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The significance of anthropochory in *Hercinothrips femoralis* (Thysanoptera: Thripidae) – Short Communication

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Abstract: After the first record of banded greenhouse thrips, *Hercinothrips femoralis* (Reuter, 1891) in Slovakia in 2008, a peculiar occurrence in the extreme subalpine environment of Podbanské (High Tatra Mts.), Slovakia, during the summer of the same year was observed. Since this species of exotic thrips is known to be almost sedentary, the mode of dispersal was hypothesised to be related to passive transport via weather currents. According to our observations of unintentional dispersal, a test was conducted to research a previously unidentified introduction pathway of this species. Our preliminary results show that passive transport by humans plays a crucial role in the dispersal of *H. femoralis.*

Keywords: anthropochorous; banded greenhouse thrips; basil; pest; spread; thrips

The importance of dynamic dispersal pathways in insects (Stinner *et al.* 1983; Robinet *et al.* 2009; Carrasco *et al.* 2010; Bullock *et al.* 2018), including thrips (Kirk & Terry 2003; Fedor 2004; Fedor *et al.* 2010, Masarovič *et al.* 2017) is widely recognised. The increases in global trade and the movement of people and goods inadvertently created and strengthened pathways for insects to invade previously inaccessible environments (Kiritani 2001; Kirk & Terry 2003; Makra *et al.* 2017). The minute size and often cryptic nature of thrips predisposes them as potentially effective pests, when in reality, only about 1%, out of more than 6 200 species of thrips (ThripsWiki 2019), are currently considered serious pests (Fedor *et al.* 2004; Morse & Hoddle 2005).

Hercinothrips femoralis is a known pest in greenhouses with records reaching back to the end of the 19th century, with the first description credited to Prof. O. M. Reuter (White 1916). Few occurrences were recorded through the 20th century (Hartzell 1926; Buchanan 1932; Denmark 1976) until the second half of the century, when it resurfaced in Hungary (Jenser & Czencz 1988) and a first record in Australia was made (Houston *et al.* 1991). Routine occurrences of *H. femoralis* in greenhouses around Europe were noted in recent decades with the first records from Slovenia (Trdan 2002), Greece (Roditakis *et al.* 2006), Croatia (Simala & Milek 2008) and Slovakia (Varga 2008). The most recent reoccurrence was published in 2016 from South Korea (Lee & Lee 2016) where it was recorded severely damaging ornamental plants in a private household. The northernmost outdoor record came from Podbanské (the High Tatra Mountains), Slovakia, during June and July of 2008 (Masarovič *et al.* 2014).

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262

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MATERIAL AND METHODS

During the winter of 2016, we commenced the rearing of *H. femoralis* for the purposes of invasive ecology research at the Faculty of Natural Sciences, Comenius University in Bratislava. The rearing was conducted by one researcher only with access to the grow room. The duties of the researcher consisted of watering the plants, the removal of the withered leaves and the exchange of the withered plants for fresh ones. After a month, we noticed the presence of *H. femoralis* in the researcher´s office, where it already started to damage the ornamental plant *Tradescantia pallida* (Rose) DR Hunt. This pattern repeated with the most visited office spaces containing any ornamental plants. Therefore, we conducted a simple test of the dispersal rate and the conditions under which this rate may vary:

4 different indoor sites in a thrips free environment were chosen, each fitted with 2 basil plants (*Ocimum basilicum*), the host plant of *H. femoralis*. Sites 1–3 (university offices) were situated approximately 350 m from the laboratory with the grow room, as the centre of the *H. femoralis* distribution. Site 4 was located 3 km from the University building (a room in a private flat). The visiting frequency and duration for each site varied (Table 1). To maintain the same probability of introduction, only one site (1–3) was visited per day. Site 4 was visited daily, but the visit was conducted later in the day, after one of the sites 1–3 was visited. The light conditions were maintained by natural light and the temperature was maintained by a central heating system with a temperature range of 20–25°C. The laboratory grow room was fitted with 10 basil plants, which were changed for new ones as soon as any withering was observed. The basil plants in the grow room were introduced to approximately 300 *H. femoralis* females. The maintenance and thrips presence at sites 2 and 3 were checked by a second researcher. For each site, the date of the first appearance of the thrips and the number of visits was recorded, if no observation was made after 150 days, the test was ended. After the successful detection of *H. femoralis*, the basil plants were removed from the study site.

The same test was repeated a second time with the grow room full of basil plants with a suboptimal water supply. The plants were changed for new ones, only if they were almost completely withered.

The collected specimens were mounted on slides using standard laboratory methods (Mound & Kibby 1998) and determined according to the nomenclature (Zur Strassen 2003).

RESULTS AND DISCUSSION

The visiting frequency, the number of visits and days to the first thrips occurrence at each site is summarised in Table 1.

No thrips were observed at site 3 under optimal conditions, therefore, we do not refer to this observation further in the results. All remaining study sites were infested by thrips under optimal and suboptimal conditions, showing a pattern similar to the pre-test observations. The fastest introduction of *H. femoralis* to the new environment (8 days under the optimal conditions/6 days under the suboptimal conditions) was recorded at site 1. Although it took 31 days for *H. femoralis* to invade site 3 from suboptimal conditions, the observation was made right after the 2nd visit. Since site 4 was not visited right after the contact of the researcher with the host plants and the site was located further from the grow room, the period to the first detection of *H. femoralis* was longer compared to the office space, visited right after the interaction.

According to these preliminary results we believe that the record of *H. femoralis* in the subalpine environment of Podbanské (the High Tatra Mts.) made by Masarovič *et al.* (2014) may have been the result of an unintentior.al human-assisted dispersal.

Table 1. Monitoring of the *H. femoralis* dispersal under optimal and suboptimal conditions

Site	Visit length (h)	No. of visits	Days to first collected individual		No. of times the site was visited	
			optimal	suboptimal	optimal	suboptimal
S1	5 – 8	5 × week	8	6	8	6
S2	1	1 × week	35	28	5	4
S3	1	1 × 30 days	–	31	5	2
S4	6 – 12	home – daily	26	13	26	13

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Since the presence of *H. femoralis* was recorded at a greenhouse located at the same faculty (Varga 2008) as Masarovič's research team, members of which repeatedly visited the sites at Podbanské (High Tatra Mts.), Slovakia and, thus, possibly introduced a population that was able to reside outdoors during the collection in June and July of 2008 (Masarovič *et al.* 2014). No further records suggest that the population was able to survive the latter months, as is often the case for exotic thrips species (Mcdonald *et al.* 1997; Mcdonald *et al.* 1999; Mcdonald *et al.* 2000; Larentzaki *et al.* 2007; Ramanand *et al.* 2017). Although it seems that *H. femoralis* is not suited to survive the outdoors conditions in Slovakia throughout the whole year, novel indoor conditions such as office spaces that are kept at relatively constant temperatures, containing ornamental plants are providing a potential niche that could be exploited year-round (Trdan *et al.* 2007; Lee & Lee 2016).

The effects on the speed of introduction was tested, by creating suboptimal rearing conditions, as previously demonstrated in *Frankliniella occidentalis* (Pergande, 1895) (Rhainds & Shipp 2009). Our simple test reveals a 31.67% average increase in the speed of introduction under the suboptimal conditions. It was previously suggested that *H. femoralis* is almost sedentary if the host plant is healthy and, therefore, the food source and possible oviposition sites are available. Although, if the food sources are scarce, *H. femoralis* starts to be much more mobile, searching for novel host plants (Laughlin 1971).

The goal of this study was to add a possible pathway of introduction of *H. femoralis* not yet described by previous authors. The presented work demonstrates how an artificial environment with specific conditions creates new possibilities for the polyphagous opportunist *H. femoralis* and how the unintentional human-assisted dispersal pathway may be an important factor in the thrips introduction to novel environments. We present our preliminary results in hope that they may serve as a background for further and more complex studies of this dispersal mechanism.

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