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Deciphering Thysanoptera: A Comprehensive Study on the Distribution and Diversity of Thrips Fauna in Pakistan

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ABSTRACT

Thrips are major crop pests and virus vectors in many parts of the world. Despite their economic importance, thrips diversity in Pakistan is not well documented. Surveys were carried out from year 2009 to 2012 to decipher thrips fauna in Pakistan. A total of 158 sites in three climatic regions were surveyed, and specimens were collected from a wide range of flora. Following taxonomic keys, we identified 12 species from 3 genera of the suborder Tubulifera and 30 species from 17 genera of the suborder Terebrantia. Of these one species (*Apterygothrips pellucidus* Ananthakrishnan) from Tubulifera and 7 species (*Chirothrips meridionalis* Bagnall, *Chaetanaphothrips orchidii* Moulton, *Megalurothrips usitatus* Bagnall, *Megalurothrips distalis* Karny, *Neohydatothrips samayunkur* Kudo, *Taeniothrips major* Bagnall, *Thrips trehernei* Priesner) from Terebrantia and four genera (*Apterygothrips, Chaetanaphothrips, Neohydatothrips , Taeniothrips*) were first reports from Pakistan. A checklist of species reported in Pakistan since 1947 including those from the current survey was compiled.

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MA designed and planned the study. RI and IU collected the data. RI and SD analyzed the data. All authors prepared the manuscript.

Key words
Thrips, Crop pests, Tubulifera, Terebrantia

INTRODUCTION

Thrips (Thysanoptera) are minute, slender bodied insects with piercing-sucking mouthparts (Hunter and Ullman, 1992). They are unique among insects in that they possess only one complete left mandible (Heming, 1993). Thrips feed on leaves, pollen, fruits, liquids (Kirk, 1995; Lewis, 1997), while half of all known thrips species feed on fungi. Some thrips are known as predators of mites and other thrips (Mound and Marullo, 1998).

Thrips are serious pests of a wide range of agricultural crops including ornamental, vegetable, and fruits in both greenhouses and open field cultivation throughout the world (Tommasini and Maini, 1995). Tospoviruses (*Bunyaviridae*) are transmitted by thrips and cause significant losses in quality and yield of many vegetables, legume and ornamental crops in many tropical and subtropical regions (Mumford *et al.*, 1996; Pappu *et al.*, 2009; Mandal *et al.*, 2012). For example, onion thrips, *Thrips tabaci* Lindemann, is a polyphagous insect and pest of many plants such as cotton, cucurbits, and onions (Lewis, 1997; Ullah *et al*., 2010; Ullah *et al*., 2014) and vectors of *Tomato spotted wilt virus* and *Iris yellow spot virus* which have a wide host range (Jenser *et al.*, 2003). Thrips also have important beneficial effect on crops (Kirk, 1984) for example, *Thrips hawaiiensis* Morgan is an effective pollinator for oil palms (Syed, 1979) in the Malaysia, and *Thrips flavus* is an effective pollinator for oilseed rape in India (Veer, 1978).

According to the traditional and widely accepted classification of the order Thysanoptera (Priesner, 1961), the order Thysanoptera has been divided into two suborders: Terebrantia and Tubulifera. The suborder Terebrantia includes eight families, and the suborder Tubulifera is represented by a single worldwide family (Mound and Minaei, 2007; Mound *et al.*, 1980). Phlaeothripidae is the largest family of Thysanoptera. This family includes 3,568 described species in 455 genera (ThripsWiki, 2014) from two subfamilies, Phlaeothripinae and Idolothripinae. Almost 50% of the species of Phlaeothripidae feed on fungal hyphae found on dead branches and leaf litter, but a large number of Oriental species produce leaf galls. One group of species in this family is abundant on flowers of grasses and Asteraceae, and a few species are predators of arthropods. Twenty six species of family Phlaeothripidae were reported from Pakistan by different authors (Akram, 2000; Akram *et al.*, 2003b; Ali, 1976; Saeed and Yousuf, 1994; Umar *et al.*, 2004; Present study). Family Aeolothripidae includes 198 extant species. In 29 genera

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of Aeolothripidae, 6 genera and 11 species were found in fossil form (ThripsWiki, 2014). The second largest family of the order Thysanoptera is Thripidae. It has 2,121 species in 306 genera. Family Thripidae is divided into 4 subfamilies (Mound and Minaei, 2007). Panchaetothripinae with 151 species in 40 genera of which 5 species and 2 genera are in fossil form. Dendrothripinae with 98 species in 15 genera of which 6 species and 4 genera are fossil records. Sericothripinae with 152 species in 3 genera. The largest subfamily Thripinae includes 1,730 species in 248 genera of which 64 species and 13 genera are fossil records (ThripsWiki, 2014).

There are approximately 6000 described species of thrips (Mound, 2007). Thrips are distributed worldwide in tropical and temperate zones inhabiting forests, grasslands, bushes, leaves and flowers (Lewis, 1973), litter and galls (Mound, 1972). Thrips diversity is higher in the warm tropical parts than in the colder regions of the world. In the Indian subcontinent, several studies documented the thrips diversity from India. Ananthakrishnan and Sen (1980) provided a critical assessment of the taxonomic criteria, classification, and keys for the identification 650 species from India. Nearly 100 species of the genus *Thrips* Linnaeus were reported in the area between the Indian peninsula, Australia, and the Pacific islands (Palmer, 1992). Bhatti (1980) recorded and generated keys to 33 thrips species from India. Ananthakrishnan (1973) published mycophagous Thysanoptera of India and Palmer and Mound (1978) also reported nine genera of fungus-feeding Thysanoptera from the oriental region. Sen *et al*. (1988) gave the keys and description of Thysanoptera of north-eastern India. *Merothrips indicus* was described from Tamil Nadu and Kerala in India and *Merothrips* morgani Hood was redescribcd from Indian specimens (Bhatti and Ananthakrishnan, 1975).

An illustrated key of 65 genera of Thripinae from South-East Asia was provided by Mound and Ng (2009). Tillekaratne *et al.* (2007) described thrips species from Sri Lanka under three families (Aeolothripidae, Thripidae, Phlaeothripidae), 46 genera and 78 species. Later, Tillekaratne *et al.* (2011) provided the list of 72 thrips species in 45 genera from Sri Lanka. Of the nine families of order Thysanoptera (Mound and Minaei, 2007), Aeolothripidae, Thripidae and Phlaeothripidae are the more prevalent thrips families of the subcontinent for example, *Haplothrips* spp., *Megalurothrips* spp., *Microcephalothrips abdominalis* are widely distributed thrips species in the subcontinent (Tillekaratne *et al.*, 2011).

However, despite the significance as a crop pest and virus vector, thrips from Pakistan have not been fully explored. However, studies conducted so far on the incidence and description of thrips species in Pakistan (Akram, 2000; Akram *et al.*, 2002; 2003a,b; Palmer, 1992; Saeed and Yousuf, 1994; Shah, 2001; Umar *et al.*, 2004) provided some baseline information about this important pest. The objective of this study was to survey, identify and compile a comprehensive list of thrips species occurring in Pakistan.

MATERIALS AND METHODS

Locations surveyed

Thrips specimens were collected from 158 localities across the country during 2009-2012. Collection locations were selected based on accessibility, vegetation type, and habitat type. GPS coordinates were recorded and locations were mapped (Fig. 1). The collection sites spread over an altitude range of 127-2660 m in five agro-ecological regions of the country in 37 administrative districts *viz.*, Abbas pur, Bahawalpur, Bagh, Chakwal, Dera ghazi khan, Forward kahuta, Faisalabad, Gujranwala, HariPur hazara, Haveli, Hyderabad, Islamabad, Jaranwala, Kaghan, Mirpur khas, Muzaffarabad, Multan, Murree, Nagar parker, Neelum, Naran, Narowal, Nankana, Pallandri, Paye, Rawalpindi, Rawala kot, Sheikhupura, Sahiwal, Sargodha, Sailkot, Shakar ghar, Seri, Shogran, Sanghar, Tando allahyar, Taxila and Umerkot. At each collection site, natural and cultivated vegetation (crops, ornamental plants, shrubs, trees and weeds) were examined for thrips. All collection sites represented the following habitat categories:

Agricultural fields

Agricultural research stations, farmer fields and crop nurseries in Districts; Chakwal, Faisalabad, Islamabad, Nankana Sahib, and Azad Jammu and Kashmir.

Floricultural fields

Botanical garden, University of Agriculture Faisalabad (UAF), botanical garden National Agricultural Research Centre (NARC), Islamabad and several other flower farms in Azad Jammu and Kashmir, Faisalabad, Lahore, Sahiwal.

Natural forests

The forest of Changa-manga, Chinji national park, Toba tak Singh forestation, Harrappa vegetation areas.

Disturbed habitats

Road sides, foot paths, home gardens, fallow rice

fields, weedy patches and grasslands in different location sites.

Collection of specimens

Thrips were collected by beat method (Bradley and Mayer, 1994). Foliage or inflorescence of plants and shrubs was beaten on a white blank paper and thrips were collected with a fine camel hair brush. Specimens were transferred to 1.5 ml Eppendorf tubes containing 85% ethanol and stored in a freezer until further analysis.

Slide preparation

Slides were prepared for identifications using Hoyer's Medium, a water-soluble mountant Individual thrips were fixed with ventral side upward in a drop of Hoyer's Mountant on a cover slip (13mm circle, No. 0 or 1), and a slide was placed immediately into an oven, or onto a hot-plate, at about 50°C and left for 24 h and then examined under a microscope. Slides were left in the oven for 3 weeks to dry, then sailed the edges of cover slips using nail varnish. Insect specimens were labeled with name of the collector, and place and date of collection.

Morphological identification

Thrips were identified using the published description (http://www.ozthrips.org, http://keys.lucidcentral.org/keys/v3/thrips_of_california). In addition, standardized morphological keys for thrips were used to identify the species level (Akram, 2000). Morphological characters were studied using a compound microscope (Olympus BX 41) under magnifications, 40X, 100X and 400X. Voucher specimens were verified by Sueo Nakahara, USDA ARS, Beltsville, MD., USA. ThripsWiki (2014) was accessed on 26 Apr 2014 for the valid species names of thrips reported in Pakistan since 1947 including thrips from the current survey.

RESULTS

Thrips species recorded in present survey

A total of 42 species of thrips in 20 genera from 3 families were found during the current survey. Family Thripidae included the most number of species 29 and genera 16. Family Phlaeothripidae was represented by 12 species in 3 genera making it the second largest family of thrips collected, followed by family Aeolothripidae with 1 species and 1 genus. 4 genera and 8 thrips species are first time reported from Pakistan.

The three newly recorded genera *Neohydatothrips,* *Chaetanaphothrips,* and *Taeniothrips* were each represented by a single newly recorded species: *Neohydatothrips samayunkur*, *Taeniothrips major*, and *Chaetanaphothrips orchidii*. *T. trehernei* from the genus *Thrips*, one species *Chirothrips meridionalis* from the genus *Chirothrips*, two species *Megalurothrips usitatus* and *M. distalis* from the genus *Megalurothrips*, and one species *Apterygothrips pellucidus* were identified in the genus *Apterygothrip*. Twenty six of the species in our survey have been reported as cosmopolitan pests and five as potential viral vectors (Moritz *et al*., 2001).

Thrips diversity in Pakistan

Thrips species from Pakistan documented in prior reports and from this survey are presented in Table 1. A total of 85 species in 40 genera have been recorded from three families (Aeolothripidae, Thripidae and Phlaeothripidae) and two suborders (Terebrantia and Tubulifera) (Table I). Each family listed by the currently valid genera and species name, and each species name is referenced to its record from Pakistan. Thrips species recorded in the current survey are indicated by an asterisk (*). Thrips species previously not recorded from Pakistan are indicated by symbol (†) in Table I. Source plants and collection localities of thrips species are provided for the new records in current survey (Table II).

Table I.- A check list of thrips species recorded from Pakistan (1947- todate):

Ser. no.	Genus	Reference
a)	Family Phlaeothripidae	
1	*Bamboosiella* Ananthakrishnan	
	Bamboosiella murreensis Φ	Saeed and Yousuf, 1994
2	*Bamboosiella varia* Ananthakrishnan and Jagadish	Akram, W., 2000
3	*Allothrips* Hood	Akram *et al.*,
	Allothrips pillichellus Priesner	2003b
4	*Apterygothrips* Priesner	Present study
	Apterygothrips pellucidus (Ananthakrishnan) †	
5	*Ecacanthothrips* Bagnall	Akram, W.,
	Ecacanthothrips tibialis (Ashmead)	2000
6	*Ethirothrips* Karny	Akram *et al.*,
	Ethirothrips longisetis (Ananthakrishnan and Jagadish)	2003b
7	*Gynaikothrips* Zimmermann	
	Gynaikothrips khushabensis Φ	Saeed and Yousuf, 1994
8	*Gynaikothrips robustus* Φ	Saeed and Yousuf, 1994
9	*Haplothrips* Amyot and Serville subgenus *Haplothrips*	Ali, R., 1976

10	*Haplothirps* (H.) *bagrolis* Bhatti *	
	Haplothirps (H.) *ciliatus* * Φ	Saeed and Yousuf, 1994
11	*Haplothirps* (H.) *ganglbaueri* Schmutz *	Ali, R., 1976
12	*Haplothirps* (H.) *gowdeyi* (Franklin) *	Saeed and Yousuf, 1994
13	*Haplothirps* (H.) *longisetosus* Ananthakrishnan	Saeed and Yousuf, 1994
14	*Haplothirps* (H.) *stylatus* * Φ	Saeed and Yousuf, 1994
15	*Haplothirps* (H.) *tenuipennis* Bagnall *	Saeed and Yousuf, 1994
16	*Haplothrips* (H.) *andresi* Priesner *	Akram, W., 2000
17	*Haplothrips* (H.) *bicolour* (Ananthakrishnan)	Akram, W., 2000
18	*Haplothrips* (H.) *ceylonicus* Schmutz	Akram, W., 2000
19	*Haplothrips* (H.) *reuteri* * Karny	Akram, W., 2000
20	*Haplothrips* (H.) *howei* (Mound & Minaei, 2007)	Akram, W., 2000
21	*Trybomiella* Bagnall (subgenus)	
	Haplothrips (T.) *clarisetis* Priesner	Saeed and Yousuf, 1994
22	*Plicothrips* Bhatti	
	Plicothrips apicalis Bagnall *	Ali, R., 1976
23	*Ananthakrishnana* Bhatti	
	Ananthakrishnana euphorbiae Priesner *	Saeed and Yousuf, 1994
24	*Liothrips* Uzel	
	Liothrips aberrans Muraleedharan and Sen	Akram, W., 2000
25	*Liothrips bournieri* Sen	Akram, W., 2000
26	*Liothrips infrequens* Muraleedharan and Sen *	Akram, W., 2000
b)	Family Aeolothripidae	
1	*Aeolothrips* Haliday	
	Aeolothrips distinctus Bhatti	Saeed and Yousuf, 1994
	Aeolothrips intermedius Bagnall *	Saeed and Yousuf, 1994
	Aeolothrips collaris Priesner	Akram, W., 2000
c)	Family Thripidae	
1	*Anaphothrips* Uzel	
	Anaphothrips sudanensis Trybom *	Akram, W., 2000
2	*Anascirtothrips* Bhatti	
	Anascirtothrips arorai Bhatti	Saeed and Yousuf, 1994
3	*Aptinothrips* Haliday	
	Aptinothrips rufus Haliday	Akram, W., 2000
4	*Arorathrips* Bhatti	
	Arorathrips mexicanus Crawford *	Akram, W., 2000
5	*Astrothrips* Karny	
	Astrothrips stannardi Bhatti	Saeed and Yousuf, 1994
6	*Astrothrips tumiceps* Karny	Akram, W., 2000
7	*Caliothrips* Daniel	
	Caliothrips indicus Bagnall	Akram, W., 2000
8	*Chaetanaphothrips* Priesner	
	Chaetanaphothrips orchidii Moulton †	Present study
9	*Chirothrips* Haliday	
	Chirothrips africanus Priesner	Saeed and Yousuf, 1994
10	*Chirothrips meridionalis* Bagnall †	Present study
11	*Dendrothripoides* Bagnall	
	Dendrothripoides ipomoeae Bagnall	Akram, W., 2000
12	*Dendrothripoides innoxius* †	Present study
13	*Elbuthrips* Bhatti	
	Elbuthrips latis Bhatti (1973)	Saeed and Yousuf, 1994
14	*Fulmekiola* Karny	
	Fulmekiola serrata Kobus	Akram, W., 2000
15	*Frankliniella* Karny	
	Frankliniella insularis Franklin	Saeed and Yousuf, 1994
16	*Frankliniella schultzei* Trybom *	Ali, R., 1976
17	*Helionothrips* Bagnall	
	Helionothrips mube Kudo	Akram, W., 2000
18	*Hydatothrips* Karny	
	Hydatothrips atactus Bhatti *	Akram, W., 2000
19	*Hydatothrips ekasi* Kudo	Akram, W., 2000
20	*Indothrips* Bhatti	
	Indothrips religiosus Φ	Saeed and Yousuf, 1994
21	*Megalurothrips* Bagnall	
	Megalurothrips peculiaris Bagnall *	Akram, W., 2000
22	*Megalurothrips usitatus* Bagnall †	Present study
23	*Megalurothrips distalis* Karny †	Present study
24	*Microcephalothrips* Bagnall	Ali, R., 1976
	Microcephalothrips abdominalis Crawford *	
25	*Mycterothrips* Trybom	Akram *et al.*, 2002
	Mycterothrips nilgiriensis Ananthakrishnan *	
26	*Bregmatothrips* Hood	Akram, W., 2000
	Bregmatothrips binervis Kobus	
27	*Neohydatothrips* John	Present study
	Neohydatothrips samayunkur Kudo †	
28	*Pseudodendrothrips* Schmutz	Akram, W., 2000
	Pseudodendrothrips bhatti Kudo *	
29	*Rhipiphorothrips* Morgan	Saeed and Yousuf, 1994
	Rhipiphorothrips cruentatus Hood	
30	*Scirtothrips* Shull	Saeed *et al.*, 1994
	Scirtothrips bispinosus Bagnall	
31	*Scirtothrips dorsalis* Hood *	Ali, R., 1976
32	*Scirtothrips mangiferus* Φ	Saeed *et al.*, 1994
33	*Scirtothrips oligochaetus* Karny*	Saeed *et al.*, 1994
34	*Scolothrips* Hinds	Saeed and

	Scolothrips rhagebianus Priesner *	Yousuf, 1994
35	*Sorghothrips* Priesner	Saeed and
	Sorghothrips jonnaphilus Ramakrishna	Yousuf, 1994
36	*Stenchaetothrips* Bagnall	Akram, W.,
	Stenchaetothrips biformis Bagnall	2000
37	*Stenchaetothrips faurei* Bhatti	Akram, W., 2000
38	*Taeniothrips* (Amyot & Serville, 1843)	Present study
	Taeniothrips major Bagnall †	
39	*Thrips* Linnaeus	Akram *et al.*,
	Thrips alatus Bhatti *	2003a
40	*Thrips apicatus* Priesner *	Saeed and Yousuf, 1994
41	*Thrips beharensis* Ramakrishna and Margabandhu	Saeed and Yousuf, 1994
42	*Thrips carthami* Shumsher *	Palmer, 1992
43	*Thrips coloratus* Schmutz *	Palmer, 1992
44	*Thrips decens* Palmer *	Akram *et al.*, 2003a
45	*Thrips evulgo* Palmer	Palmer, 1992
46	*Thrips flavus* Schrank *	Palmer, 1992
47	*Thrips florum* Schmutz *	Akram *et al.*, 2003a
48	*Thrips garuda* Bhatti	Akram *et al.*, 2003a
49	*Thrips hawaiiensis* Morgan *	Palmer, 1992
50	*Thrips kodaikanalensis* Ananthakrishnan and Jagadish	Akram, W., 2000
51	*Thrips orientalis* Bagnall	Saeed and Yousuf, 1994
52	*Thrips palmi* Karny *	Palmer, 1992
53	*Thrips subnudula* Karny	Palmer, 1992
54	*Thrips tabaci* Lindemann *	Palmer, 1992
55	*Thrips trehernei* Priesner †	Present study
56	*Thrips unonae* Priesner	Akram *et al.*, 2003a

(*) thrips species recorded in the current survey, (†) thrips species first records from Pakistan. (Φ) Previous reported species from Pakistan for which I could not find the valid names in any database. Specimens are also not available to confirm the valid names.

DISCUSSION

Our study found that members of Thysanoptera are widely distributed throughout the country including tropical coastal lands, subtropical continental lowlands, and subtropical continental highlands. Thrips species were found on different plant species including crops, ornamental plants, and weeds. Most thrips species found during the surveys belonged to the families Thripidae and Phlaeothripidae. Species of family Phlaeothripidae were mostly found from subtropical continental highlands but they were also present in the subtropical continental lowlands. The most commonly found genus of family Phlaeothripidae in the current study was genus *Haplothrips.* Two species of genus *Haplothrips* (*H. ganglbaueri* and *H. tenuipennis*) were found to be distributed throughout the country.

The most abundant species of family Thripidae in our study were major pests and virus-vectors including, *T. palmi, T. tabaci, T. flavus, S. dorsalis,* and *F. schultzei*. Genus *Thrips* is the largest genus of the subfamily Thripinae. It includes more than 280 species (Mound and Masumoto, 2005). This genus is diverse and found in many parts of the world except the Neotropical region. Several species of economic importance are included in this genus (Bhatti, 1980). Many species in genus *Thrips* are economically important pests. These include *T. angusticeps* Uzel, *T. eridionalis* Priesner, *T. flavus* Schrank, *T. hawaiiensis* (Morgan), *T. palmi* Karny and *T. tabaci* Lindeman (Moritz *et al.,* 2001). *T. palmi* is an Asian polyphagous thrips species that spread around the world during the 1980s (Mound, 2005). *T. trehernei* was also found for the first time in Pakistan. *Scirtothrips* is another important genus of family Thripidae. It includes 103 species from around the world (ThripsWiki, 2014), several of which are important pests (Mound and Palmer, 1981, Mirab-balou *et al.*, 2013).

Two species of genus *Scirtothrips* (*S. dorsalis, S. oligochaetus*) were recorded from Pakistan in current study. Genus *Scolothrips* (Thripidae) includes the well known predator species of mites (Mound, 2011). Sixteen species in this genus are recognized (ThripsWiki, 2014), of which one species (*S. indicus*) was found in the current study. *Microcephalothrips abdominalis* (sunflower thrips), was found in Faisalabad region as well as Sind. Species of genus *Megalurothrips* Bagnall includes thirteen species (ThripsWiki, 2014), some of them are pests legume crops (Masumoto, 2010). The species of this genus breed in the flowers of Fabaceae. Although Palmer (1987) has provided details on species of the genus *Megalurothrips,* their identification continues to be a challenge. Three species of genus *Megalurothrips* (*M. usitatus, M. distalis* and *M. peculiaris*) were found at both highland and lowland sites, on several plant species.

In summary, this study adds new information to the diversity of Thysanoptera in Pakistan. A total of 42 thrips species were collected, representing 3 families and 20 genera. The array produced 8 species and 4 genera that were reported for the first time from Pakistan. Intensive surveys of thrips fauna, with repetitive collections during different seasons of the year are needed to better understand the highly diverse thrips fauna from this region. The number of wide spread, virus vector species recognized in this study is alarming, and may prove devastating if not taken care of. Therefore, detailed molecular studies should be performed to uncover virus vector interactions in thrips to avoid disease epidemics in future.

Table II.- GPS coordinates and plant sources of new recorded thrips species in current study.

Species	Location (GPS coordinate)	Source plants
Apterygothrips pellucidus (Ananthakrishnan, 1968)	32°9167' N, 72°7167'E 32°5457' N, 72°4251'E	*Avena sativa* L. (Poaceae), *Evolvulus alsinoides* (L.) L. (Convolvulaceae), *Erigeron sublyratus* DC. (Asteraceae).
Chaetanaphothrips orchidii (Moulton, 1907)	33°91' N, 73°4'E 33°7' N, 73°6833'E 33°5437' N, 73°243'E 33°4215' N, 73°4038'E	*Brassica oleracea var. botrytis* L. (Brassicaceae), *Brassica oleracea* L. (Brassicaceae), *Oxalis annae F. Bol.* (Oxalidaceae), *Evolvulus alsinoides* L. (Convolvulaceae).
Chirothrips meridionalis (Bagnall, 1927)	32°5333' N, 71°9333'E 33°75' N, 73°1333'E 33°91' N, 73°4'E	*Triticum aestivum* L. (Poaceae), *Bidens pilosus* L. (Asteraceae), *Brassica oleracea* L. (Brassicaceae).
Megalurothrips distalis (Karny, 1913) †	34°3667' N, 73°45 'E 24°7333' N, 69°7833'E 24°4331' N, 69°4850'E	*Calendula officinali* (Asteraceae), *Lantana montevidensis* (Verbenaceae), *Lantana pastazensis* (Verbenaceae).
Megalurothrips usitatus (Bagnall, 1913) †	26°0333' N, 68°9333'E 33°8' N, 72°9167'E 33°8' N, 73°9667'E 33°7' N, 73°6833'E 33°8167' N, 73°8167'E	*Acacia karoo* (Fabaceae), *Sesbania bispinosa* (Fabaceae), *Ambrosia trifida* (Asteraceae), *Viola glabella* (Violaceae), *Brassica napus* L. (Brassicaceae).
Neohydatothrips samayunkur (Kudo, 1995)	34°4' N, 73°3833'E 34°243' N, 73°239'E 34°2352' N, 73°2324'E 33°469' N, 73°5222'E 33°7667' N, 73°8833'E 33°8' N, 73°9667'E	*Eupatorium sp.* (Asteraceae), *Melilotus indicus* L. (Fabaceae), *Bidens pilosus L.* (Asteraceae), *Euphorbia sp.* (Euphorbiaceae), *Mimosa pudica* L. (Fabaceae), *Mimosa invisa Mart.* (Fabaceae).
Taeniothrips major (Bagnall, 1916)	34°15' N, 73°6833'E 33°9' N, 73°3833'E 33°542' N, 73°232'E 33°8167' N, 73°8167'E	*Achyranthes aspera* L. (Amaranthaceae), *Callistephus chinensis* (L.) *Nees* (Asteraceae), *Capsicum frutescens* L. (Solanaceae), *Amaranthus spinosus* L. (Amaranthaceae).
Thrips trehernei (Priesner, 1927)	33°74' N, 73°77'E 35°74' N, 71°7'E 35°4333' N, 71°4233'E 34°82' N, 74°34'E	*Rosa* L. (Rosaceae), *Dahlia* cav. (Asteraceae), *Chenopodium* L. (Amaranthaceae), *Erigeron sublyratus* DC. (Asteraceae).

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Statement of conflict of interest

Authors have declared no conflict of interest.

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