge between mango flowering seasons (Aliakbarpour & Che Salmah 2011) and during the application of pesticides to mango flowers. The weeds act as a reservoir (Katayama 2006), encouraging the occurrence of several pests in agricultural fields (Ghosheh & Al-Shannag 2000). Hence, the determination of the thrips species composition on field populations of wild host plants is extremely important for developing a strategy to control thrips populations in the field.

The composition of thrips species infesting vegetables and ornamentals has been investigated in Malaysia (Vijayasegaran 1986; Khoo & Ooi 1989; Safruddin *et al.* 1989; Fauziah & Saharan 1991; Mound & Azidah 2009). However, thrips species have not been investigated in mango orchards in Malaysia, although thrips are regarded as one of the most important pests attacking mango inflorescences (Pena *et al.* 1998). The purposes of this study were to determine the thrips species infesting mango panicles on Pulau Pinang in differently managed mango orchards and to describe the distinguishing characteristics of the larval thrips collected.

## **MATERIALS AND METHODS**

### **Description of the Orchards**

Samples were taken from a treated mango orchard located at Kampung Perlis and an untreated mango orchard located at Kampung Sungai Burung, both in the district of Balik Pulau, Pulau Pinang. These areas are located near 5.417°N, 100.233°E and have an equatorial climate. The various pesticides routinely applied in the treated orchard included imidacloprid, cypermethrin, mancozeb, abamectin, chlorpyrifos, paclobutrazol and difenoconazole. These pesticides were used against several insect pests and fungal diseases throughout the year at the grower's discretion. The untreated orchard was not treated with any pesticides, but it received the recommended fertiliser applications. The mango orchards were supplied with water by irrigation through drip tubes spread over the orchards. The predominant variety of mango grown was MA224.

The thrips species inhabiting mango panicles were sampled weekly during two consecutive mango flowering seasons from January through September 2009. The thrips inhabiting different weed plants growing around the mango trees inside the treated orchard were collected on a weekly basis between June 2008 and March 2009. The thrips were collected between 1000 and 1300 hr on each sampling date. The time of mango flowering in different regions is primarily determined by climatic conditions. In Malaysia, mango

flowering is seasonal, normally occurring twice yearly from January through March (the main season) and August through September (the side season).

#### **Sampling of Thrips Species Using CO<sub>2</sub> Collection Technique**

Samples were collected from 35 randomly selected mango trees. Two panicles were arbitrarily selected from each tree for sampling. Each panicle was gently covered with a plastic bag, and the thrips enclosed within the plastic bag were immobilised with CO<sub>2</sub> (supplied by Malaysian Oxygen Berhad, Petaling Jaya, Selongor, in a 25 cm × 55 cm cylinder) released at a flow rate of 3.45 kPa (50 PSI) into the bag for 30 s (Aliakbarpour & Che Salmah 2010) and immediately fastened with a rubber band. The plastic bags were marked with the date and tree number and transported to the laboratory for further analysis. In the laboratory, the plastic bags were washed thoroughly with 70% ethanol. Adult and immature thrips were sorted under a stereomicroscope and mounted on microscope slides according to the methodology proposed by Mound (2007).

#### **Sampling of Thrips on Weeds in the Treated Orchard**

Several weed species grew in the treated mango orchard. To sample thrips on the weeds, the orchard was stratified into six units. Five plants were randomly collected from each weed species in each unit (a total of 30 plants). A weed plant with flowers and leaves was gently inserted into a 500 ml plastic bottle containing 70% ethanol, and its stem was quickly cut off with a pair of scissors to minimise the number of thrips flying away from the plant. The plant parts were immediately lowered into the bottle and capped. In the laboratory, the bottles were agitated vigorously to dislodge all thrips from the plants. The thrips on the weed plants were separated from the plant parts under a stereomicroscope using a collecting needle.

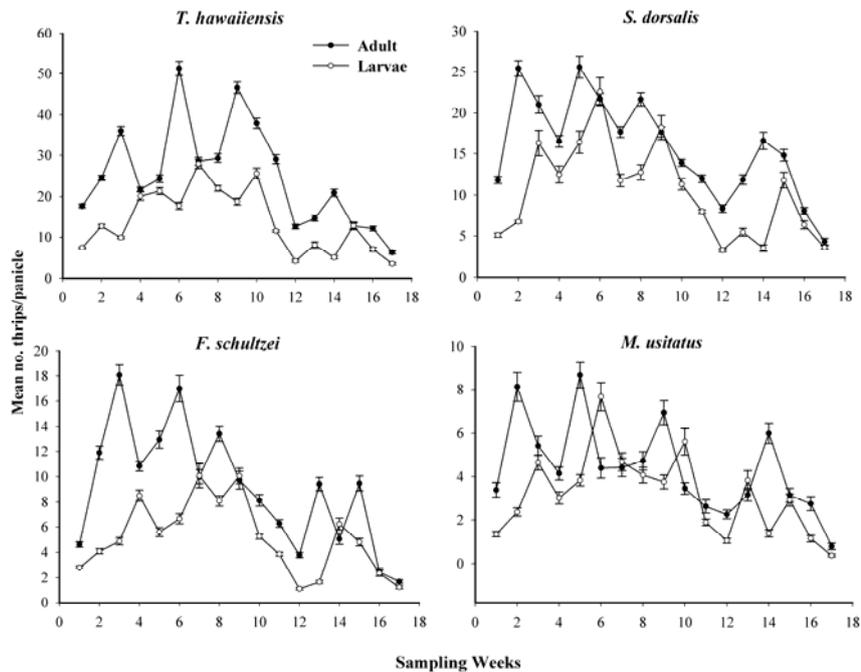
#### **Identification**

Prepared slides were labelled with appropriate data. The slides were examined under a compound microscope (Olympus, CX41RF, Singapore) equipped with an attached camera. The thrips species were recognised by examining their characteristic details and features. The identification of thrips adults was performed using the taxonomic key provided by Moritz *et al.* (2004). The characters of *Thrips hawaiiensis* collected in this study were compared with the descriptions in Mound and Azidah (2009). The identification of larvae to the respective genera was conducted based on guidance furnished by Dr. Laurence Mound (private communication). Identified species (adults) were sent to Dr. Surakrai Permkam at the Department of Pest Management, Faculty of Natural Resources, Prince Songkla University, Hat Yai, Thailand for final verification. A series of voucher specimens were deposited in the Insect Collection Unit, Laboratory of Entomology, Universiti Sains Malaysia, Pulau Pinang.

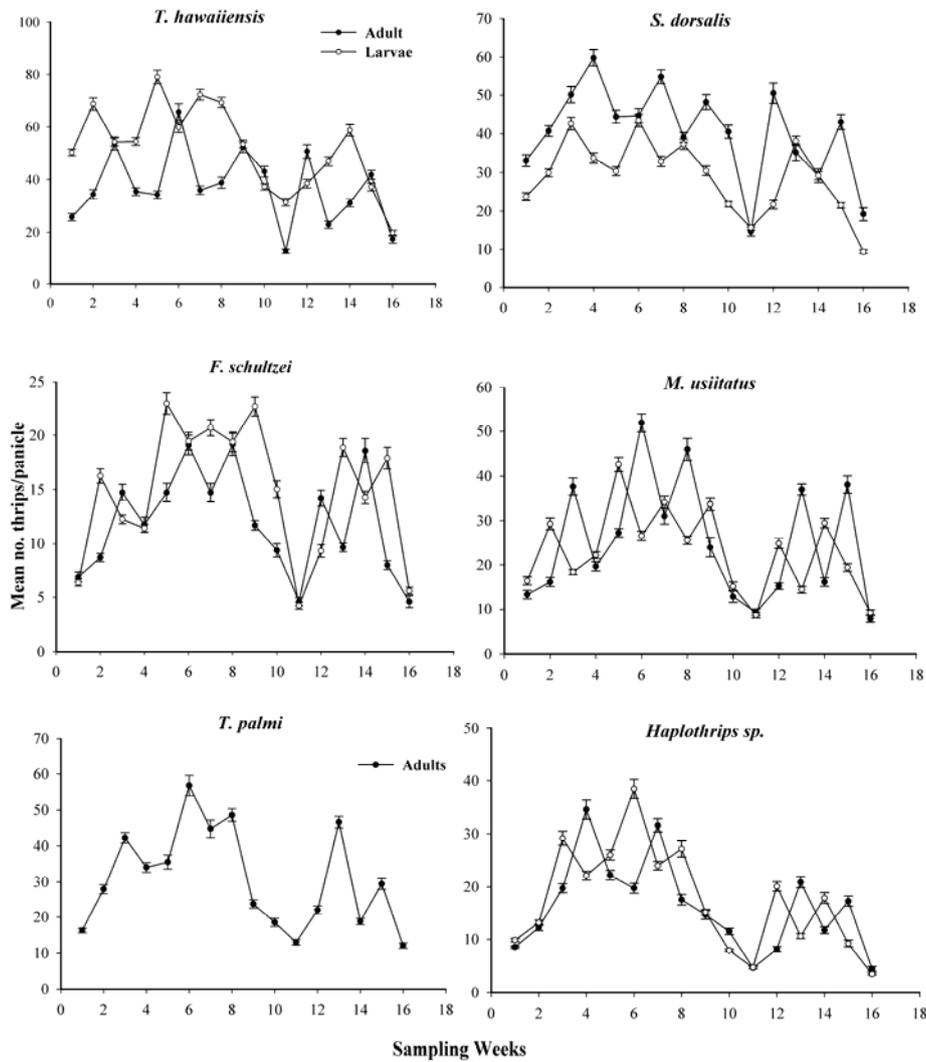
## RESULTS AND DISCUSSION

### Composition and Abundance of Thrips in Treated and Untreated Orchards

Four thrips species were found at higher abundances in the untreated mango orchard than in the treated orchard throughout the study period (Fig. 1 and 2). Six species, including the four found in the treated orchard, were encountered in the untreated orchard (Fig. 3). *T. hawaiiensis* was the most abundant species found in the treated orchard (44.3%), and *Scirtothrips dorsalis* was the most abundant species recovered from mango panicles in the untreated orchard (25.0%) (Table 1). Interestingly, no male thrips was found for any species collected other than *Haplothrips* sp. Of six thrips species found in the orchards during this study, five species belonged to different genera (*Thrips*, *Scirtothrips*, *Frankliniella*, *Megalurothrips* and *Haplothrips*). Thus, for example, the *Scirtothrips* larvae collected could be assumed to be *Scirtothrips dorsalis*. However, two thrips species belonged to the same genus (*Thrips*). Accordingly, the larvae of *T. hawaiiensis* and *T. palmi* were combined and analysed as a single group.



**Figure 1:** Mean ( $\pm$ SEM) number of four thrips species per panicle collected from the treated orchard during the study. Thrips larvae were identified only to genera. Data taken during the dry and rainy seasons were pooled (weeks 1 to 11: dry season; weeks 12 to 17: rainy season).



**Figure 2:** Mean ( $\pm$ SEM) number of six thrips species per panicle collected from the untreated orchard during the study. Thrips larvae were identified only to genera. Data taken during the dry and rainy seasons were pooled (weeks 1 to 10: dry season; weeks 11 to 16: rainy season). Because it is not possible to identify thrips larvae to the species level, the larvae of *T. hawaiiensis* and *T. palmi* were combined into a single group for analysis (larvae in *T. hawaiiensis*: larval *T. hawaiiensis* + *T. palmi*).

Because insecticides were routinely applied to control several pests of mango in the treated orchard, the recorded thrips species might have tolerated the insecticide pressures or could have developed some degree of resistance to



(a)



(b)



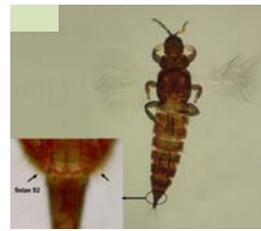
(c)



(d)



(e)



(f)



(g)

**Figure 3:** (a) *F. schultzei*, (b) *M. usitatus*, (c) *S. dorsalis*, (d) *T. hawaiiensis*, (e) *T. palmi*, (f) *Haplothrips* sp. (female), (g) *Haplothrips* sp. (male).

the chemicals. More species were able to live in the untreated orchard or in those orchards with a minimal use of insecticides. Although these two orchards were relatively close to each other (approximately 2 km apart), the absence of *T. palmi* and *Haplothrips* sp. in the treated orchard suggested that these two species were very susceptible to insecticide treatments. More studies on untreated mango orchards would confirm the susceptibility of these two species to pesticides.

All thrips species inhabited not only mango flowers but also many weed species in the treated orchard. Hence, the weeds served as additional hosts and refuges for the pests, as reported from other localities worldwide. Mango flower thrips were the most prevalent on weeds during the non-flowering period, when mango panicles were not available in the field. The thrips populations on the weed hosts decreased to low levels but increased to high levels on the mango panicles when the mango flowers bloomed during the flowering seasons (Aliakbarpour & Che Salmah 2011). Atakan and Uygur (2005) collected *Frankliniella occidentalis* from 49 weed species in a vegetable production area in Turkey. Pearsall and Myers (2000) found that most thrips reproduction took place on the flowers of ground-cover plants after the completion of nectarine blooming. As documented by Katayama (2006), weeds served as alternate hosts for western flower thrips, *Frankliniella occidentalis*, during the early spring. Our results suggest that weed species provide alternate food and oviposition sites for thrips when their most favoured host plant is not available. It is possible that the control of these weed species would eliminate sources of thrips infestation in the orchard.

Among the various weed species growing in the orchard, six species were infested with thrips (Table 2). The thrips species collected from these weeds were similar to the thrips species found on the mango flower panicles. *Mimosa pudica* and *Cleome rutidosperma* supported the largest densities of thrips throughout the year (Fig. 4 and 5). These two species and *Echinochloa colonum* were important alternate host plants for the most important thrips pests in this study (Fig. 6). *T. hawaiiensis*, along with two other species, *S. dorsalis* and

**Table 1:** Thrips species recovered from mango panicles using the CO<sub>2</sub> collection technique during the study.

Thrips species	Treated orchard		Untreated orchard	
	No. of sampling occasions	Total number	No. of sampling occasions	Total number
<i>T. hawaiiensis</i>	17	29857 (44.3)*	16	38833 (22.3)
<i>S. dorsalis</i>	17	18821 (30.6)	16	44146 (25.0)
<i>F. schultzei</i>	17	10830 (16.6)	16	13340 (7.5)
<i>M. usitatus</i>	17	5207 (8.5)	16	28206 (16.0)
<i>Thrips palmi</i>	17	0	16	34332 (19.2)
<i>Haplothrips</i> sp.	17	0	16	18162 (9.9)

Note: \* Percentage of total species

*Frankliniella schultzei*, was found on *Borreria laevicaulis* and *Veronia cinerea* (Fig. 7 and 8). *Asystasia coromandeliana* hosted two species of thrips, *T. hawaiiensis* and *Megalurothrips usitatus* (Fig. 9). The most abundant species was *T. hawaiiensis*, whereas the least abundant species was *M. usitatus*.

**Table 2:** Number of adults of various thrips species collected from different plant species in the treated mango orchard from June 2008 to March 2009. Thrips larvae were identified only to genera. A: adults, L: larvae.

Family	Scientific name	<i>T. hawaiiensis</i>		<i>S. dorsalis</i>		<i>F. schultzei</i>		<i>M. usitatus</i>	
		A	L	A	L	A	L	A	L
Fabaceae	<i>Mimosa pudica</i>	2490	1272	1832	774	1263	520	1150	525
Capparidaceae	<i>Cleome rutidosperma</i>	1921	772	1722	818	1130	582	1095	673
Poaceae	<i>Echinochloa colonum</i>	2481	1082	1671	819	1123	558	821	537
Asteraceae	<i>Veronica cinerea</i>	1048	535	957	455	494	319	0	0
Acanthaceae	<i>Asystasia coromandeliana</i>	663	390	0	0	0	0	853	533
Rubiaceae	<i>Borreria laevicaulis</i>	1180	488	1330	579	469	320	0	0
Rubiaceae	<i>Hedyotis verticillata</i>	0	0	0	0	0	0	0	0
Fabaceae	<i>Calapogonium caeruleum</i>	0	0	0	0	0	0	0	0
Poaceae	<i>Eleusine indica</i>	0	0	0	0	0	0	0	0

### Distinguishing Characteristics of Selected Thrips Larvae

Thrips larvae represented a large component of the thrips population in the mango orchards (Aliakbarpour & Che Salmah 2010). The morphological features of thrips adults are well defined. However, identification of larval thrips is difficult because the taxonomy of thrips larvae is poorly developed (Kucharczyk 2004). A number of morphological characteristics that differentiate thrips genera are described below.

#### Genus *Frankliniella*

Because there is no taxonomic key for the identification of larvae to the species level, the diagnostic characteristics of each genus were determined by Dr. Laurance Mound (private communication). The descriptions of the other characters were based on the authors' observations. The larvae of this genus have campaniform sensillae on tergite IX located approximately twice as far apart as the median dorsal pair of setae [Fig. 10(a)], abdominal segment II with spiracle, abdominal segment X without a row of microtrichia between the insertions of dorsal setal pair I, and dorsal setae I and II of abdominal segment IX pointed or slightly knobbed.

Species Composition of Thrips in Mango Orchards

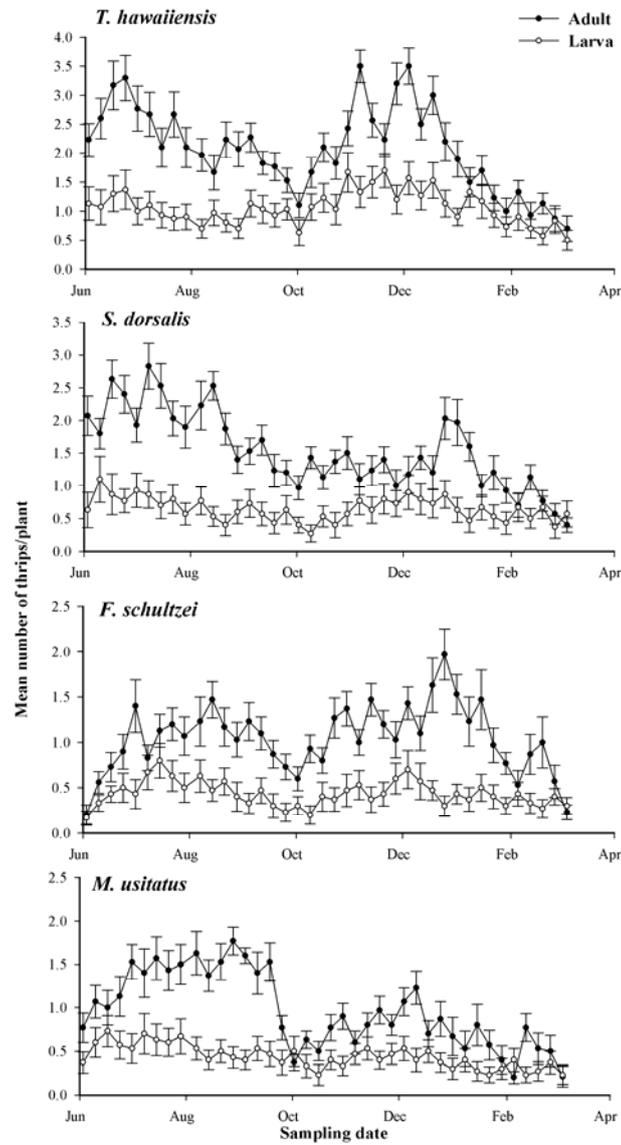
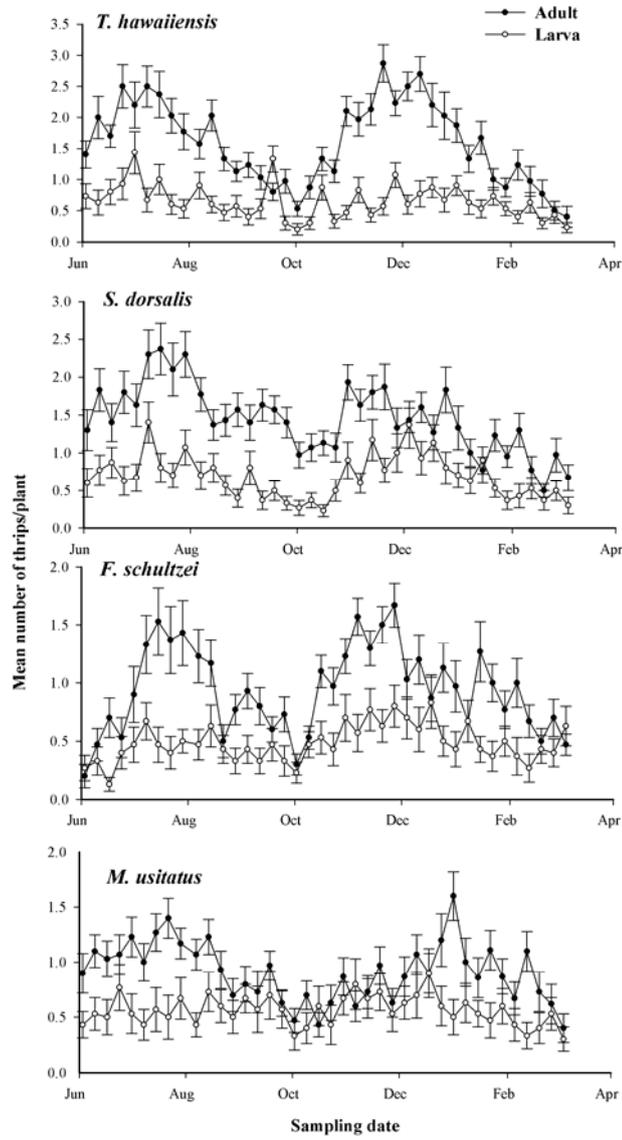
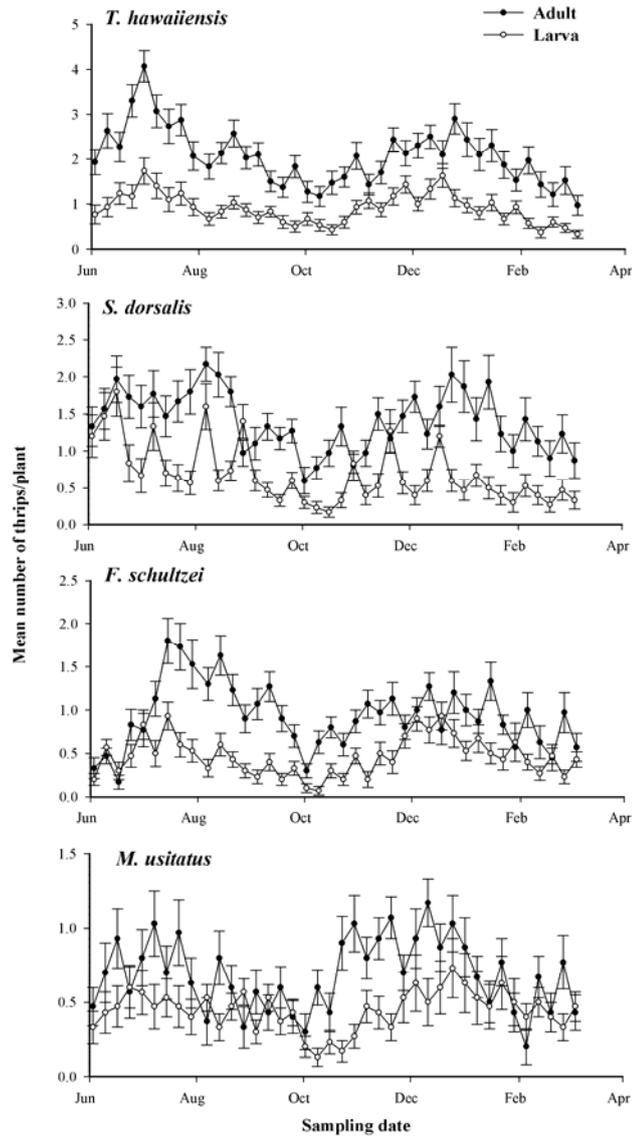


Figure 4: Mean ( $\pm$ SEM) number of thrips adults and larvae (identified to genera) on *M. pudica*.

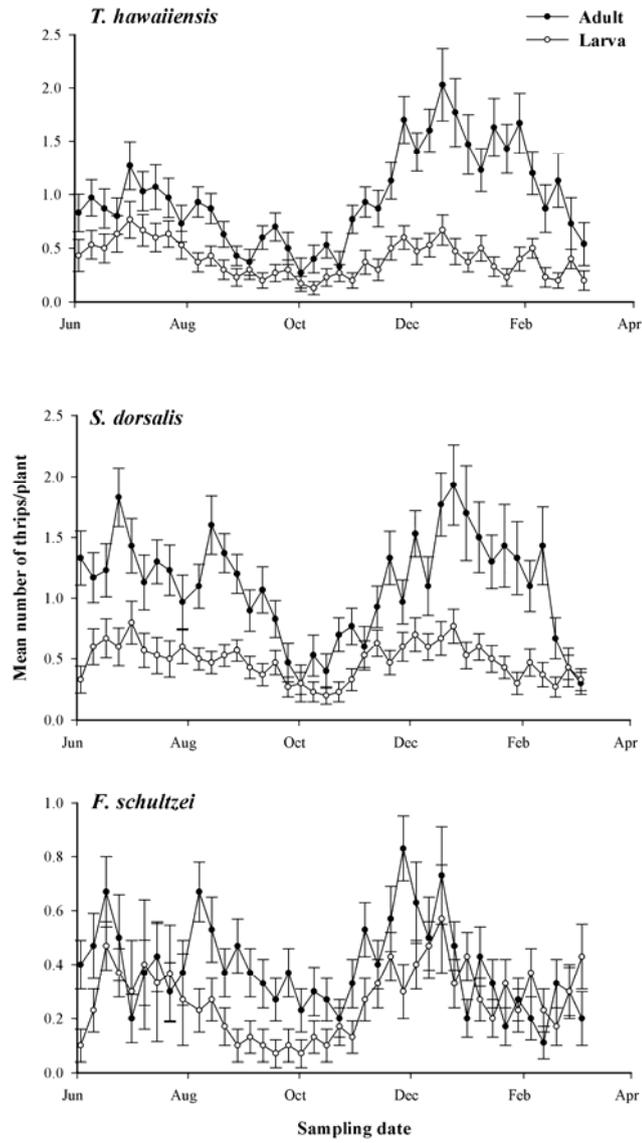


**Figure 5:** Mean ( $\pm$ SEM) number of thrips adults and larvae (identified to genera) on *C. rutidosperma*.

Species Composition of Thrips in Mango Orchards

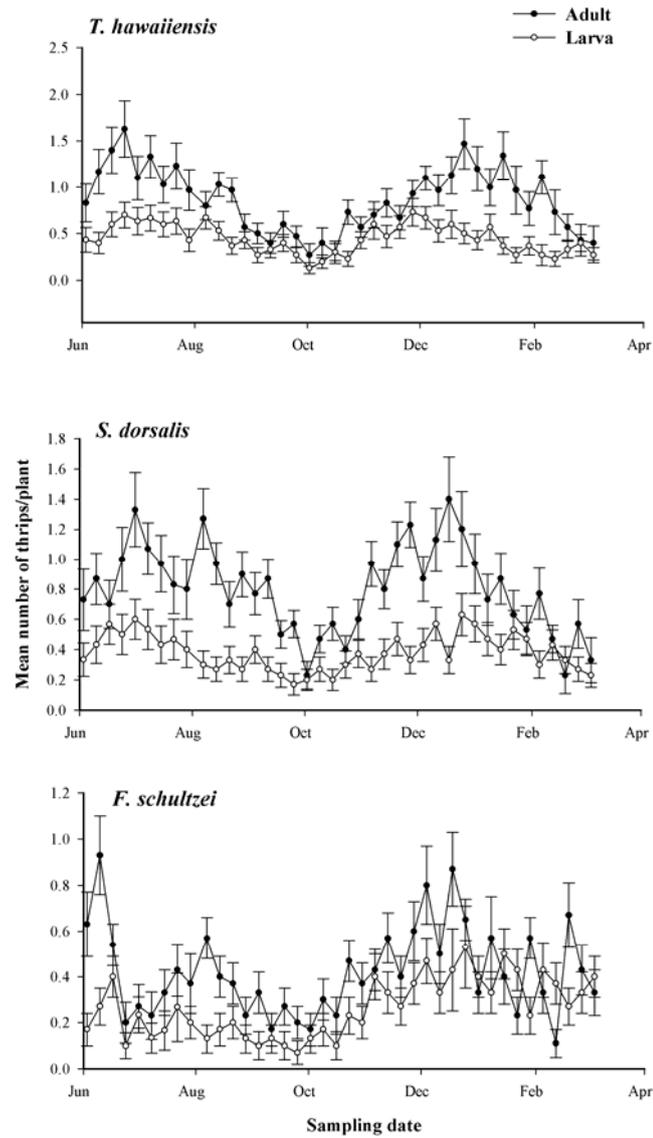


**Figure 6:** Mean ( $\pm$ SEM) number of thrips adults and larvae (identified to genera) on *E. colonum*.

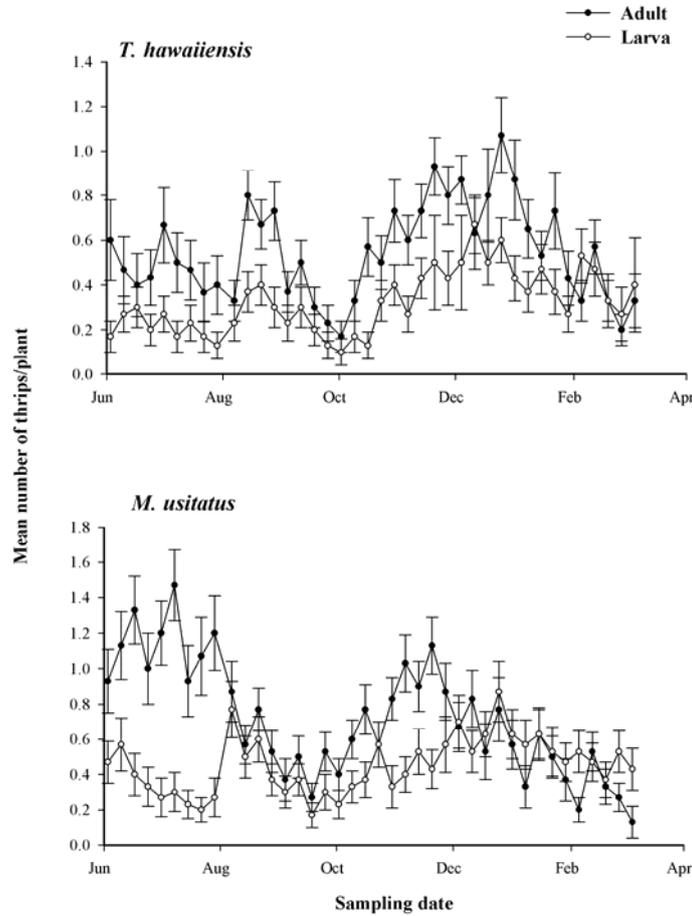


**Figure 7:** Mean ( $\pm$ SEM) number of thrips adults and larvae (identified to genera) on *B. laevicaulis*.

Species Composition of Thrips in Mango Orchards



**Figure 8:** Mean ( $\pm$ SEM) number of thrips adults and larvae on *V. cinerea*.



**Figure 9:** Mean ( $\pm$ SEM) number of thrips adults and larvae (identified to genera) on *A. coromandeliana*.

**Genus *Megalurothrips***

The larvae of this genus have a row of tiny teeth on the posterior margin of tergite VIII [Fig. 10(b)], abdominal segment II with spiracles, abdominal segment X with a row of microtrichia between the insertions of dorsal setal pair I, and dorsal setae I and II of abdominal segment IX pointed.

**Genus *Scirtothrips***

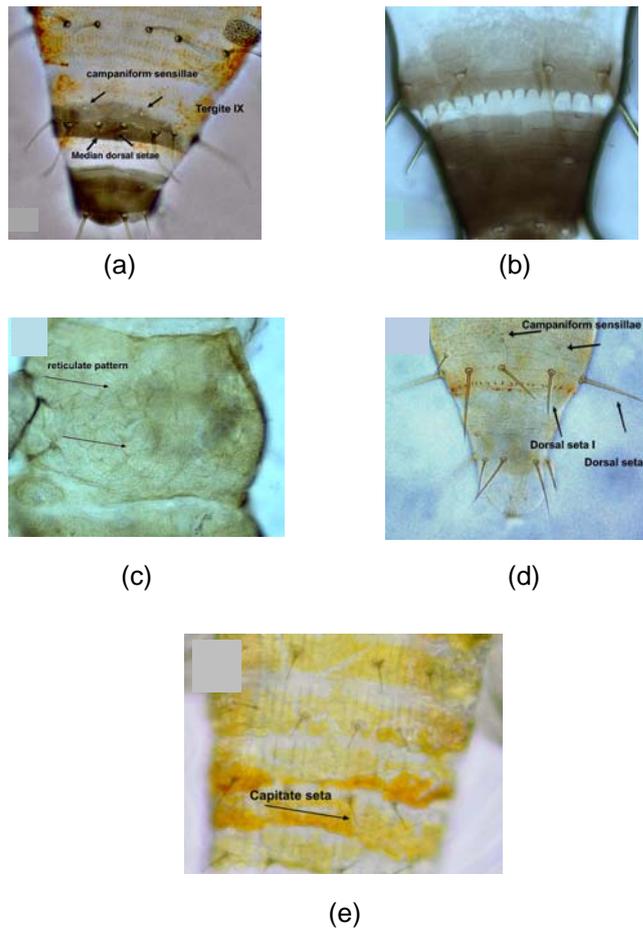
The larvae of this genus have reticulate sculpturing and a remarkable pattern of lines on the pronotum (Hoddle & Mound 2003), with a distinctive sculpturing of tiny dots over its whole surface [Fig. 10(c)].

**Genus Thrips**

The larvae of this genus have campaniform sensillae on tergite IX as far apart as the dorsal median setae [Fig. 10(d)], abdominal segment II with spiracles, and dorsal setae I and II of abdominal segment IX slightly knobbed.

**Genus Haplothrips**

The larvae of this genus have red-pigmented eyes, antennal segments IV–VII dark brown, I–III weakly shaded, and abdominal segments with major capitata setae [Fig. 10(e)].



**Figure 10:** Larvae of thrips from various genera. (a) *Frankliniella* (tergite IX), (b) *Megalurothrips* (tergite VIII), (c) *Scirtothrips* (pronotum), (d) *Thrips* (tergite IX), (e) *Haplothrips* (abdominal segment).

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