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Territorial distribution, classification and relationships amongst Italian Thysanoptera

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Abstract

The Italian thrips fauna includes, at present, 255 species of different origin: more than 170 species live in Central and Northern Europe, more than 60 are Mediterranean or North African, and 12 are introduced from more distant countries. The recognition of four large Italian territorial areas (North, Continental South, Sardinia and Sicily) is important when trying to understand adaptations of species to different habitats and biology. Such knowledge is of basic importance to explain the introduction and spread of exotic species, particularly pest species. Predators are restricted to the genera *Scolothrips* Hinds, *Haplothrips* Amyot et Serville and *Karnyothrips* Watson. In contrast, about 33 species belonging to the family Phlaeothripidae are mycophagous and found mostly in southern habitats. Phytophagous species represent more than 70% of the Italian Thysanoptera, and are listed by considering their host associations into those with native plants and those with plants not native to Italy.

In this way, about 35 species are reported as Mediterranean and related to the native flora, living only in the southern regions of the Peninsula. Comments on peculiarities of the Italian thrips fauna - different distribution of the species inside the territories, and high biodiversity for the presence of several endemic, Mediterranean and introduced species - are also provided.

Key words: thrips fauna, species, biology, regional distribution, territory, endemic.

Introduction

The Italian thrips fauna includes 255 species (De Marzo and Ravazzi, 2004; Marullo, 2004; De Marzo and Ravazzi, 2007; Ravazzi, 2010). Most of these are known from neighbouring countries (Marullo and zur Strassen, 1994; 2002) and only a few are endemic species described recently (Marullo and Ravazzi, 2001; De Marzo and Ravazzi, 2002; Ravazzi, 2008). The Italian Thysanoptera have various origins: about 170 are European species living in Centre-North Europe, 56 are Mediterranean and North-African and 12 are introduced from elsewhere (Marullo, 2004). In this paper, the host-plant range of the Italian thrips species is examined and tabulated based on literature references that contain sufficient information to substantiate the host relationships. The distribution of thrips species within the Italian territory is poorly known, with only a few recent papers (Vesmanis, 1986; Marullo and zur Strassen, 1994; 2002; Marullo, 2004) recording such geographic distributions. The regional division of Italy into four major territories (North, Continental South, Sicily and Sardinia) is important when considering the biology and adaptation to habitats of species. Such knowledge is basic to understanding the geographical diffusion of newly introduced species, particularly pest species.

The Italian territory is here considered subdivided into two main areas: the North, which comprises only the northern continental regions (Piedmont, Aosta Valley, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna) instead the South, including also central Italian regions (Tuscany, Umbria, Marche, Abruzzo, Molise, Lazio, Campania, Basilicata, Apulia and Calabria) plus two major islands (Sardinia and Sicily). This simplified territorial division is convenient because of the lack of suitable studies on the thrips fauna of Sardinia and Sicily, which do not allow a

detailed analysis separated from the continental regions. The aim of the present contribution is to provide an approach to the territorial distribution of Thysanoptera in Italy, and to examine the relationships between the species. An analysis is conducted of relationships between the Italian thrips fauna and the feeding preferences and host plant ranges of the species.

Methods

The available literature data have been tabulated to produce four lists of the Italian Thysanoptera regarding the distribution of genera, the distribution and amount of species, the feeding preference and the host plant associations relating to the phytophagous species. The genera and species are listed alphabetically under five families and nomenclature follows that used in the most recent web-based checklist (Mound, 2011), which should also be referred to for all the synonyms for the names listed into tables. The term feeding preference is used to distinguish between predatory, mycophagous and phytophagous species. The cited thrips species are those whose references on host plants provide sufficient information to support the possibility that the indicated host relationship is correct (Marullo, 2004).

Results

Table 1 lists the Italian Thysanoptera genera distributed into northern and southern regions or shared between them. A total of 89 genera is reported for Italy: 15 (about 17%) are known only for North Italy, 35 (about 39%) are present only in the South, whereas 39 genera (about 44%) are shared. A few introduced genera, i.e. *Parthenothrips* Uzel and *Platythrips* Uzel, of the family

Table 1. Distribution of the Italian Thysanoptera genera.

Family	North	South	Shared
Aeolothripidae		<i>Orothrips</i> Moulton 1907	<i>Aeolothrips</i> Haliday 1836 <i>Rhipidothrips</i> Uzel 1895
Fauriellidae	<i>Ropotamothrips</i> Pelikan 1958		
Melanthripidae			<i>Ankothrips</i> Crawford 1909 <i>Melanthrips</i> Haliday 1836
Stenurothripidae		<i>Holarthrothrips</i> Bagnall 1924	
Thripidae	<i>Apterothrips</i> Bagnall 1908 <i>Baliothrips</i> Uzel 1895 <i>Dictyothrips</i> Uzel 1895 <i>Iridothrips</i> Priesner 1940 <i>Microcephalothrips</i> Bagnall 1926 <i>Parthenothrips</i> Uzel 1895 <i>Platythrips</i> Uzel 1895 <i>Pseudodendrothrips</i> Schmutz 1913 <i>Sphaerophothrips</i> Priesner 1928 <i>Theilopedothrips</i> zur Strassen 1995	<i>Agrostothrips</i> Hood 1954 <i>Asphodelothrips</i> zur Strassen 1995 <i>Bregmatothrips</i> Hood 1912 <i>Caprithrips</i> Faure 1933 <i>Cestrothrips</i> Priesner 1964 <i>Collembolothrips</i> Priesner 1935 <i>Eryngyothrips</i> Bhatti 1979 <i>Phibalothrips</i> Hood 1918 <i>Physothrips</i> Karny 1912 <i>Scirtothrips</i> Shull 1909 <i>Scolothrips</i> Hinds 1902 <i>Sitothrips</i> Priesner 1931 <i>Stenchaetothrips</i> Bagnall 1926 <i>Tamaricothrips</i> Priesner 1964	<i>Anaphothrips</i> Uzel 1895 <i>Aptinothrips</i> Haliday 1836 <i>Ceratothrips</i> Reuter 1899 <i>Chirothrips</i> Haliday 1836 <i>Dendrothrips</i> Uzel 1895 <i>Drepanothrips</i> Uzel 1895 <i>Frankliniella</i> Karny 1910 <i>Heliothrips</i> Haliday 1836 <i>Hemianaphothrips</i> Priesner 1925 <i>Kakothrips</i> Williams 1914 <i>Limothrips</i> Haliday 1836 <i>Mycterothrips</i> Trybom 1910 <i>Neohydatothrips</i> John 1929 <i>Odontothrips</i> Amyot et Serville 1843 <i>Oxythrips</i> Uzel 1895 <i>Pezothrips</i> Karny 1907 <i>Prosopothrips</i> Uzel 1895 <i>Rubiothrips</i> Schliephake 1975 <i>Sericothrips</i> Haliday 1836 <i>Stenothrips</i> Uzel 1895 <i>Taeniothrips</i> Amyot et Serville 1843 <i>Tenothrips</i> Bhatti 1967 <i>Thrips</i> L. 1758
Phlaeothripidae	<i>Bagnalliella</i> Karny 1920 <i>Hindsiothrips</i> Stannard 1958 <i>Lispothrips</i> Reuter 1899 <i>Xylaplothrips</i> Priesner 1928	<i>Allothrips</i> Hood 1908 <i>Apterygothrips</i> Priesner 1933 <i>Ataliothrips</i> Bhatti 1995 <i>Bacillothrips</i> Buffa, 1908 <i>Bactrothrips</i> Karny 1912 <i>Bebelothrips</i> Buffa 1909 <i>Cephalothrips</i> Uzel 1895 <i>Chiraplothrips</i> Priesner 1931 <i>Gynaikothrips</i> Zimmermann 1900 <i>Hoplandrothrips</i> Hood 1912 <i>Karnyothrips</i> Watson 1923 <i>Neoheegeria</i> Schmutz 1909 <i>Podothrips</i> Hood 1913 <i>Poecilothrips</i> Uzel 1895 <i>Priesneriella</i> Hood 1927 <i>Siphonothrips</i> Buffa 1908 <i>Sophiothrips</i> Hood 1934 <i>Treherniella</i> Watson 1924 <i>Tylothrips</i> Hood 1937	<i>Acanthothrips</i> Uzel 1895 <i>Amphibolothrips</i> Buffa 1909 <i>Bolothrips</i> Priesner 1926 <i>Compsothrips</i> Reuter 1901 <i>Cryptothrips</i> Uzel 1895 <i>Haplothrips</i> Amyot et Serville 1843 <i>Hoplothrips</i> Amyot et Serville 1843 <i>Liothrips</i> Uzel 1895 <i>Megalothrips</i> Uzel 1895 <i>Megathrips</i> Targioni-Tozzetti 1881 <i>Phlaeothrips</i> Haliday 1836 <i>Pseudocryptothrips</i> Priesner 1919
Totals	15	35	39

Thripidae are reported only for North Italy but can also be found in southern areas. Only species of the genera *Apterothrips* Bagnall and *Dictyothrips* Uzel have north European origins and can colonize northern habitats, so also species of *Bagnalliella* Karny, *Hindsiothrips* Stannard and *Lispothrips* O.M.Reuter, in Phlaeothripidae, are exclusive to northern regions. The only species of *Xylaplothrips* Priesner may also be present in the South. Species of five Mediterranean genera, *Agrostothrips* Hood, *Asphodelothrips* zur Strassen, *Cestrothrips* Priesner, *Eryngyothrips* Bhatti and *Sitothrips* Priesner in family Thripidae, live only in the South, whilst species of genera *Scirtothrips* Shull, *Scolothrips* Hinds and

Stenchaetothrips Bagnall are introduced. Amongst Phlaeothripidae, only species of genera *Allothrips* Hood, *Apterygothrips* Priesner, *Bacillothrips* Buffa, *Chiraplothrips* Priesner, *Neoheegeria* Schmutz and *Siphonothrips* Buffa can be considered as native to southern Italian areas; all the other phlaeothripids have to be considered introduced from tropical and warm world countries, except for *Hoplandrothrips ellisi* Bagnall, a northern European species, collected only in southern continental Italian regions.

In table 2, the number of recorded species for each genus is reported; amongst 255 Italian thrips species, about 44% live in southern areas, 22% constitute the

Table 2. Distribution and amount of the Italian Thysanoptera species.

Family	Genus	North	South	Shared
Aeolothripidae	<i>Aeolothrips</i> Haliday 1836	0	5	8
	<i>Orothrips</i> Moulton 1907	0	1	0
	<i>Rhipidothrips</i> Uzel 1895	0	2	1
Fauriellidae	<i>Ropotamothrips</i> Pelikan 1958	1	0	0
Melanthripidae	<i>Ankothrips</i> Crawford 1909	0	1	1
	<i>Melanthrips</i> Haliday 1836	1	4	2
Stenurothripidae	<i>Holarthrothrips</i> Bagnall 1924	0	1	0
Thripidae	<i>Agrostothrips</i> Hood 1954	0	1	0
	<i>Anaphothrips</i> Uzel 1895	1	1	1
	<i>Apterothrips</i> Bagnall 1908	1	0	0
	<i>Aptinothrips</i> Haliday 1836	0	3	2
	<i>Asphodelothrips</i> zur Strassen 1995	0	1	0
	<i>Baliothrips</i> Uzel 1895	1	0	0
	<i>Bregmatothrips</i> Hood 1912	0	1	0
	<i>Caprithrips</i> Faure 1933	0	1	0
	<i>Ceratothrips</i> Reuter 1899	0	1	1
	<i>Cestrothrips</i> Priesner 1964	0	1	0
	<i>Chirothrips</i> Haliday 1836	0	4	2
	<i>Collemboothrips</i> Priesner 1935	0	1	0
	<i>Dendrothrips</i> Uzel 1895	2	1	2
	<i>Dictyothrips</i> Uzel 1895	1	0	0
	<i>Drepanothrips</i> Uzel 1895	0	0	1
	<i>Eryngyothrips</i> Bhatti 1979	0	1	0
	<i>Frankliniella</i> Karny 1910	0	0	4
	<i>Heliothrips</i> Haliday 1836	0	0	1
	<i>Hemianaphothrips</i> Priesner 1925	0	1	0
	<i>Iridothrips</i> Priesner 1940	1	0	1
	<i>Kakothrips</i> Williams 1914	0	2	1
	<i>Limothrips</i> Haliday 1836	1	1	3
	<i>Microcephalothrips</i> Bagnall 1926	1	0	0
	<i>Mycterothrips</i> Trybom 1910	1	0	2
	<i>Neohydatothrips</i> John 1929	1	0	1
	<i>Odontothrips</i> Amyot et Serville 1843	1	7	4
	<i>Oxythrips</i> Uzel 1895	1	3	3
	<i>Pezothrips</i> Karny 1907	0	2	0
	<i>Phibalothrips</i> Hood 1918	0	1	0
	<i>Physothrips</i> Karny 1912	0	2	0
	<i>Platythrips</i> Uzel 1895	1	0	0
	<i>Prosopothrips</i> Uzel 1895	1	1	0
	<i>Pseudodendrothrips</i> Schmutz 1913	1	0	0
	<i>Rubiothrips</i> Schliephake 1975	3	0	1
	<i>Scirtothrips</i> Shull 1909	0	2	0
	<i>Scolothrips</i> Hinds 1902	1	1	0
	<i>Sericothrips</i> Haliday 1836	0	0	1
	<i>Sitothrips</i> Priesner 1931	0	1	0
	<i>Sphaeropothrips</i> Priesner 1928	1	0	0
	<i>Stenchaetothrips</i> Bagnall 1926	1	0	0
	<i>Stenothrips</i> Uzel 1895	0	0	1
	<i>Taeniothrips</i> Amyot et Serville 1843	0	0	2
	<i>Tamaricothrips</i> Priesner 1964	0	1	0
	<i>Tenothrips</i> Bhatti 1967	0	1	4
	<i>Theilopedothrips</i> zur Strassen 1995	1	0	0
	<i>Thrips</i> L. 1758	10	9	18
	Phlaeothripidae	<i>Acanthothrips</i> Uzel 1895	0	0
<i>Allothrips</i> Hood 1908		0	1	0
<i>Amphibolothrips</i> Buffa 1909		1	1	0
<i>Apterygothrips</i> Priesner 1933		0	2	0
<i>Ataliothrips</i> Bhatti 1995		0	1	0
<i>Bacillothrips</i> Buffa 1908		0	1	0
<i>Bactrothrips</i> Karny 1912		0	1	0
<i>Bagnalliella</i> Karny 1920		1	0	0
<i>Bolothrips</i> Priesner 1926		2	2	2
<i>Cephalothrips</i> Uzel 1895		0	2	0
<i>Chiraplothrips</i> Priesner 1931		0	2	0
<i>Compsothrips</i> Reuter 1901		1	2	0

(continued)

(Table 2 continued)

Family	Genus	North	South	Shared
Phlaeothripidae	<i>Cryptothrips</i> Uzel 1895	0	0	1
	<i>Gynaikothrips</i> Zimmermann 1900	0	1	0
	<i>Haplothrips</i> Amyot et Serville 1843	5	9	9
	<i>Hindsiothrips</i> Stannard 1958	1	1	0
	<i>Hoplandrothrips</i> Hood 1912	0	1	0
	<i>Hoplothrips</i> Amyot et Serville 1843	1	3	2
	<i>Karnyothrips</i> Watson 1923	0	1	0
	<i>Liothrips</i> Uzel 1895	1	2	2
	<i>Lispthrips</i> Reuter 1899	1	0	0
	<i>Megalothrips</i> Uzel 1895	1	1	0
	<i>Megathrips</i> Targioni-Tozzetti 1881	0	2	1
	<i>Neoheegeria</i> Schmutz 1909	0	1	0
	<i>Phlaeothrips</i> Haliday 1836	0	1	1
	<i>Podothrips</i> Hood 1913	0	1	0
	<i>Poecilothrips</i> Uzel 1895	0	1	0
	<i>Priesneriella</i> Hood 1927	0	2	0
	<i>Pseudocryptothrips</i> Priesner 1919	0	0	1
	<i>Siphonothrips</i> Buffa 1908	0	1	0
	<i>Sophiothrips</i> Hood 1934	0	1	0
	<i>Treherniella</i> Watson 1924	0	1	0
	<i>Tylothrips</i> Hood 1937	0	1	0
	<i>Xylaplothrips</i> Priesner 1928	1	0	0
	Totals*		55	112

* comprehensive of the omitted species: *Bradinothrips musae*, *Chaetanaphothrips orchidii*, *Hercinothrips femoralis* in Thripidae; *Bebelothrips latus* in Phlaeothripidae (see text).

northern species and 34% are shared between the two areas. Three introduced species are omitted, *Bradinothrips musae* (Hood), *Chaetanaphothrips orchidii* (Moulton) and *Hercinothrips femoralis* (O.M.Reuter) because they are restricted to protected crops (in greenhouses). Also omitted is the species of genus *Bebelothrips* Buffa whose collecting data are not available.

In table 3 the relationships between the Italian Thysanoptera species and their feeding preferences is outlined. Phytophagous species are represented in Aeolothripidae by four species, although predatory aeolothripids are more numerous, mainly facultative predators, but with a few obligate predators, such as *A. albicinctus* Haliday, *A. cursor* Priesner, *A. melaleucus* Haliday and *A. versicolor* Uzel, which can be found in all the Italian territories and the possibility to colonize their host is due to the diffusion of such plants (*Alnus*, *Fraxinus*, *Salix*) inside the Peninsula, including the two largest islands (Sicily and Sardinia).

All Melanthripidae species are phytophagous as well as *Holarthrothrips tenuicornis* Bagnall the only Stenurothripidae species known for Italy. The family Thripidae includes all phytophagous species and two predators, *Scolothrips longicornis* Priesner and *Scolothrips uzeli* (Schille).

Mycophagous thrips species are all included in Phlaeothripidae (Marullo, 1997): 19 species in Idolothripinae are spore feeders and 13 species in Phlaeothripinae are hyphae feeders; only two phlaeothripid species are known as obligatory predators, *Haplothrips kurdjumovi* Karny and *Karnyothrips flavipes* (Jones) the former on mites and eggs of moths, the latter on scale insects. Instead *Haplothrips subtilissimus* Haliday is a facultative predator.

day is a facultative predator.

Mycophagous species have to be considered host-specific even if the fungus species is unknown; their host associations is ascertained only for a few species, such as *Megathrips lativentris* (Heeger) related to fungi living in *Quercus* litter, or *Bolothrips dentipes* (O.M.Reuter), a spore feeder of grasses, whereas species of genus *Hoplothrips* Amyot et Serville are fungus feeders associated with dead woody tissues of deciduous trees.

Table 4 lists the phytophagous thrips species and their associations with plants that are native or not to the Italian flora. The highly polyphagous introduced species, *Frankliniella occidentalis* (Pergande), is here omitted. The listed species of Aeolothripidae have a phytophagous dietary and occasionally might have a predatory habit.

Species of the family Aeolothripidae are mostly host-specific on plants native to the Italian flora: the Mediterranean species *Aeolothrips gloriosus* Bagnall, *Aeolothrips melisi* Priesner and *Orothrips priesneri* (Titschack) are each associated with one family of plants, whereas the Mediterranean species *Aeolothrips collaris* Priesner and the European *Aeolothrips ericae* Bagnall are polyphagous living on several botanical families. The family Melanthripidae includes all flower feeders, often monophagous, in the genera *Melanthrips* Haliday and *Ankothrips* D.L.Crawford; three Mediterranean species, *Melanthrips ficallii* Buffa, *Melanthrips fuscus* (Sulzer) and *Ankothrips mavromoustakisi* Priesner are host specific on Resedaceae, Rosaceae and Poaceae, living on plant species native to the Italian flora. However, *M. fuscus* extends to northern regions living on the European genus *Crataegus*.

Table 3. Relationships between the Italian Thysanoptera species and their feeding preference.

Family	Phytophagous	Predators	Mycophagous
Aeolothripidae	<i>Orothrips priesneri</i> (Titschack 1958)	<i>Aeolothrips albicinctus</i> • Haliday 1836	
	<i>Rhipidothrips brunneus</i> Williams 1913	<i>Aeolothrips collaris</i> •• Priesner 1919	
	<i>Rhipidothrips gratosus</i> Uzel 1895	<i>Aeolothrips cursor</i> • Priesner 1939	
	<i>Rhipidothrips unicolor</i> zur Strassen 1965	<i>Aeolothrips ericae</i> •• Bagnall 1920	
		<i>Aeolothrips fasciatus</i> •• (L. 1758)	
		<i>Aeolothrips gloriosus</i> •• Bagnall 1914	
		<i>Aeolothrips intermedius</i> •• Bagnall 1934	
		<i>Aeolothrips melaleucus</i> ♦ Haliday 1852	
		<i>Aeolothrips melisi</i> •• Priesner 1936	
		<i>Aeolothrips propinquus</i> •• Bagnall 1924	
		<i>Aeolothrips tenuicornis</i> •• Bagnall 1926	
		<i>Aeolothrips versicolor</i> ♦ Uzel 1895	
	Melanthripidae	<i>Ankothrips mavromoustakisi</i> Priesner 1939	
<i>Ankothrips niezabitoskii</i> (Schille 1910)			
<i>Melanthrips acetosellae</i> John 1927			
<i>Melanthrips ficallii</i> Buffa 1907			
<i>Melanthrips fuscus</i> (Sulzer 1776)			
<i>Melanthrips libycus</i> Priesner 1936			
<i>Melanthrips nigricornis</i> Bagnall 1913			
<i>Melanthrips pallidior</i> Priesner 1919			
<i>Melanthrips rivnayi</i> Priesner 1936			
Stenurothripidae	<i>Holarthrothrips tenuicornis</i> Bagnall 1927		
Thripidae	All species except those reported as predators		
		<i>Scolothrips longicornis</i> ** Priesner 1926	
		<i>Scolothrips uzeli</i> ** (Schille 1911)	
Phlaeothripidae/ Idolothripinae			<i>Allothrips pillichellus</i> ○ (Priesner 1925)
			<i>Bacillothrips longipes</i> ○ (Reuter 1901)
			<i>Bactothrips buffai</i> ○ (Karny 1921)
			<i>Bolothrips bicolor</i> ○ (Heeger 1852)
			<i>Bolothrips cingulatus</i> ○ (Karny 1916)
			<i>Bolothrips dentipes</i> ○ (Reuter 1880)
			<i>Bolothrips icarus</i> ○ (Uzel 1895)
			<i>Bolothrips insularis</i> ○ (Bagnall 1914)
			<i>Bolothrips italicus</i> ○ Mound 1974
			<i>Compsothrips albosignatus</i> ○ (Reuter 1884)
			<i>Compsothrips maroccanus</i> ○ Priesner 1964
			<i>Compsothrips uzeli</i> ○ (Hood 1952)
			<i>Cryptothrips nigripes</i> ○ (Reuter 1880)
			<i>Megalothrips bonannii</i> ○ Uzel 1895
			<i>Megalothrips delmasi</i> ○ Bournier 1956
			<i>Megathrips elegans</i> ○ (Buffa 1908)
			<i>Megathrips inermis</i> ○ Priesner 1937
			<i>Megathrips lativentris</i> ○ (Heeger 1852)
			<i>Priesneriella mavromoustakisi</i> ○ (Crawford 1948)
	Phlaeothripidae/ Phlaeothripinae		
			<i>Amphibolothrips grassii</i> ○○ Buffa 1909
			<i>Amphibolothrips knechteli</i> ○○ (Priesner 1936)
			<i>Bebelothrips latus</i> ○○ Buffa 1909
		<i>Haplothrips kurdjumovi</i> + Karny 1913	<i>Hindsiothrips bonessi</i> ○○ (Titschack 1955)
		<i>Haplothrips subtilissimus</i> •• (Haliday 1852)	<i>Hoplandrothrips ellisi</i> ○○ Bagnall 1914
			<i>Hoplothrips caespitis</i> ○○ (Uzel 1895)
			<i>Hoplothrips corticis</i> ○○ (De Geer 1773)
			<i>Hoplothrips fungi</i> ○○ (Zetterstedt 1828)
			<i>Hoplothrips germanae</i> ○○ Bournier 1961
			<i>Hoplothrips pedicularius</i> ○○ (Haliday 1836)
		<i>Karnyothrips flavipes</i> * (Jones 1912)	<i>Phlaeothrips pillichianus</i> ○○ (Priesner 1924)
			<i>Sophiothrips terminalis</i> ○○ (Bagnall 1927)
		<i>Xylaplothrips fuliginosus</i> **/○ (Schille 1911)	

• obligatory predator (at the collar of grasses or cultivated herbaceous plants); •• facultative predator; ♦ obligatory predator (on leaves of trees); * predator of scale insects; ** predator of mites on leaves; ○ spore feeders; ○○ hyphae feeders; + predator of mites and eggs of moths.

Table 4. Phytophagous thrips species and associations to the Italian flora.

Family	Species	Plant family	Plant genus
Aeolothripidae	<i>Aeolothrips collaris</i> Priesner 1919 ●	Apiaceae, Brassicaceae, Asteraceae, Fabaceae, Lamiaceae	<i>Brassica</i> , <i>Calendula</i> , <i>Calicotoma</i> , <i>Clinopodium</i> , <i>Eryngium</i> , <i>Rosmarinus</i>
	<i>Aeolothrips ericae</i> Bagnall 1920	Brassicaceae, Asteraceae, Ericaceae, Lamiaceae	<i>Brassica</i> , <i>Calendula</i> , <i>Erica</i> , <i>Rosmarinus</i>
	<i>Aeolothrips gloriosus</i> Bagnall 1914 ●	Anacardiaceae	<i>Pistacia</i>
	<i>Aeolothrips intermedius</i> Bagnall 1934	Rosaceae	<i>Crataegus</i>
	<i>Aeolothrips melisi</i> Priesner 1936 ●	Fabaceae	<i>Cytisus</i>
Melanthripidae	<i>Orothrips priesneri</i> (Titschack 1958) ●	Rosaceae	<i>Crataegus</i>
	<i>Ankothrips mavromoustakis</i> Priesner 1939 ●	Poaceae	<i>Arundo</i>
	<i>Ankothrips niezabitowskii</i> (Schille 1910)	Cupressaceae	<i>Juniperus</i>
	<i>Melanthrips acetosellae</i> John 1927	Polygonaceae	<i>Rumex</i>
	<i>Melanthrips ficalbii</i> Buffa 1907 ●	Resedaceae	<i>Reseda</i>
Stenurothripidae	<i>Melanthrips fuscus</i> (Sulzer 1776) ●	Rosaceae	<i>Crataegus</i>
	<i>Holarthrothrips tenuicornis</i> Bagnall 1927 ▲	Palmae	<i>Phoenix</i>
Thripidae	<i>Anaphothrips obscurus</i> (Muller 1776)	Poaceae	<i>Arundo</i>
	<i>Aptinothrips elegans</i> Priesner 1924 ●	Poaceae	<i>Agropyron</i>
	<i>Aptinothrips rufus</i> Haliday 1836	Poaceae	<i>Ampelodesma</i>
	<i>Asphodelothrips croceicollis</i> (Karny 1914) ●	Liliaceae	<i>Asphodelus</i>
	<i>Bradinothrips musae</i> (Hood 1956) ▲	Araceae	<i>Spathyphyllum</i>
	<i>Caprithrips melanophthalmus</i> (Bagnall 1927) ●	Poaceae	<i>Cymbopogon</i>
	<i>Ceratothrips ericae</i> (Haliday 1836)	Ericaceae	<i>Erica</i>
	<i>Chirothrips aculeatus</i> Bagnall 1927	Poaceae	<i>Dactylis</i>
	<i>Chirothrips africanus</i> Priesner 1932 ●	Poaceae	<i>Arundo</i>
	<i>Chirothrips manicatus</i> Haliday 1936	Poaceae	<i>Agropyrum</i> , <i>Arundo</i>
	<i>Chirothrips pallidicornis</i> Priesner 1938 ●	Poaceae	<i>Dactylis</i>
	<i>Dendrothrips deegeri</i> Uzel 1895	Oleaceae, Fagaceae	<i>Fraxinus</i> , <i>Quercus</i>
	<i>Dendrothrips phyllireae</i> (Bagnall 1927)	Oleaceae	<i>Phyllirea</i> , <i>Ligustrum</i>
	<i>Drepanothrips reuteri</i> Uzel 1895	Vitaceae, Fagaceae	<i>Vitis</i> , <i>Quercus</i>
	<i>Eryngiothrips ferulae</i> (Priesner 1933) ●	Apiaceae	<i>Ferula</i>
	<i>Frankliniella intonsa</i> (Trybom 1895)	Fabaceae	<i>Vicia</i>
	<i>Frankliniella pallida</i> (Uzel 1895)	Fabaceae	<i>Vicia</i>
	<i>Hemianaphothrips articulatus</i> Priesner 1925	Salicaceae, Poaceae	<i>Salix</i> , <i>Calamagrostis</i>
	<i>Iridothrips iridis</i> (Watson 1924)	Iridaceae	<i>Iris</i>
	<i>Kakothrips robustus</i> (Uzel 1895)	Fabaceae	<i>Melilotus</i> , <i>Ononis</i>
	<i>Limothrips angulicornis</i> Jablonowski 1894	Poaceae	<i>Hordeum</i>
	<i>Limothrips cerealium</i> Haliday 1836	Poaceae	<i>Triticum</i>
	<i>Limothrips consimilis</i> Priesner 1926	Poaceae	<i>Dactylis</i>
	<i>Limothrips denticornis</i> Haliday 1836	Poaceae	<i>Triticum</i>
	<i>Neohydatothrips gracilicornis</i> (Williams 1916)	Fabaceae	<i>Vicia</i>
	<i>Odonthrips</i> spp. ●	Fabaceae	<i>Genista</i> , <i>Medicago</i>
	<i>Oxythrips ajugae</i> Uzel 1895	Cupressaceae	<i>Cupressus</i>
	<i>Oxythrips ulmifoliorum</i> (Haliday 1836)	Apiaceae, Ulmaceae	<i>Eryngium</i> , <i>Ulmus</i>
	<i>Oxythrips uncinatus</i> Priesner 1940	Fagaceae	<i>Quercus</i>
	<i>Pezothrips dianthi</i> (Priesner 1921) ●	Caryophyllaceae	<i>Dianthus</i>
	<i>Pezothrips kellyanus</i> (Bagnall 1916) ●	Rutaceae, Oleaceae, Pittosporaceae	<i>Citrus</i> , <i>Jasminus</i> , <i>Pittosporum</i>
	<i>Rubiothrips vitalbae</i> (Bagnall 1926)	Ranunculaceae	<i>Clematis</i>
	<i>Sericothrips bicornis</i> (Priesner 1931) ●	Fabaceae	<i>Lotus</i> , <i>Trifolium</i>
	<i>Sitiothrips arabicus</i> (Priesner 1931)	Poaceae	<i>Hordeum</i>
	<i>Stenothrips graminum</i> Uzel 1895	Poaceae	<i>Avena</i> , <i>Triticum</i>
	<i>Taeniothrips inconsequens</i> (Uzel 1895)	Rosaceae	<i>Prunus</i>
	<i>Tamaricothrips tamaricis</i> (Bagnall 1926) ●	Tamaricaceae	<i>Tamarix</i>
	<i>Tenothrips croceicollis</i> (Priesner 1919) ●	Asteraceae	<i>Centaurea</i>
	<i>Tenothrips discolor</i> (Karny 1907) ●	Asteraceae	<i>Helichrysum</i>
	<i>Tenothrips frici</i> (Uzel 1895) ●	Asteraceae, Lamiaceae, Brassicaceae	<i>Centaurea</i> , <i>Rosmarinus</i> , <i>Alyssum</i>
	<i>Thrips alni</i> Uzel 1895	Betulaceae	<i>Alnus</i>
	<i>Thrips atratus</i> Haliday 1836	Lamiaceae, Lamiaceae, Ericaceae	<i>Rosmarinus</i> , <i>Teucrium</i> , <i>Stachys</i>
<i>Thrips brevicornis</i> Priesner 1920	Brassicaceae	<i>Lobularia</i>	
<i>Thrips flavus</i> Schrank 1776	Lamiaceae, Caprifoliaceae	<i>Rosmarinus</i> , <i>Viburnum</i>	
<i>Thrips italicus</i> (Bagnall 1926) ●	Caryophyllaceae	<i>Dianthus</i>	
<i>Thrips major</i> Uzel 1895	Myrtaceae, Ericaceae, Brassicaceae	<i>Eucalyptus</i> , <i>Arbutus</i> , <i>Lobularia</i>	
<i>Thrips meridionalis</i> (Priesner 1926) ●	Rosaceae, Fabaceae	<i>Prunus</i> , <i>Cytisus</i>	
<i>Thrips minutissimus</i> L. 1758	Anacardiaceae, Poaceae, Betulaceae	<i>Pistacia</i> , <i>Ampelodesma</i> , <i>Carpinus</i> , <i>Quercus</i>	
<i>Thrips nigropilosus</i> Uzel 1895	Asteraceae	<i>Achillea</i>	
<i>Thrips sambuci</i> Heeger 1854	Caprifoliaceae	<i>Sambucus</i>	
<i>Thrips tabaci</i> Lindeman 1889 ●	Myrtaceae, Brassicaceae, Solanaceae	<i>Eucalyptus</i> , <i>Lobularia</i> , <i>Lycopersicon</i>	
<i>Thrips urticae</i> F. 1781	Urticaceae	<i>Urtica</i>	
<i>Thrips verbasci</i> (Priesner 1920) ●	Scrophulariaceae	<i>Verbascum</i>	
Phlaeothripidae	<i>Apterygothrips caricis</i> Marullo et Ravazzi 2003 ●	Cyperaceae	<i>Cyperus</i>
	<i>Ataliothrips reuteri</i> (Bagnall 1913) ●	Tamaricaceae	<i>Tamarix</i>
	<i>Chiraplothrips graminellus</i> Priesner 1939 ●	Poaceae	<i>Cymbopogon</i>
	<i>Gynaikothrips ficorum</i> (Marchal 1908) ▲	Moraceae	<i>Ficus benjamina</i>

(continued)

(Table 4 continued)

Family	Species	Plant family	Plant genus
	<i>Haplothrips andresi</i> Priesner 1931 •	Ericaceae, Anacardiaceae, Poaceae (grasses), Lamiaceae	<i>Erica, Pistacia, Rosmarinus, Arundo</i>
	<i>Haplothrips biroii</i> (Priesner 1938)	Lamiaceae	<i>Rosmarinus</i>
	<i>Haplothrips distinguendus</i> (Uzel 1895)	Asteraceae, Ericaceae	<i>Centaurea, Erica</i>
	<i>Haplothrips hispanicus</i> Priesner 1924 •	Brassicaceae, Apiaceae	<i>Lobularia, Eryngium</i>
	<i>Haplothrips leucanthemi</i> (Schrank 1781)	Asteraceae	<i>Chrysanthemum</i>
	<i>Haplothrips mateolanus</i> De Marzo et Ravazzi 2002 •	Chenopodiaceae	<i>Atriplex</i>
	<i>Haplothrips simplex</i> (Buffa 1909) •	Asteraceae	<i>Calendula</i>
	<i>Haplothrips subtilissimus</i> (Haliday 1852)	Betulaceae, Salicaceae, Ulmaceae	<i>Alnus, Salix, Ulmus</i>
	<i>Liothrips oleae</i> (Costa 1857) •	Oleaceae	<i>Olea</i>
	<i>Liothrips pragensis</i> Uzel 1895	Fagaceae	<i>Quercus</i>
	<i>Podothrips graminum</i> Priesner 1938 •	Poaceae	<i>Phragmites, Arundo</i>
	<i>Priesneriella clavicornis</i> (Knechtel 1936)	Poaceae	<i>Lygeum</i>
	<i>Treherniella afra</i> Priesner 1935 •	Poaceae (grasses)	

▲ species not native to Italy; • Mediterranean species.

Three introduced species, *H. tenuicornis* in family Stenurothripidae, *B. musae* in Thripidae and *Gynai-kothrips ficorum* (Marchal) in Phlaeothripidae, are monophagous on host plants that are not native to Italy, and their surviving is due only to the possibility for their host plants growing in particular conditions (i.e. in greenhouses for *Ficus benjamina* and *Spathyphyllum*, or on *Phoenix dactylifera* plants growing along the streets close to sea in several southern Italian towns).

All genera listed in the family Thripidae include species related to host plants native to the Italian flora; they also include the most harmful species to vegetable-ornamental crops and orchards (Tommasini and Maini, 1995; Tommasini and Ceredi, 2007). A few genera, *Anaphothrips* Uzel, *Aptinothrips* Haliday, *Chirothrips* Haliday, *Limothrips* Haliday, *Sitothrips* and *Stenothrips* Uzel are host specific to Poaceae.

The Mediterranean genus *Sitothrips* and the European genus *Chirothrips* include a few North African species which live and breed on wild Poaceae only in some southern areas (Marullo, 2005). Fourteen Mediterranean species are listed and mostly related to monophagous genera *Aptinothrips* Haliday, *Asphodelothrips*, *Caprithrips* Faure, *Eryngyothrips*, *Sitothrips*, *Tamaricothrips* Priesner and *Tenothrips* Bhatti. The polyphagous genus *Thrips* L. includes a few highly monophagous species, living on one plant genus or one plant species, i.e. *Thrips sambuci* Heeger, *Thrips urticae* F., *Thrips verbasci* (Priesner). Three listed species are North European, *Iridothrips iridis* (Watson), *Thrips alni* Uzel and *T. urticae*, and can be found only in northern Italy.

In the family Phlaeothripidae only the Mediterranean genera *Apterygothrips* and *Chiraplothrips*, are exclusive of southern regions, and host specific on wild Cyperaceae and Poaceae; instead the European genera *Haplothrips* Amyot et Serville and *Liothrips* Uzel are represented by a few Mediterranean or European species, mostly monophagous on one plant family. Three species are host specific on Poaceae, the Mediterranean *Podothrips graminum* Priesner and *Treherniella afra* Priesner, and the European *Priesneriella clavicornis* (Knechtel), all living in the South. Only two species are polyphagous, *Haplothrips andresi* Priesner on wild plants (*Arundo*, *Pistacia*, *Erica*) in southern regions and the European *H. subtilissimus* in forestry habitats.

Discussion

The number of Thysanoptera species recognized from Italy, demonstrates that they constitute one of the less numerous orders of insects. As reported in the relevant project on the Checklist of the Italian Fauna (Minelli *et al.*, 1995), approximately the Italian fauna comprises 57,500 species of animals of which 46,000 are arthropods and among them 37,000 species are insects (Minelli, 1996). The insects represent 64% of all animal species. In particular, 12,000 Coleoptera species constitute 32% of the insects - more than 20% of the whole Italian fauna; 7,500 Hymenoptera species represent 18%; 5,100 Lepidoptera species represent 14%; 3,500 Rhynchota 9% and the remaining 2,100 species of insects represent 5.7%.

The Italian Thysanoptera represents less than 1% (0.68%) of the insects living in Italy. However, the results produced in this study confirm some aspects pointed out for the larger groups in the main checklist (Minelli *et al.*, 1995). Following the analysis in tables 1 and 2, the high biodiversity is shown by 89 genera which are mainly distributed in southern regions or shared with the North. The abundance of genera in the South is due to the presence of some exclusively Mediterranean taxa, such as *Asphodelothrips*, *Caprithrips*, *Collembolothrips* Priesner in Thripidae, and 19 phlaeothripid genera that are southern or introduced from warm world countries.

Similarly, an high proportion of species occurs in the southern regions (112 species corresponding to the 44% of all thrips fauna). Very likely, the spreading and the diffusion of southern species is favoured by climatic conditions and host-specificity. The host plant range of each species is of primary importance for their development; if a species develops on one plant family or one plant species that is a native of the flora, then the possibility to establish permanently in southern regions is substantial. This conclusion arises following analysis of the data of associations to the Italian flora in table 4: the south Mediterranean species as *Sitothrips arabicus* Priesner, *Chirothrips africanus* Priesner and *P. graminum* all specific to Poaceae, are established on cereal crops and wild grasses in southern Italy, because such plants provide similar habitats at different sites. These thrips

might be considered candidates to become pests on cereal crops in new habitats: this possibility is favoured by their feeding on leaves and by surviving and developing in the field, where they have many alternative hosts. Moreover, under such conditions they could have more than one generation per year, because the wild grasses might provide conditions for breeding and feeding when the annual cereal crop is finished (Marullo, 2005).

The recognition of new endemic species, which is related to restricted areas, characterized by typical flora and separated from neighbouring territory, occurred in the past and in more recent years. New genera and species were described by Buffa (1908; 1909), such as genus *Bacillothrips* and genus *Siphonothrips* from Sardinia, genus *Amphibolothrips* and related species *Amphibolothrips grassii* Buffa from Albano lake in Lazio, genus *Bebelothrips* and *Bebelothrips latus* Buffa species from Giglio island (close to Tuscany); more recently, new species have been described, such as *Apterygothrips caricis* Marullo et Ravazzi (Marullo and Ravazzi, 2001) from Sardinia, *Haplothrips mateolanus* De Marzo et Ravazzi (De Marzo and Ravazzi, 2002) from Basilicata, and *Odontothrips penninus* Ravazzi (Ravazzi, 2008) from Piedmont Apennine. These records confirm that the endemic species amongst the Italian thrips fauna might be in greater numbers, even though not yet recognized. Stoch (2000; 2003) considered the large percentage of endemic species in the Italian Fauna (from 10% to 25%), as the highest value for the European Fauna and spreading in some parts of the Peninsula's territory (Prealps and along Apennine chain, Sardinia and main islands). Endemic species are not present at highest areas of Alps and the Po River Plain. This situation has historical considerations resulting from the depauperization of the Alpine fauna during the glacial Quaternary period. The complete lack of endemic species of Po River Plain is possibly related to the young geological age of that area.

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