

THRIPIDAE (INSECTA: THYSANOPTERA) ON PETUNIA VARIETIES FROM WESTERN ROMANIA – TAXONOMIC KEYS

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Abstract. The vast majority of the Thripidae (Insecta:Tysanoptera) species are pest species with phytophagous feeding habits, being economically important horticultural pest globally, attacking a wide range of ornamental plants. In addition to causing extensive crop damage, the species are notorious for vectoring destructive plant viruses, mainly belonging to the Tospovirus genus. This study aims to monitoring the thrips species collected from 6 Petunia x hybrida varieties in western Romania, to present the taxonomic keys for identification, and studies its population dynamics during the season. The Petunia x hybrid varieties used in the experiment were: Tropical, Purple Picotee, Cherry Pop, Bicolor Yellow Red, Orange Bouquet, Pink Bouquet. The observations were carried out for a period of 70 days – from 10 February to 20 May, using colored sticky traps. Traps were placed above the crop canopy to intercept dispersing thrips from wider areas. After an atent monitoring of Petunia x hybrida varieties in greenhouses, 6 thrips species were collected and identified, as followed: Frankliniella occidentalis Pergande, Frankliniella fusca Hinds, Frankliniella schultzei Trybom, Thrips tabaci Lindeman, Thrips palmi Karny and Heliothrips haemorrhoidalis Bouché – all being polyphagous species. Frankliniella occidentalis Pergande was the most harmful species, causing the highest damage on flowers, and was able to survive and reproduce at higher rates.

Keywords: Thripidae, petunia, varieties, taxonomic key, western Romania

INTRODUCTION

The Thysanoptera order includes phytophagous and predatory insects, characterized by narrow, hyaline wings, strongly fringed on the edges; sizes generally less than 3 mm, with asymmetrical piercing/sucking mouthparts (LEWIS, 1991; BENTANCOURT et al., 2009). It is an order related to Hemiptera and comprises 5938 species, grouped into nine families (MOUND, 2013). Traditionally, the importance of thrips is of agricultural and horticultural interest, especially for plants in greenhouses, but there are information that says about this order, when the density of the populations is very high can cause various human ailments, such as: allergic conjunctivitis, sting-induced dermatitis, severe pruritic rash (MOUND et al., 2002).

Among horticultural plants, especially in greenhouses, the most attacked by thrips are vegetable and grown ornamental flowers (PALMER, 1987). In Romania, petunias are among the most popular flowers, used for planting in pots and on the ground, in greenhouses or in gardens, for ornamental purposes.

The most common pests on petunia crops in our country are thrips. Thrips feeding damage symptoms in Petunia x hybrida varieties include petal discoloration, petal scarring and distortion, incomplete petal expansion, streaking and ultimately cause the qualitative and quantitative deterioration of the flower production, the losses can range between 80 - 100% impairment qualitative (OGAH, 2011).

According to KNECHTEL (1951), in Romania, 91 species belonging to the *Thripidae* family are known, and according to VASILIU – OROMULU (2002) their number exceeds 150. The information about the ecology and dynamics of thrips populations, particularly in the petunia varieties, is limited.

Frankliniella occidentalis Pergande, *Frankliniella fusca* Hinds, *Thrips tabaci* Lindeman and *Heliothrips haemorrhoidalis* Bouché are common species to ornamental plants, but are also frequently found in the inflorescences of flowering and vegetable plants in greenhouses (Vîrteiu et al., 2015).

The aim of present paper was to determine the diversity of thrips species collected from 6 varieties of *Petunia x hybrida*, from a solar farm located in Dudeștii Noi (Timiș county), through the main taxonomic keys characteristics and also to study the thrips population dynamics during the season.

MATERIAL AND METHODS

The thrips species were collected as part of a wider research that includes studies on the diversity of *Thysanoptera* from greenhouse flowering crops in western Romanian in 2021 – 2022 period. The experiments were done in greenhouse *Petunia x hybrida* crop from Dudeștii Noi (Timiș County). Located in the central-northern area of Timiș county (45°50'16" N latitude and 21°06'02" E longitude, altitude 99 a.m.s.l.), the Dudeștii Noi locality - covers an area of 5039.5 ha, of which 3550.7 ha is agricultural land, and 8.63 ha orchards, vineyards, fruit and wine nurseries, greenhouses. The greenhouse surface cultivated with flowers, on which the researches were carried out, was 121 square meter. Among the flowers, petunias were chosen in the research - the occupied area being 14 square meters.

In order to obtain vigorous plants, a series of fertilizations were carried out as follows:

- when transplanting to stimulate rooting and maintain short internodes, fertilized with - Algaren Twin (25 ml/ 10 l water) mixed with MagicP Star (10 ml/ 10 l water); simultaneously applying foliar Algaren Twin (15 ml/ 10 l water)
- 10 – 15 days after transplanting King Life 12 – 48 – 8 + Mg (10g/ 10 l water) was applied and Calfomyth (35 ml/ 10 l water) was applied foliar
- after 10 – 15 days from the first treatment, 2 more treatments with Drin (15 ml/ 10 l water) and Foliacon 22 (25 ml/ 10 l water) were applied foliar, and King Life 30 was administered when watering – 10 – 10 + Mg (7 – 10 ml/ 10 l water)
- when the buds appeared, King Life 20 – 20 -20 (7 – 10 g/l water) and foliar Calfomyth (35 ml/ 10 l water) were applied
- at flowering, applied once with watering: King Life 8 – 5 – 40 + Mg (10 ml/ 10 l water); Algaren Twin (15 ml/ 10 l water) and foliar applied Calfomyth (35 ml/ 10 l water)

Samples of thrips species were collected on leaves and flowers of 6 *Petunia x hybrida* varieties: Tropical, Purple Picotee, Cherry Pop, Bicolor Yellow Red, Orange Bouquet, and Pink Bouquet. The survey was conducted between 10 February and 20 May 2022. Thrips were sampled using 22.5 x 10.2 cm, double – sided yellow, orange and blue sticky traps (PARNEA et al., 2018; VÎRTEIU et al., 2018; VÎRTEIU et al., 2021). For each petunia variety, 3 traps (a trap/color) were equally placed along the perimeter of a plot. The traps were fixed with plastic spring clamps and attached to cables suspended at heights of 20 cm above the plants. Each plot consists of 30 petunia plants. Traps were replaced at ~14-d intervals, and taken to the laboratory and stored at ~4.5°C until thrips could be counted and identified (BRØDSGAARD, 1989; GILLESPIE & VERNON, 1990).

RESULTS AND DISCUSSIONS

The *Thripidae* family is one of the largest families belonging to the order *Thysanoptera* and it includes two subfamilies: *Panchaethripinae* and *Thripinae*, as well as 1710 species (JACOT-GUILLARMOD, 1971, 1974; MOUND, 1997, 2009). They appear in various habitats, the most numerous being in vegetable and flower crops, mainly phytophagous species, rarely mycophagous or zoophagous. Among phytophagous species, several subfamilies are known, but the most important is *Thripinae*. At the level of *Thripini* tribe, informal group - genera are used as follows: genus - group *Frankliniella*, *Megalurothrips*, *Taeniothrips*, *Thrips* (MOUND ET AL., 1980), genus - group *Trichromothrips* (MASUMOTO & OKAJIMA, 2005), *Scirtothrips* (MASUMOTO & OKAJIMA, 2007) and *Anaphothrips* (MOUND & MASUMOTO, 2009), which are monophyletic, and which will also be used in this paper. The vast majority of pests, such as: *Frankliniella occidentalis*, *Thrips tabaci* or *Thrips palmi*, belong to these genera - group.

The correct identification of thrips species is the first and most important step for the integrated management program, and the dichotomous determination keys presented in the paper were chosen to facilitate the identification of greenhouse petunia thrips species in the western part of the country. In the following paragraphs, the morphological keys for the subfamilies *Panchaethripinae* and *Thripinae*, with the genera *Heliothrips*, *Frankliniella* and *Thrips* and the related bibliographic sources are synthesized. The determination keys for a new invasive species for our country, *Frankliniella schultzei*, will also be included, as well as those for a little-known species, introduced a few years ago, namely *Thrips palmi*.

6 thrips species were collected and identified feeding on greenhouse petunia inflorescences in Dudeștii Noi, as follows: *Frankliniella occidentalis*, *Frankliniella fusca*, *Frankliniella schultzei*, *Thrips tabaci*, *Thrips palmi* and *Heliothrips haemorrhoidalis* (table 1 and 2).

Table 1.

Thripidae species on colored sticky traps in greenhouse *Petunia x hybrida* crop, Dudeștii Noi, 2022

Colored sticky traps	<i>Frankliniella occidentalis</i>	<i>Frankliniella intonsa</i>	<i>Frankliniella schultzei</i>	<i>Thrips tabaci</i>	<i>Thrips palmi</i>	<i>Heliothrips haemorrhoidalis</i>	Total
Yellow	29	21	3	56	1	8	118
Blue	35	6	0	10	9	12	72
Orange	19	10	0	18	2	7	56

Table 2.

Thripidae species on *Petunia x hybrida* varieties, Dudeștii Noi, 2022

Colored sticky traps	<i>Petunia x hybrida</i> varieties						Total
	Tropical	Purple Picotee	Cherry Pop	Bicolor Yellow Red	Orange Bouquet	Pink Bouquet	
Yellow	35	13	17	15	22	16	118
Blue	24	16	9	11	5	7	72
Orange	7	1	4	19	24	1	56
Total	66	30	30	45	51	24	246

Key to Subfamilies of *Thripidae*

(*The key is compiled from MASUMOTO, 2010)

- 1(2) Legs covered with microtrichial rows; postoccipital area behind occipital apodemes usually well developed and distinctly sculptured, with anatomizing striae; pronotum with an area of macula near posterior margin; metasternum thickened at posterior margin.....**3**
- 2(1) Legs not covered with annulated microtrichial rows, but usually with anastomosing or weak striae or reticulate.....**4**
- 3 Head and legs usually strongly reticulate; terminal antennal segment usually very slender and acute; apex forewing first vein usually fused with costal vein near base; meso - and metathoracic endofurca without spinula; body strongly sclerotized***Panchaethripinae***
- 4(3) Head and legs usually not reticulate; if reticulate then terminal antennal segment not acute; and forewing first vein not fused to costa near base; meso - and metathoracic endofurca with or without spinula; body usually not strongly sclerotized.....***Thripinae***

Key to Genera of *Thripinae*

(*The key is compiled from HAMODI & ABDUL-RASSOUL, 2004)

- 1(2) Body surface without reticulate sculpture.....**2**
- 2(3) Wings present.....**4**
- 3(4) Antennae eight-nine segments, sense cone on third and fourth segments simple or forked.....**5**
- 4(3) Antennal segment VIII about as long as VII; maxillary palp three segment.....***Heliothrips***
- 5(6) Pronotum symmetrical in shape, with 1-2 posteroangular setae or none; 2nd antennal segment symmetrical, sense cone on segment 3,4 forked; head normal; antero and postero - angular pronotum provide with 1-2 long setae; abdominal segmented carried a micro setae or none.....**7**
- 6(5) Bodies seats shorter, dark or brown; fore wing pale, setae of veins arranged in a serial on veins, color and size different; pronotum with one anteroangular and 2 posteroangular setae.....***Frankliniella***
- 7(8) Legs normal, the forelegs tibia always provided with spines, tarsi with one-two segment sometimes with a claw, reticular only on pterothora 10.....**8**
- 8(7) Antennae segmented carried micro setae; maxillary palps 3 segmented; comb present; anterior tarsi sometimes provided with one tooth; abdominal segment cylindrical in shape.....***Thrips***

Key to *Heliothrips* species

(*The key is compiled from NAKAHARA et al., 2015; XIE et al., 2019)

- 1(2) Body surface dark brown when mature, strongly reticulate; yellow legs; hialine wings.....**2**
- 2(1) Fore wing apex round, with very broad base, without reticulate area, costal vein fused to first longitudinal vein and bearing long cilia, venal setae inconspicuous.....**3**
- 3(4) Female abdominal tergites 10 light brown to yellow – brownish in the basal areas and with a darker apical band, VIII – IX segment sometimes yellow; antennal segment VI

yellow at least in basal half; antennal segment IV 0.75 as long as III, with ventral sense cone no more than 0.5 as long as segment, mesoscutum with reticles anterior to median setae irregularly polygonal.....*H. haemorrhoidalis*

***Heliothrips haemorrhoidalis* Bouche, 1833**

Remarks: The species was present on all 3 sticky traps used in the experiment and on all 6 petunia varieties analyzed. The favorite color was blue, and the highest number of specimens was recorded in the Orange Bouquet variety. Judging by the presence in the samples and taking into account the information from the literature (MOUND, 1976; MOUND & MARULLO, 1996) this species has a cosmopolitan distribution; although it was originally described in Europe, the origin of this thrips is South America (CSIRO, 2009), being introduced to continental Europe together with ornamental and vegetable plants from tropical and subtropical America. The cosmopolitan distribution is mainly due to its food habit (it feeds on both cultivated and wild plants) and its location, in the greenhouses; it prefers mature (aged) leaves, especially underdeveloped ones, avoiding vigorous and branched ones.

Key to *Frankliniella* species

(*The key is compiled from WANG et al., 2019)

- 1(2) 8 segmented antennae.....2
- 2(3) Abdominal sternite III lacking porous plates; the tarsi have 1–2 segments, with an eversible adhesive bladders apically; antennal segment III slightly elongated.....3
- 3(4) The wings, when present, consist of two pairs of a slender, sclerified or rod-like axis bearing a dense fringe of long hairs4
- 4(5) Forewing first and second veins each with complete (or almost complete) row of setae; abdominal tergites VI–VIII with paired ctenidia laterally.....5
- 5(4) The forewings are pale, slightly smoky; ocellar setae pair III arising at a level ahead of posterior ocelli; abdominal sternite II without discal setae medially and the female sternite VII with S1 setae arising at posterior margin, fore tarsus without tooth *F. occidentalis*
- 6(7) Abdominal tergite VIII posteromarginal comb absent at least medially, some with irregular weak teeth laterally.....7
- 7(8) Abdominal tergite VIII posteromarginal comb absent at least medially; ocellar setae pair III arising within ocellar triangle, between hind ocelli, some with irregular weak teeth laterally; posterior tibiae lighter in color than femurs.....*F. schulzei*
- 8(9) Postocular setae pair IV short, much shorter than distance between hind ocelli; pronotum anterior margin generally with 1 pair of small setae between the major anteromarginal pair.....*F. intonsa*

***Frankliniella occidentalis* Pergande, 1895**

Remarks: The species is present in all samples and sampling dates, with a total of 83 specimens collected. The largest number of specimens was collected from the Tropical petunia variety, followed by the Bicolor Red Yellow variety. The chromatic preferences of the species are directed towards the blue color - 35 specimens, followed by yellow - 29 specimens, and the orange trap with 19 specimens was the last. The species is widespread in the temperate zones, but is native to western North America (KIRK & TERRY, 2003). Currently, it is perhaps the most studied thrips species, as it causes damage to a very wide range of horticultural plants, both through direct feeding, but especially through the transmission of tospoviruses (REITZ, 2009). In Romania, the species is present in all regions, mainly in the areas involved in the

flower plant trade (COVACI, 2012) and in the western part of the country, the species is considered a major pest of ornamental and vegetable plants in greenhouses (VÎRTEIU, 2015).

***Frankliniella schulzei* Trybom, 1910**

Remarks: The species is mentioned for the first time in the *Thripidae* fauna of our country, most likely being accidentally introduced, once with flower planting material from the neighboring country Hungary, where the species is mentioned since 2016 (SZÉNÁSI et al., 2016). It is recommended to continue the research to certify the presence of thrips, and also to sent the biological material to specialists in our country to confirm the identification. A number of 3 specimens were collected, the preferred color being yellow, and the varieties of petunias being Tropical and Pink Bouquet. Globally, the species is known as the tomato thrips, the frequent spread of the species being most likely through the plant trade, so the country of origin of this species is still unclear, according to some authors being South America or Africa (WANG et al ., 2019). This tropical species is exceptional within the genus *Frankliniella* in that the ocellar setae pair III arising within ocellar triangle, between hind ocelli, and the abdominal tergite VIII of the female lacks a postero-marginal comb; body color is variable, either brown with yellow pronotum, tibiae and tarsi, or yellow with faint brown tinges on tergites (CAVALLERI & MOUND, 2012). As a pest, it is of economic importance as it is associated with many crops, but it is also an important vector of tospoviruses.

***Frankliniella intonsa* Trybom, 1895**

Remarks: From the petunia crop, in 2022 a number of 37 specimens were collected, of which the largest number were collected from the Bicolor Yellow Red and Tropical varieties, the preferred color being yellow. The species is polyphagous, widely distributed in Europe and north-west America. In Romania it is one of the most common species, being spread over large areas in the western area, feeding and reproducing on the flowers and inflorescences of many ornamental plants, and not only.

Key to *Thrips* species

(*The key is compiled from CLUEVER & SMITH, 2017)

- 1(2) Abdominal sternites lacking discal setae, setae present only at posterior margin.....2
- 2(3) Abdominal tergite III and VII with a pair of prominent distal setae.....3
- 3(4) Row of setae on forewings 1st vein with spaces between setal bases much greater than length of each seta; ocellar setae II not longer than setae III.....4
- 4 (3) 4-7 distal setae on the forewings 1st vein; metanotal campaniform sensilla absent; ciliate microtrichia on lateral thirds of tergites IV–VI present on sculpture lines; ocellar III setae arising within the ocellar triangle; male with narrow transverse porous plates on abdominal sternites III – V..... ***T. tabaci***
- 5 (6) Antennae 7 segmented; abdominal tergites II with 4 lateral setae.....6
- 6 (5) Antennal segments IV and V brown distally, VI and VII brown; fore wings pale.....7
- 7 (6) Antennae segments III and IV slightly constricted at apex and with forked sense cone, VII short; pronotum with 2 pairs of posteroangular setae, anterior and posterior margin each with 3-4 pairs of setae; metanotal median setae arising far the behind anterior margin; fore wing first vein usually with 3 (or 2) setae on distal half and second vein with a complete row of about 15 setae; abdominal sternites IV–VI without discal setae ***T. palmi***

***Thrips tabaci* Lindeman, 1888**

Remarks: In 2022, 84 specimens belonging to this species were collected from the petunia crop, most of them being collected from the inflorescences of the Tropical petunia variety, but also from the Orange Bouquet variety. Following the chromatic preferences, it was found that yellow is the most preferred color with 56 specimens, being followed by orange with 18 specimens, and blue with only 10 specimens. It is a species with a cosmopolitan distribution, except in the tropics. It is assumed that the origin area of the species is in the Mediterranean region. Although it is particularly abundant in onions, this species shows a pronounced polyphagism, reproducing on numerous host plants, including mono - and dicotyledonous (DIAZ - MONTANO et al., 2011; FAIL, 2016).

***Thrips palmi* Karny, 1925**

Remarks: The number of specimens collected was relatively low, during the 7 collection dates, identifying 12 specimens, most of which were collected from the Purpele Picotee variety. The blue color is clearly superior to the chromatic preferences of this species, so with the help of this trap, 9 of the 12 specimens were collected. A polyphagous species, it mainly attacks plants from the *Cucurbitaceae* and *Solanaceae* families (ROTENBERG et al., 2015). It seems that the species originated in the southern part of Asia, from where it spread rapidly in the latter part of the 20th century. Nowadays the species has a cosmopolitan distribution, being found from Asia to the Pacific and the Caribbean, but also in North, Central and South America (in limited areas). In Europe, the species was introduced once with the import of cut flowers but also with vegetable or fruit planting material. The species causes significant economic damage to crop plants, both as a direct result of its feeding pattern and its ability to transmit tospoviruses. It is a species whose polyphagism is considered to be accentuated, among thrips, attacking plants from 36 botanical families (Bournier, 1983).

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