



Diversity and population dynamics of thrips species on horticultural crops in Punjab

Sandeep Singh* and R. R. Rachana**

ICAR-AICRP on Fruits, Department of Fruit Science, Punjab Agricultural University, Ludhiana 141 004, Punjab

ABSTRACT

Thrips fauna of Punjab have been poorly studied despite their significance on fruit and ornamental plants. Surveys and surveillances were, therefore, carried out in the six agro-ecological zones of the Indian Punjab since 2004, to study the biodiversity of thrips species on fruit crops and ornamental plants. During these surveys, 12 species of thrips viz., *Frankliniella schultzei* (Trybom), *Haplothrips ganglbaueri* Schmutz, *Haplothrips* sp., *Megalurothrips distalis* (Karny), *Rhipiphorotherips cruentatus* Hood, *Rhipiphorotherips pulchellus* Morgan, *Rhipiphorotherips* sp., *Scirtothrips bispinosus* (Bagnall), *Scirtothrips dorsalis* Hood, *Thrips florum* Schmutz, *Thrips hawaiiensis* (Morgan) and *Thrips palmi* Karny have been recorded in Punjab. Out of these, *F. schultzei*, *M. distalis*, *R. pulchellus*, *S. bispinosus* and *T. hawaiiensis* have been recorded for the first time from Punjab. Among fruit crops, *Eriobotrya japonica* (Thunb) Lindl., *Malus* sp., *Psidium guajava* L., *Punica granatum* L., *Pyrus communis* L., *Syzygium cumini* (L.) Skeels. and *Vitis vinifera* L. have been reported as new host plants for *H. ganglbaueri*, *M. distalis* and *T. florum*, *S. bispinosus*, *Rhipiphorotherips* sp., *Rhipiphorotherips* sp., *S. dorsalis*, *R. cruentatus* and *R. pulchellus* and *R. cruentatus* and *Haplothrips* sp., respectively. *Mansoa alliacea* Gentry., *Polianthes tuberosa* L., *Rosa indica* L., *Tabernaemontana* spp., and *Tagetes* sp. are here reported as new ornamental host plants to *T. florum* and *T. palmi*, *F. schultzei*, *T. palmi*, *S. dorsalis* and *T. florum*, respectively. Diagnostic features, distribution and host plant data for all the recorded species are given. The number of known species of thrips in Punjab is thus increased to fifty one. The population of thrips on different plant parts in fruit crops ranged from 75.3 to 210.6 in citrus, 40.8 to 78.3 in guava, 25.3 to 40.3 in mango, 80.4 in pear, 80.3 to 100.3 in grapes, 42.3 to 200.3 in pomegranate, 80.4 to 215.6 in loquat, 573.3 in jamun and 76.4 in apple. Among ornamental plants, the population ranged from 105.6 to 280.3 in rose, 1083.4 in marigold, 250.3 in tuberose, 325.3 in garlic creeper, 654.3 in single chandni and 780.3 in double chandni. The percent damage caused by the thrips on different plant parts in fruit crops ranged from 15.3 to 70 % in citrus, 2.7 to 5.3 % in guava, 2.0 to 3.5 % in mango, 3.5 % in pear, 10.3 to 15.6 % in grapes, 2.3 to 5.7 % in pomegranate, 5.6 to 10.3 % in loquat, 3.4 % in jamun and 5 % in apple. Among ornamental plants, the per cent damage ranged from 3.4 to 5.3 % in rose, 15.3 % in marigold, 5.3 % in tuberose, 10.3 % in garlic creeper, 15.4 % in single chandni and 18.3 % in double chandni.

Key words: Thrips biodiversity, fruit crops, ornamental plants.

INTRODUCTION

Punjab falls in northwest sub-tropical zone among the six horticultural zones/regions of India where the fruit crops of sub-tropical, tropical and temperate regions are grown. Currently, fruit crops occupy an area of 86.7 thousand ha with a total production of 1850 thousand tonnes and out of which citrus alone occupies 57.2 thousand ha with total production of 1281 thousand tonnes. Major fruits being commercially cultivated in Punjab are citrus, guava, mango, pear, litchi, peach, ber, amla, plum, grapes, etc (Anon., 2). The crop husbandry under such climatic condition has some typical pest problems, as the pests have an easy access to any fruit crop from other regions. Besides, the collection and evaluation of germplasm

for the release of improved cultivars and improvement in production technology have a significant impact on increased pest ravages at different stages of fruit crops of north Indian sub-tropics.

Thrips belongs to the order Thysanoptera and are minute, slender and soft bodied fragile insects having heavily fringed wings. They have asymmetrical, rasping and sucking type of mouth parts with which they lacerate the plant tissues and suck the oozing cell sap. Adult females have serrated ovipositor, which helps in causing injury to the leaves, flowers and other plant parts, for egg-laying. They feed on leaves, flowers and/or on both. Species which feed on leaves, their nymphs and adults congregate on ventral surfaces, more towards the leaf tips and feed on mesophyll tissue (Butani, 4). The affected leaves show silvery sheen and rarely mixed with faecal matter. The leaves get distorted, crinkled and mottled due to heavy

*Corresponding author's E-mail: sandeep_pau.1974@pau.edu

**Division of Germplasm Collection and Characterization, ICAR-NBAIR, Bengaluru, 560 024, Karnataka.

infestation. On inflorescence, discolouration can be observed at feeding site which subsequently turns brown, shrivelled and shed off prematurely. Severe infestation results in malformation of flower-buds which in turn affects the fruit setting capacity of the infested flowering plants. Those infesting living tissue of plants are sap feeders while flower dwelling species feed on pollens. A few predate on mites, scale insects and other thrips (Mound, 5).

Thrips are more common in warmer tropical parts of the world than in the temperate regions. The world record indicates the occurrence of nearly 6147 species (ThripsWiki, 9). In India, a total of 739 species belonging to 259 genera are listed, of which 309 species in 116 genera belonged to the suborder Terebrantia and 430 species in 143 genera belonged to the suborder Tubulifera (Tyagi and Kumar, 10).

Thrips feed on various horticultural plants which hamper their aesthetic as well as economic value. Their small size and rapid movement make it difficult to detect them in vegetation, and they can also act as virus vectors on different host plants (Silagyi and Dixon, 8). Losses caused by thrips to agricultural and horticultural products during the past decades increased considerably, resulting in huge economic loss of million dollars (ThripsWiki, 9). But from Punjab, hardly any earlier reports are present on this aspect. Hence, the present investigation was carried out to study the diversity and population dynamics of the thrips fauna on different fruit crops and ornamental crops in the Indian Punjab.

MATERIALS AND METHODS

Field collections of thrips were carried out from 35 sites located in the 22 districts of Punjab viz. Amritsar, Barnala, Bathinda, Fazilka, Faridkot, Fatehgarh Sahib, Ferozepur, Gurdaspur, Hoshiarpur, Jalandhar, Kapurthala, Ludhiana, Mansa, Moga, Pathankot, Patiala, Ropar, Sangrur, SBS Nagar, Sri Muktsar Sahib and Taran Taran Sahib, covering six agro-ecological regions, from February 2004 to May 2019. Twenty five fruit trees and ornamental plants each were surveyed in every district for collection of thrips.

Different host plants were closely examined for population of thrips. At the time of collection, plant parts harbouring them and their nature of damage due to infestation were recorded. They were collected by beating the foliage and flowers and transferred in vials containing thrips preservative media (9 parts 10% alcohol + 1 part glacial acetic acid + 1 ml Triton X-100 in 1000 ml of the mixture). The vials were labelled with host name, location and collection date for identification. Specimens were mounted in Canada balsam for permanent preservation (Bhatti, 3) and were identified using appropriate

keys (Ananthkrishnan and Sen, 1; Palmer *et al.*, 6). They were observed through a Nikon Eclipse 80i microscope and micro images were captured with a Nikon DS-Vil camera mounted on this microscope. Voucher specimens are deposited with ICAR-National Bureau of Agricultural Insect Resources (ICAR-NBAIR), Bengaluru, Karnataka, India.

Fruit and ornamental plants showing symptoms of thrips infestation and harbouring their population were considered as host plants. Common fruit crops were identified in the orchards itself. Ornamental plants were identified in consultation with experts of Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana. Fruit and ornamental plants infested with thrips were closely examined for type of damage and checked for symptoms such as curling, crumpling, leaf discolouration and bud and fruit scarring. Population of thrips from different fruit and ornamental plants was observed and per cent damage was also recorded on various plant parts like flowers, leaves and fruits from five trees/plants.

RESULTS AND DISCUSSION

During the investigation, twelve species of thrips were recorded on different horticultural crops like *Citrus* sp., *Eriobotrya japonica* (Thunb) Lindl. (Loquat), *Mangifera indica* (L.) (Mango), *Mansoa alliacea* Gentry. (Garlic creeper), *Polianthes tuberosa* L. (Tuberose), *Psidium guajava* L. (Guava), *Punica granatum* L. (Pomegranate), *Pyrus communis* L. (Pear), *Rosa indica* L. (Rose), *Syzygium cumini* (L.) Skeels. (Jamun), *Malus* sp. (Apple), *Tabernaemontana coronaria* (Double chandni), *Tabernaemontana divaricata* (Single chandni) and *Tagetes* sp. (Marigold) and *Vitis vinifera* L. (Grapes). Identified thrips species were *Frankliniella schultzei* (Trybom), *Haplothrips ganglbaueri* Schmutz, *Haplothrips* sp., *Megalurothrips distalis* (Karny), *Rhipiphorothrips cruentatus* Hood, *Rhipiphorothrips pulchellus* Morgan, *Rhipiphorothrips* sp., *Scirtothrips bispinosus* (Bagnall), *Scirtothrips dorsalis* Hood, *Thrips florum* Schmutz, *Thrips hawaiiensis* (Morgan) and *Thrips palmi* Karny on various host plants (Figs. 1–10).

Host plants, thrips species, their activity period, plant parts affected and symptoms of damage are presented in Table 1 and Plates A and B. The mean population and damage (%) of different species of thrips in Punjab have been presented in Table 2.

Diagnostic characters, distribution records, host plants and damage symptoms are as follows.

Suborder Terebrantia: Family Thripidae

F. schultzei (Fig. 1)

Diagnosis: Ocellar setae pair III arising close together between anterior margins of hind ocelli and as long as side of ocellar triangle. Postocular setae pair IV as long as distance between hind ocelli. Pronotum with

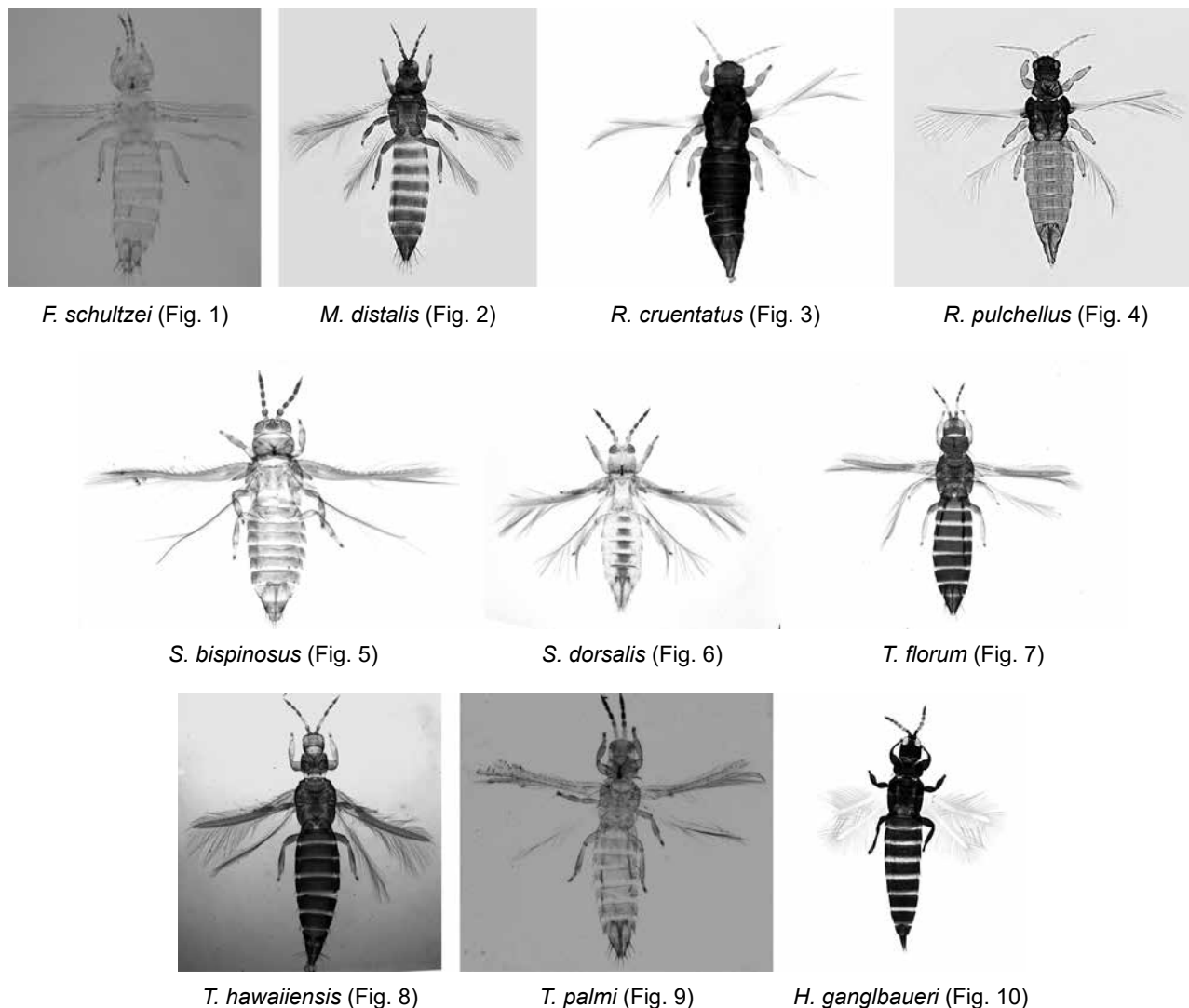


Plate A. Different thrips species observed on horticultural crops in Punjab

5 pairs of major setae; anteromarginal setae slightly shorter than anteroangulars, one pair of minor setae present medially between posteromarginal submedian setae. Campaniform sensilla on metanotum absent. Posteromarginal comb on tergite VIII not developed.

Distribution: Andaman Island, Delhi, Karnataka, Meghalaya, Punjab (New record), Tamil Nadu, Uttar Pradesh, West Bengal.

Host plants: *P. tuberosa* (New record)

Damage symptoms: Population was observed on flowers during November to January. Brown streaks on buds are the characteristic symptoms and under severe infestation, they get distorted. Infested flowers showed burnt appearance along the margin, which makes them unmarketable. They look as if dried due to scorching heat (Fig. 11).

M. distalis (Fig. 2)

Diagnosis: Ocellar setae pair III placed near the front ocelli and 3-4 times as long as the distance between their bases. Comb on abdominal tergite VIII well developed laterally at posterior margin but widely interrupted medially. A patch of microtrichia anterior to the spiracle on tergite VIII. Tergites IX and X each with long, dark apical setae and pointed at apex. Sternite VII with median pair of posteromarginal setae anterior to posterior margin. Male with numerous lanceolate, sternal discal setae.

Distribution: Andaman Island, Arunachal Pradesh, Meghalaya, Punjab (New record), Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Host plants: *E. japonica* (New record)

Damage symptoms: Nymphs and adults were observed on flowers during November to January. Brown corky spot on the fruit is the characteristic symptom (Fig. 12).

Table 1. Thrips species observed in Punjab during 2014 to 2019.

Host plants	Thrip species	Activity period	Plant parts affected	Districts
<i>Citrus</i> sp.	<i>Thrips florum</i> Schmutz, <i>Thrips hawaiiensis</i> (Morgan) and <i>Scirtothrips dorsalis</i> Hood	January to November	Flowers, fruits, and leaves	Bathinda, Faridkot, Fazilka, Hoshiarpur, Ludhiana, Mansa, Moga, Mohali, Pathankot, SBS Nagar, Sri Muktsar Sahib
<i>Psidium guajava</i> L.	<i>Rhipiphorothrips</i> sp.	June to December	Fruits and leaves	Barnala, Ludhiana, Patiala, Sangrur, SBS Nagar
<i>Mangifera indica</i> (L.)	<i>S. dorsalis</i> and <i>T. hawaiiensis</i>	May-June	Fruits and tender leaves	Gurdaspur, Hoshiarpur, Ludhiana, Mohali, Ropar
<i>Pyrus communis</i> L.	<i>S. dorsalis</i>	May to September	Tender leaves	Amritsar, Fazilka, Ludhiana, Taran Taran Sahib
<i>Vitis vinifera</i> L.	<i>Rhipiphorothrips cruentatus</i> Hood and <i>Haplothrips</i> sp.	April to October	Berries and leaves	Bathinda, Ludhiana, Mansa
<i>Punica granatum</i> L.	<i>Rhipiphorothrips</i> sp.	April to January	Flower buds, fruits and leaves	Jalandhar, Fazilka, Ludhiana
<i>Eriobotrya japonica</i> (Thunb) Lindl.	<i>Haplothrips ganglbaueri</i> Schmutz, <i>Megalurothrips distalis</i> (Karny) and <i>T. florum</i>	November to April	Flowers and fruits	Ludhiana, Gurdaspur, Pathankot
<i>Syzygium cumini</i> (L.) Skeels	<i>R. cruentatus</i> and <i>Rhipiphorothrips pulchellus</i> Morgan	November to January	Fruits and leaves	Amritsar, Faridkot, Ludhiana, Patiala
<i>Malus</i> sp.	<i>Scirtothrips bispinosus</i> (Bagnall)	December-January	Leaves	Ludhiana, Hoshiarpur
<i>Rosa indica</i> L.	<i>T. hawaiiensis</i> and <i>Thrips palmi</i> Karny	Throughout the year	Flower buds, flowers and leaves	Ludhiana, Patiala
<i>Tagetes</i> sp.	<i>T. hawaiiensis</i> and <i>T. florum</i>	January to March	Flowers	Ludhiana, Patiala
<i>Polianthes tuberosa</i> L.	<i>Frankliniella schultzei</i> (Trybom)	November-January	Flowers	Ludhiana
<i>Mansoa alliacea</i> Gentry	<i>T. florum</i> and <i>T. palmi</i>	December	Flowers	Ludhiana
<i>Tabernaemontana divaricata</i>	<i>T. florum</i> , <i>T. hawaiiensis</i> and <i>S. dorsalis</i>	April to November	Flowers	Ludhiana, Patiala
<i>Tabernaemontana coronaria</i>	<i>T. florum</i> , <i>T. hawaiiensis</i> and <i>S. dorsalis</i>	April to November	Flowers	Ludhiana, Patiala

***R. cruentatus* (Fig. 3)**

Diagnosis: Rugose structure on head and pronotum. Simple sense cones on antennal segment III and IV. Male has a characteristic laterally projecting tooth on abdominal segment IV. Female colour varies, but the fully coloured females are dark to blackish brown. Males have dark head and thorax and light brownish abdomen.

Distribution: Andaman Island, Assam, Delhi, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Host plants: *S. cumini* (New record), *V. vinifera* (New record)

Damage symptoms on different host plants

S. cumini: Nymphs were found congregated in large number on ventral side of leaves. Affected leaves had large yellowish patches which turned reddish-brown and finally became brittle. The damage symptoms were observed on fruits and leaves (Fig. 13) during June-July and January-November, respectively. Brown corky spot on fruit is the characteristic symptom (Fig. 14).

V. vinifera: Nymphs and adults rasp the ventral surface of the tender leaves and flower-stalks and sucks the oozing sap. Leaves develop silvery white scorchy patches (Fig. 15) with curly tips which gradually get deformed and ultimately fall down. Attack on flower-stalks results in flower shedding. On berries, formation of scab like symptoms are the characteristic features (Fig. 16). *R. pulchellus* (Fig. 4)

Diagnosis: Body bicoloured. Pronotum yellow, shaded brown on sides. Abdomen pure yellow. Tergite X completely divided, bearing a small pair of apical setae with their apices expanded. Male without lateral projection on abdominal segment IV.

Distribution: Delhi, Madhya Pradesh, Punjab (New record), West Bengal.

Host plants: *S. cumini* (New record)

Damage symptoms: Similar to that of *R. cruentatus* on *S. cumini*.

Population of *Rhipiphorotheirus* sp. was observed on *P. guajava* (Figs. 17-18) and *P. granatum* (Figs. 19-21). *S. bispinosus* (Fig. 5)

Diagnosis: Head with only one pair of major median postocular setae. Pronotal B2 setae almost four times as long as other setae. Median metanotal setae short, arising far from anterior margin. Median reticles on metanotum with fine internal markings. Tergites with dark patch medially. Forewing frequently without setae on lower vein. Male with drepanae on tergite IX.

Distribution: Karnataka, Punjab (New record), Tamil Nadu.

Host plants: *Malus* sp. (New record)

Damage symptoms: Nymphs and adults feed on ventral surface of the leaves, resulting in leaf surface distortion.

S. dorsalis (Fig. 6)

Diagnosis: Body yellow with median brown marking on tergites III–VII. Postocular and ocellar region closely striate. Ocellar setae pair III arise between posterior ocelli, well behind tangent between their anterior margins. Two pairs of post-ocellar setae as long as ocellar setae pair III. Pronotum striate closely, posteromarginal setae S2 longer than S1.

Distribution: Andhra Pradesh, Assam, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Host plants: *Citrus* sp., *M. indica*, *P. communis* (New record), *Tabernaemontana* spp. (New record)

Damage symptoms on different host plants

Citrus sp.: The damage was observed on leaves during January to November. Due to heavy infestation, the leaves get distorted, wrinkled and mottled (Fig. 22). On fruits, white shiny rings were observed around the neck which badly affects their market value (Fig. 23).

M. indica: Nymphs and adults congregate on ventral surface of the leaf during May-June, more towards the leaf tip and feed on mesophyll leaving silvery sheen. In case of severe attack, the leaf tip turn brown and get curled (Fig. 24). Discolouration on inflorescence at the feeding site can be observed which subsequently turn brown and die off.

P. communis: Infestation on new leaves occurs during May to September. The affected leaves get distorted, wrinkled and mottled (Fig. 25).

Tabernaemontana spp.: Infestation on flowers occurs during April to November. Nymphs are observed actively moving inside flowers. Discolouration of flowers occurs (Fig. 26).

T. florum (Fig. 7)

Diagnosis: Head with ocellar setae III outside ocellar triangle. Postocular seta II very much smaller than I or III. Mesonotum without sculpture lines close to anterior campaniform sensilla. Clavus with subapical seta longer than apical seta. Sternites III–VII with 6–14 discal setae.

Distribution: Andaman Island, Delhi, Karnataka, Punjab.

Host plants: *Citrus* sp., *E. japonica* (New record), *M. alliacea* (New record), *Tabernaemontana* spp., *Tagetes* sp. (New record)

Damage symptoms on different hosts plants

Citrus sp.: Thrips were found in abundance on flower buds during February-March. The affected flower-buds become smaller in size. Feeding scars were prominent on petals and the petals became shrunked. Fruit setting was adversely affected.

E. japonica: Nymphs and adults were found in abundance on flower buds during November-December. Feeding scars were prominent on petals.

M. alliacea: Thrips were found in abundance on flower buds during December. Feeding scars were prominent on petals and the petals became shrunked.

Tabernaemontana spp.: During April to November, nymphs and adults were seen in flowers which greatly reduced flower quality.

Tagetes sp.: Thrips were present deep inside the flowers, during January to March. Blackish spots appeared on the feeding site (Fig. 27).

T. hawaiiensis (Fig. 8)

Diagnosis: Head with ocellar setae III outside ocellar triangle. Postocular setae I and II subequal. Mesonotum with sculpture lines close to anterior campaniform sensilla. Clavus with apical seta longer than subapical seta. Sternites III–VII with 12–25 discal setae.

Distribution: Andaman Island, Assam, Delhi, Karnataka, Meghalaya, Punjab (New record), Sikkim, West Bengal.



P. tuberosa flower (Fig. 11)



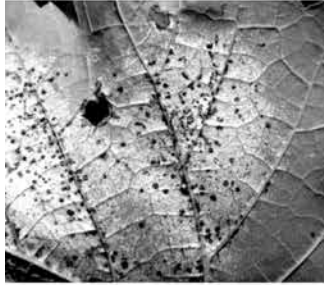
E. japonica fruit (Fig. 12)



S. cumini leaf (Fig. 13)



S. cumini fruits (Fig. 14)



V. vinifera leaf (Fig. 15)



V. vinifera berries (Fig. 16)



P. guajava leaf (Fig. 17)



P. guajava fruit (Fig. 18)



P. granatum leaves (Fig. 19)



P. granatum flower bud (Fig. 20)



P. granatum fruit (Fig. 21)



Citrus sp. leaf (Fig. 22)



Citrus sp. fruit (Fig. 23)



M. indica leaves (Fig. 24)



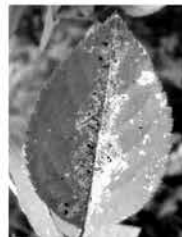
P. communis leaves on nursery (Fig. 25)



T. coronaria (Fig. 26)



Tagetes sp. flower (Fig. 27)



R. indica leaf (Fig. 28)



R. indica flower (Fig. 29)

Plate B. Damage symptoms of thrips on different horticultural crops.

Host plants: *Citrus* sp., *M. indica*, *R. indica*, *Tabernaemontana* spp., *Tagetes* sp.

Damage symptoms: Similar to that of *T. florum*. *T. palmi* (Fig. 9)

Diagnosis: Ocellar setae pair III small, arising outside ocellar triangle and postocular setae pair I slightly longer than ocellar setae III. Metanotum with irregular longitudinal lines converging to posterior margin, with anteriorly curving transverse lines; median setae arising well behind anterior margin, campaniform sensilla present. Forewing first vein with 3 distal setae. Abdominal tergite II with 4 marginal setae laterally; tergite VIII with complete comb.

Distribution: Delhi, Karnataka, Odisha, Punjab.

Host plants: *M. alliacea* (New record), *R. indica* (New record)

Damage symptoms

Similar to that of *T. florum* on *M. alliacea*.

On *R. indica*, leaves get distorted and crinkled with black spots (Fig. 28). Blackish-brown scars appear on flower-buds. Numerous nymphs and adults were observed inside the flowers which reduced the market value (Fig. 29).

Suborder Tubulifera: Family Phlaeothripidae
H. ganglbaueri (Fig. 10)

Diagnosis: Antennal segment III pale, asymmetrical. Antennal segments III and IV with 0+1 and 2+2 (+1) sense cones. Post ocular setae expanded apically. Major pronotal setae well developed, dilated apically. Fore tibia yellow with brown margins, tarsi yellow. The S1 setae on tergum IX weakly blunt to slightly expanded at apex.

Distribution: Andaman Island, Andhra Pradesh, Delhi, Haryana, Karnataka, Madhya Pradesh, Meghalaya, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Host plants: *E. japonica* (New record)

Damage symptoms

Similar to that of *T. florum* on *E. japonica*.

The survey represents first comprehensive collection of thrips on fruits and ornamental plants from the Punjab, India with updated records and their host plants. Thrips of India have been extensively documented by Tyagi and Kumar (10) and Rachana and Varatharajan (7). Host plant compilation of thrips species from Punjab is lacking and hence, comparison with earlier documents is hardly possible. A total of 46 terebrantian thrips species have been earlier reported from Punjab by various thrips taxonomists (Tyagi and Kumar, 10). We have added five more species to the fauna of Punjab and thus increased the known species to 51. The newly reported five species represented family Thripidae and two subfamilies viz., Panchaethripinae and Thripinae. The family Thripidae represents agriculturally important pests and vectors and hence, demands significance.

Our study newly reported *S. bispinosus* on *Malus* sp. This discovery greatly extends the geographic distribution and host range of this species that has been known only from South India infesting tea. New host associations reported for various species in this study need to be further explored for their pest status. Salient findings from our study demands more survey and exploration in this field from Punjab state.

The population of thrips on different plant parts in fruit crops ranged from 75.3 to 210.6 in citrus, 40.8 to 78.3 in guava, 25.3 to 40.3 in mango, 80.4 in pear, 80.3 to 100.3 in grapes, 42.3 to 200.3 in pomegranate, 80.4 to 215.6 in loquat, 573.3 in jamun and 76.4 in apple. Among ornamental plants, the population ranged from 105.6 to 280.3 in rose, 1083.4 in marigold, 250.3 in tuberose, 325.3 in garlic creeper, 654.3 in single chandni and 780.3 in double chandni (Table 2). The per cent damage caused by the thrips on different plant parts in fruit crops ranged from 15.3 to 70 % in citrus, 2.7 to 5.3 % in guava, 2.0 to 3.5 % in mango, 3.5 % in pear, 10.3 to 15.6 % in grapes, 2.3 to 5.7 % in pomegranate, 5.6 to 10.3 % in loquat, 3.4 % in jamun and 5 % in apple. Among ornamental plants, the per cent damage ranged from 3.4 to 5.3 % in rose, 15.3 % in marigold, 5.3 % in tuberose, 10.3 % in garlic creeper, 15.4 % in single chandni and 18.3 % in double chandni (Table 2).

This study reports a total of 12 thrips species from Punjab, India on fruit crops (*Eriobotrya japonica* (Thunb) Lindl., *Malus* sp., *Psidium guajava* L., *Punica granatum* L., *Pyrus communis* L., *Syzygium cumini* (L.) Skeels., and *Vitis vinifera* L.) and ornamental plants (*Mansoa alliacea* Gentry., *Polianthes tuberosa* L., *Rosa indica* L., *Tabernaemontana* spp., and *Tagetes* sp.). Out of these, *F. schultzei*, *M. distalis*, *R. pulchellus*, *S. bispinosus*, *T. hawaiiensis* have been recorded for the first time from Punjab on any host plant.

Our study has newly added five species of thrips in the family Thripidae to Punjab state records collected from different hosts. Thus, we have increased the number of known species of thrips in Punjab from 46 to 51. Newly reported host associations need to be explored further for confirming pest status. Since thrips are economically very important as crop pests, virus vectors and pollinators, further surveys and studies in this field are needed to thoroughly understand the thysanopteran fauna of Punjab and their host plant associations. The data on population and per cent damage depicts the importance of thrips on fruit crops and ornamental plants in Punjab.

DECLARATION

The authors declare no conflict of interest.

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Table 2. Mean population and damage (%) of different species of thrips in Punjab during 2019.

Host plants	Thrip species	Population of thrips*			Damage (%)*		
		25 flowers/ plant	25 leaves/ plant	25 fruits/ plant	Flowers	Leaves	Fruits
<i>Citrus</i> sp.	<i>Thrips florum</i> Schmutz, <i>Thrips hawaiiensis</i> (Morgan) and <i>Scirtothrips dorsalis</i> Hood	210.6	75.3	103.5	15.3	70	23
<i>Psidium guajava</i> L.	<i>Rhipiphorothrips</i> sp.	-	40.8	78.3	-	5.3	2.7
<i>Mangifera indica</i> (L.)	<i>S. dorsalis</i> and <i>T. hawaiiensis</i>	-	25.3	40.3	-	2.0	3.5
<i>Pyrus communis</i> L.	<i>S. dorsalis</i>	-	80.4	-	-	3.5	-
<i>Vitis vinifera</i> L.	<i>Rhipiphorothrips cruentatus</i> Hood and <i>Haplothrips</i> sp.	-	100.3	80.3	-	10.3	15.6
<i>Punica granatum</i> L.	<i>Rhipiphorothrips</i> sp.	42.3	80.7	200.3	5.0	2.3	5.7
<i>Eriobotrya japonica</i> (Thunb) Lindl.	<i>Haplothrips ganglbaueri</i> Schmutz, <i>Megalurothrips distalis</i> (Karny) and <i>T. florum</i>	215.6	-	80.4	10.3	-	5.6
<i>Syzygium cumini</i> (L.) Skeels	<i>R. cruentatus</i> and <i>Rhipiphorothrips pulchellus</i> Morgan	-	573.3	-	-	3.4	-
<i>Malus</i> sp.	<i>Scirtothrips bispinosus</i> (Bagnall)	-	76.4	-	-	5.0	-
<i>Rosa indica</i> L.	<i>T. hawaiiensis</i> and <i>Thrips palmi</i> Karny	280.3	105.6	-	5.3	3.4	-
<i>Tagetes</i> sp.	<i>T. hawaiiensis</i> and <i>T. florum</i>	1083.4	-	-	15.3	-	-
<i>Polianthes tuberosa</i> L.	<i>Frankliniella schultzei</i> (Trybom)	250.3	-	-	5.3	-	-
<i>Mansoa alliacea</i> Gentry	<i>T. florum</i> and <i>T. palmi</i>	325.3	-	-	10.3	-	-
<i>Tabernaemontana divaricata</i>	<i>T. florum</i> , <i>T. hawaiiensis</i> and <i>S. dorsalis</i>	654.3	-	-	15.4	-	-
<i>Tabernaemontana coronaria</i>	<i>T. florum</i> , <i>T. hawaiiensis</i> and <i>S. dorsalis</i>	780.3	-	-	18.3	-	-

*Based on 5 trees/plants

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