JOURNAL OF PLANT PROTECTION RESEARCH Vol. 51, No. 4 (2011)

BIODIVERSITY OF THRIPS SPECIES (THYSANOPTERA) ON FLOWERING HERBS IN CRACOW, POLAND

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Received: November 17, 2010
Accepted: July 11, 2011

Abstract: Thrips specimens were collected from 2004 to 2006 from the Herb Collection of the Faculty of Horticulture, the Agricultural University in Cracow, Poland and from 2006 to 2008 from the Botanical Garden in Cracow, Poland. We collected 16,058 adult thrips belonging to 22 Thysanoptera taxa from the flowers and inflorescences of 37 species of herbs from both of the collections. Thrips species composition infesting the flowers and inflorescences of herbs were very similar and not dependent on the plant species and the area of research. Only the participation of particular species differed. The prevailing polyphagous species connected with flowers were: *Thrips fuscipennis, Thrips flavus, Frankliniella intonsa, Thrips albopilosus* and *Thrips major*. Also, a high number of *Thrips tabaci* and random species connected with grass as well as predatory species *Aeolothrips* were found. The flowers of *Salvia officinalis, Lavandula angustifolia, Nepeta cataria* and *Arnica montana* were the most numerously infested by adult thrips.

Key words: *Thysanoptera*, thrips, herbs, flowers

INTRODUCTION

Some thrips (Thysanoptera) cause serous damage to crops. One of the species which causes a good deal of damage is *Thrips tabaci* (Legutowska and Theunissen 2003; Pobożniak and Wiech 2004; Pobożniak *et al*. 2007). This polyphagous species willingly visits the flowers of many fruit trees, ornamental plants and herbs (Legutowska *et al*. 2005; Kucharczyk *et al*. 2006; Pobożniak 2008). There are many numerous and common polyphagous thrips species which fly well and easily move from one place to another, for example *Frankliniella intonsa* and *Thrips fuscipennis*. Such species very often visit flowers (Pobożniak *et al*. 2008; Zawirska 1994). They also feed on young, tender leaves (Lewis 1973). For many flower thrips, pollen is their major food source (Kirk 1985, 2008). This means that the thrips are likely to be able to distinguish their host by its pollen. Rearing experiments indicate that for some flower thrips, pollen is necessary for growth, sexual maturation or oviposition (Murai and Ishi 1982). Also, some predatory thrips, not normally found in flowers, also benefit from feeding on pollen. Such predatory thrips can survive and reproduce without pollen (Kirk 1985). The commonly found *Aeolothrips intermedius* is an example. Predatory larvae and adult thrips feed on larvae of other thrips, on aphids as well as on larvae and eggs of other insects. The presence of predatory larvae and adult thrips was recorded in the flowers of many plant species, including herbs (Kucharczyk *et al*. 2006).

The first aim of this research work was to determine the species composition and the quantity participation of thrips fauna infesting flowers and inflorescences of herbs. The second aim was to check which flowers of the herbs are the most numerously infested by thrips.

MATERIALS AND METHODS

Thrips specimens were collected from 2004 to 2006 from the Herb Collection of the Faculty of Horticulture, Agricultural University in Cracow, and during the period 2006–2008 at the Botanical Garden in Cracow. Thirty-four species of herbs at the Herb's Collection of Faculty of Horticulture and eight species of herbs at the Botanical Garden were selected for the analysis (Tables 2, 3). The herbs were analyzed every week during the flowering period from May to September. The number of samples differed because of the different lengths of the flowering period of each herb. For each sample, ten flowers or inflorescences were collected at the Herb Collection of the Faculty of Horticulture and twenty-five at the Botanical Garden. The samples collected from each plant were placed separately in plastic bags. At the laboratory, adult thrips specimens and their larvae were extracted and placed in a conservation fluid. Microscopic slides were prepared using the methods of Zawirska (1994). The larvae were not identified to species, because their determination is not possible. The identification of adult thrips to the species was made using the keys by Schliephake and Klimt

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(1979) and Strassen (2003). The nomenclature of thrips species and the systematics suggested by Schliephake and Klimt (1979) and Strassen (2003) were used.

The thrips species collected during the research work were assigned to a particular geographic area. The data about the geographic distribution of species representatives given in Kucharczyk (1994), Pelikán (1984), Schliephake and Klimt (1979), Strassen (1984, 1988), and Zawirska (1994) were used. For the determination of the types of infestation, the chorolical typology suggested by Czechowski and Mikołajczyk (1981) was used.

The thrips species found on the area of the research work were assigned to a particular ecologic element. The data about the place and food preferences presented in the works by Lewis (1973), Strassen (2003), Vasiliu-Oromulu (1985) and Zawirska (1988) were used. For the determination of ecologic elements related to the food specialisation and ecologic amplitude, the criteria proposed by Trojan (1981) and Czechowski, Mikołajczyk (1981) were used. For the determination of ecologic elements related to the environment preferences, the criteria proposed by Trojan (1981) and Czechowski, Mikołajczyk (1981) were used. During the analysis of the ecologic elements related to preferences about place for existence and feeding, the criteria developed by Vasiliu-Oromulu (1985), Strassen (1984) were used.

The faunistic analysis including the domination class were made. The domination class informs us about the quantity participation of a given species in the examined ecosystem. It was calculated using the formula developed by Kasprzak and Niedbała 1981:

$$D_i = \frac{n_i}{N} 100\%$$

where:
D_i – dominance of particular species,
n_i – numerousness of particular species,
N – the total number of all species.

RESULTS AND DISCUSSION

Among the flowers and inflorescences of 37 species of herbs grown in both herb collections, 16,058 adult thrips were collected, belonging to 22 Thysanoptera taxa (Tables 1–3). They were represented by 3 species from the Aeolothripidae family, 14 species from the Thripidae family and 3 species from the Phlaeothripidae family. The species composition of thrips collected in both collections was similar, but differences in the quantitative contribution were noticed. All thrips were assigned to seven zoogeographic elements: Cosmopolitan (3 species), Palearctic (6 species), Holoartic (6 species), West Palearctic (1 species), Eurosiberian (4 species), European (1 species) and Turano-European (1 species). The most numerous were polyphagous species related to the flowers, but also taxons connected with leaves of green plants and random species connected with the grass and predatory species were noticed (Table 1).

In the flowers and inflorescences of the herbs in the Botanical Garden, the following species were dominant: *T. fuscipennis* and *T. flavus* (eudominants), *F. intonsa, T. albopilosus* and *T. major* (dominants) (Table 1). The most numerous species *T. fuscipennis* were found on all herbs, but the highest number was noticed on *Salvia officinalis*, *Nepeta cataria* and *Lavandula angustifolia* (Table 2). The second, very numerous phytophagous species *T. flavus* was most frequently found on *S. officinalis* and *L. angustifolia*. The very active species *F. intonsa* and *T. major*, were very frequent in the flowers and inflorescences of nearly all analysed herbs. *F. intonsa* was the most numerous on the inflorescences of *S. officinalis,* while *T. major* on the inflorescences of *Polygonum bistorata*. *T. albopilosus* was very numerous on the inflorescences of the following 3 herb species: *S. officinalis*, *Nepeta bistorata* and *L. angustifolia*. The harmful polyphagous species *T. tabaci* was the most numerous in the flowers of *S. officinalis* and *N. bistorata* (Table 2).

In the Faculty of Horticulture plots, the clear eudominant species was *F. intonsa,* the dominant were pest *T. tabaci* and thermophilic *F. occidentalis*, which arrived from the nearby glasshouses. *F. intonsa* was present in the flowers and inflorescences of all herbs. It frequently occurred on the inflorescences of *Salvia officinalis*, *Saponaria officinalis, Allium schoenoprasum*, *Borago officinalis* and *Hypericum perforatum* (Table 3). According to Pelikán (1995), *F. intonsa* is dominant in many environments. In our investigation, *T. tabaci* was found on 27 herb species. *T. tabaci* was the most numerous on inflorescences of *S. officinalis*, *Origanum vulgare* and flowers of *Arnica montana*. It should be pointed out that on the *Borago officinalis* plant, no *T. tabaci* was found despite the occurrence of other thrip species (Table 3). This could be due to the long, thick hairs on all organs of this plant. It is also a fact that *T. tabaci* is small in comparison to the other species, which makes it difficult for *T. tabaci* to move on this plant. The very numerous species *Thrips trehernei* (dominant), connected with the Asteraceae family, occurred on the flowers of *Arnica montana*. Frequent occurrence of *A. intermedius* in the flowers of some herbs was also shown in the research work by Kucharczyk *et al*. (2006). This could confirm the high attractiveness of some herbs for this species. Our research work shows the presence of *A. intermedius* and two other *A. fasciatus* and *A. teunicornis*, but they were not very numerous (Tables 2, 3). The percentage composition of other thrips species was similar to the results obtained by Kucharczyk *et al*. (2006). It can be said that thrips species infesting the flowers and inflorescences of herbs are not dependent on the area of research, and only the species percentage compositions differ. Such conclusions are also suggested by Czepiel (2003), who found the most numerous species in the herbs were *F. intonsa* and *T. fuscipennis.*

On flowering herbs, juvenile thrips were also recorded. The presence of thrips larvae in the collected material confirms, that flowers and inflorescences of herbs are not randomly selected by these insects, but are chosen as the place for development. The flowers of *P. bistorata* created an especially favourable environment for larvae. On *P. bistorata*, 1,805 larvae were collected, which was 2 times more than collected adult thrips. For other herb species, the number of collected larvae was lower than the number of recorded adult thrips and generally a higher number of adult thrips were accompanied by a higher number of collected larvae (Tables 1,). It should be noted that no thrips were found on the flowers of *Atropa belladonna*.

Table 1. Dominance, chorological, and ecological elements of collected species of *Thysanoptera* collected from flowers of the herbs in the Botanical Garden (2006–2008) and the Herb Collection of the University of Agriculture (2004–2006)

No.	Species of *Thysanoptera*	Cholorogical elements	Feeding area	Feeding preference	Ecological elements	Dominance Botanical Garden	Dominance Herb Collection AU
Terebrantia Family: Aeolothripidae							
1	*Aeolothrips fasciatus* Linnaeus	Cos	Fl, Z	Pol	Ub	SR	SR
2	*A. intermedius* Bagnall	Pal	Fl, Z	Pol	Ub	SR	SR
3	*A. tenuicornis* Bagnall	TuEu	Fl, Z	Pol	Ub	–	SR
4	*Anaphothrips obscurus* (Müller)	Hol	Gr	Pol	Ub	–	SR
Terebrantia Family: Thripidae							
5	*Chirothrips manicatus* Haliday	Hol	Gr	Pol	Ub	SR	–
6	*Frankliniella intonsa* (Trybom)	ES	Fl	Pol	Ub	D	ED
7	*F. occidentalis* (Perg.)	Cos	Fl, F	Pol	Ub	SR	D
8	*Mycterothrips consociatus* (Targioni-Tozzetti)	ES	F	Olig	Ub	SR	R
9	*Odontothrips loti* (Haliday)	Hol	Fl	Olig	Fless	R	SR
10	*Taeniothrips inconsequens* (Uzel)	Pal	Fl, F	Olig	For	SR	–
11	*Thrips albopilosus* Uzel	ES	Fl	Pol	Ub	D	–
12	*T. atratus* Haliday	Pal	Fl	Pol	Fless	R	R
13	*T. flavus* Schrank	Pal	Fl	Pol	Ub	ED	SR
14	*T. fuscipennis* Haliday	Hol	Fl	Pol	Ub	ED	SD
15	*T. major* Uzel	Hol	F, Hr	Pol	Ub	D	R
16	*T. nigropilosus* Uzel	Pal	F	Pol	Ub	–	SR
17	*T. physapus* Linneusz	WP	Fl	Pol	Fless	SR	SR
18	*T. tabaci* Lindeman	Cos	Fl, F, Hr	Pol	Ub	SD	D
19	*T. trehernei* Preisner	Hol	Fl	Pol	Fless	SR	D
Tubulifera Family: Phlaeothripidae							
20	*Haplothrips acanthoscelis* Karny	ES	Fl	Pol	Fless	SR	SR
21	*H. aculeatus* (Fabricius)	Pal	Gr	Pol	Ub	SR	SR
22	*H. statices* (Haliday)	Eur	Fl, F	Mon	Fless	SR	–

ED – eudominants 20.1%; D – dominants 10.1 – 20.0%; SD – subdominants 5.1–10.0%; R – recedents 1.1–5.0%; SR – subrcedents < 1.0%
Cos – Cosmopolitic; Eur – European; ES – Eurosiberian; Hol – Holarctic; Pal – Palearctic; WP – West-paleartic; TuEu – Turano-Eurpean; Fl – Floricolus; F – Folicolous; Gr – Graminicolus; Hr – Herbicolous; Z – Zoophagous; Mon – Monofagous; Olig – Oligophagous; Pol – Polyphagous; Fless – Forestless areas; For – Forest Area; Ub – Ubiquitous

When taking into account herb attractiveness for thrips, generally a higher number of thrips visiting flowers and inflorescences was accompanied by a greater species composition (Tables 2, 3). Among eight species available in the Botanical Garden in Cracow, the highest number of adult thrips was noticed on flowers of *S. officinalis* (4,350), next *L. angu stifolia* (1,662) and on *N. cataria* (1,154). The lowest number was noticed on flowers of *Ruta graveolens* and *V. officinalis*. The largest differences in species composition were noted for the inflorescences of *P. bistorata* (14 species). In the inflorescences of *S. officinalis* and *N. catari*a 12 taxa were distinguished, while 10 species were distinguished in the inflorescences of *L. angustifolia* and *R. graveolens*. In other cases, this number was from 5 to 7. The inflorescences of *S. officinalis* were more heavier infested by the species connected with the flowers. *i.e. T. flavus*, *T. fuscipennis, T. allbopilosus* and *F. intonsa*. Also, the predatory species *T. tabacci* connected with both the flowers as well as the leaves of the green plants, was very frequently found on *S. officinalis*. The exception was noted for the flowers of *B. australis*, which were more heavier infested by floricole: polyphagous species *T. major* and oligophagous *Odontothrips loti* connected with the plants belonging to the Fabaceae family.

Among the thirty-four species available on the plots of the Agricultural University in Cracow, the flowers of *Arnica montana* (1,395) and *S. officinalis* (812) were the most frequently visited. The lowest number of thrips was collected on the flowers of *Dictamnus albus* (4), and next on *Angelica archangelica* and *Levisticum officinalis* and *Carum carv*. The number of species ranged from 10 in the inflorescences of *S. officinalis*, *O. vulgare* and *S. officinalis* to 2 in the inflorescences of *D. albus* and *R. graveolens* (Table 3).

Table 2. Total number of thrips (Thysanoptera) collected from flowers of the herbs in the Botanical Garden in Cracow (2006–2009)

No.	Thrips species	*Aeolothrips fasciatus*	*A. intermedius*	*Chirothrips manicatus*	*Frankliniella intonsa*	*F. occidentalis*	*Mycterothrips consociatus*	*Odontothrips loti*	*Taeniothrips inconsequens*	*Thrips albopilosus*	*T. atratus*	*T. flavus*	*T. fuscipennis*	*T. major*	*T. physapus*	*T. tabaci*	*T. trehernei*	*Haplothrips acanthoscelis*	*H. aculeatus*	*H. statices*	Total	Larvae
		1	2	5	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	*Baptisia australis*							159	2				4	283		2					450	80
2	*Fagopyrum esculentum*				133	9							7	152		7		1			309	109
3	*Lavandula angustifolia*		1	1	191					213	37	656	422	93		45	3				1,662	104
4	*Nepeta cataria*		2	1	163					276	18	30	458	20	1	183	1	1			1,154	132
5	*Polygonum bistorta*		3	15	331	6				1	1	20	19	355	1	7		3	18	2	782	1,805
6	*Salvia officinalis*	3	11		621	5				604	71	1,180	1,418	129	2	305	1				4,350	860
7	*Ruta graveolens*		19		11		2			3		113	25	27		25			1	1	227	67
8	*Valeriana officinalis*				5					5	1	86	22	23			1				143	48
	Total	3	36	17	1,520	21	2	159	2	1,102	128	2,085	2,375	1,082	4	574	6	5	19	3	9,077	3,205

Table 3. Total number of thrips (Thysanoptera) collected from flowers of the herbs in the Herb Collection of the Faculty of Horticulture, Agricultural University in Cracow (2004–2006)

No.	Thrips species	*Aeolothrips fasciatus*	*A. intermedius*	*A. tenuicornis*	*Anaphothrips obscurus*	*Frankliniella intonsa*	*F. occidentalis*	*Thrips atratus*	*T. flavus*	*T. fuscipennis*	*T. major*	*T. nigripilosus*	*T. physapus*	*T. tabaci*	*T. trehernei*	*Haplothrips acanthoscelis*	*H. aculeatus*	Total	Larvae
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	*Agastache anethiodora*					6	230	8	4	20	36			120			8	432	6
2	*Allium schoenoprasum*					200	6				2	2		65				275	28
3	*Angelica archangelica*					10				2				12				24	0
4	*Anthemis nobilis*					4			2	5				21		5		37	11
5	*Arnica montana*					44	48			5	4	32		177	1,085			1,395	211
6	*Atropa belladonna*																	0	0
7	*Borago officinalis*					178	186	22	2	28	79				36			531	21
8	*Carum carvi*					17	2			1	6							26	3
9	*Carthamus tinctorius*						36				4				34	6		80	11
10	*Coriandrum sativum*		4			17	14			55	4							94	2
11	*Dictamnus albus*						2			2								4	0
12	*Filipendula ulmaria*					63	14			9	79	6		79	1	2		253	21
13	*Helichrysum arenarium*						96							10				106	10
14	*Hysophus officinalis*					60	54	28	8	69	31			48				298	7
15	*Hypericum perforatum*	4	8			158	36							24	4		3	237	6
16	*Lavandula angustifolia*					28	152	13	5			2		29				229	31
17	*Levisticum officinale*					4				18				4				26	3
18	*Matricaria chamomilla*					31	58	7	2		1			14	51	2	8	174	17

CONCLUSIONS

Thrips species composition infesting the flowers and inflorescences of herbs were very similar and not dependent on the plant species and the area of research, only the participation of particular species differed. The polyphagous species connected with the flowers constituted the majority in the material collected from flowers and inflorescences. These were: *T. fuscipennis*, *F. intonsa*, *T. flavus*, *T. albopilosus*, *T. major* and *T. trehernei*. The polyphagous species *T. tabaci* was also very numerous. The flowers of *S. officinalis*, *L. angustifolia*, *N. cataria* and *A. montana* were the most numerously infested by adult thrips. No thrips were found in the flowers of *A. belladonna*.

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