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Investigations of *Thrips tabaci* and *Aeolothrips intermedius* population dynamics in tobacco plantations

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SUMMARY

Studies were conducted between 2015 and 2017 with yellow sticky traps in seven tobacco plantations. The purpose was to determine when and in what numbers onion thrips individuals can settle into tobacco plantations. The primary objective of the study was to determine the proper timing of chemical treatments, furthermore, the determination of crucial factors that can influence the population dynamics of Thrips tabaci.

Keywords*: onion thrips, predator thrips, tobacco, population dynamics*

INTRODUCTION

The onion thrips (*Thrips tabaci* Lindeman 1889) (Thysanoptera: Thripidae) is one of the most important thrips species both in Hungary and all over the world. It is a highly polifagous species, its damage is known from hundreds of plant species. In Hungary, it is one of the most important pest of tobacco. Besides, *T. tabaci* is one of the most important vectors of the Tomato Spotted Wilt Virus (TSWV); therefore, onion thrips has an important role in the spreading of TSWV in the tobacco orchards (Jenser et al. 2005).

In Hungary – mainly in the northeastern parts – tobacco is an important industrial plant that has been grown for centuries. 81% of the Hungarian tobacco production area is located in Szabolcs-Szatmár-Bereg County and 10% in Bács-Kiskun County. Although the importance of tobacco growing has declined by nowadays, its cultivation can assist tens of thousands of people in areas that are particularly affected by unemployment (Lukács 2002).

In the years between 2015 and 2017 studies were conducted by yellow sticky traps in seven tobacco plantations, namely Kunadacs, Pócspetri, Hajdúhadház, Apagy, Ófehértó, Debrecen and Encsencs, in 2017 instead of Apagy in Geszteréd. The purpose was to determine *T. tabaci* individuals at what time and in what numbers can settle into the tobacco plantations. The primary objective of the study is the proper timing of chemical treatments.

In addition to this, we observed the number of predatory thrips (*Aeolothrips intermedius* Bagnall 1920) individuals compared to the number of onion thrips individuals. *A. intermedius* is an important potential natural enemy of onion thrips feeding mostly on onion thrips larvae. According to Bournier et al. (1978) and Trdan et al. (2005) *A. intermedius* is the main predator of *T. tabaci*. Furthermore *A. intermedius* is able to reduce the number of phytophagous Thysanoptera species exclusively under field conditions, because in greenhouses it cannot finish its development on the prevalent *Frankliniella occidentalis* Pergande (Franco et al. 1999).

MATERIALS AND METHODS

Three yellow sticky traps per sampling place were located in the top part of tobacco plants. The catching results of 315 yellow sticky traps were examined from 14th of April to 28th of July, during 15 weeks; 399 yellow sticky traps from 12th of April to 23th of August, during 19 weeks; and 378 yellow sticky traps from 11th of April to 15th of August, during 18 weeks. In the study, Burley and Virginia tobacco varieties were involved. The traps were changed weekly by the ULT staff, then these were posted to the Plant Health and Molecular Biology National Reference Laboratory in Budapest. The number of onion thrips and predatory thrips individuals were investigated by stereo binocular microscope LEICA.

RESULTS

In 2015, 9906 *T. tabaci* adults were caught by the used 315 sticky traps from the seven tested locations. Compared to the results of previous years, in 2015, onion thrips and predatory thrips were settling into the investigated tobacco plantations in the highest number. This tendency is associated with the unusually hot and dry meteorological conditions during the whole vegetation period. According to the observed meteorological data, the growing season in 2015 was the poorest in terms of precipitation, and had the highest average temperature compared to the previous five-year period. This way, after the colonization, the damage risk of onion thrips population theoretically increased, because the reproducted thrips population could cause higher level

direct (by sucking) and indirect (by virus transmission) damages in the tobacco plantations. Overall it could result in higher level quality and quantity deterioration for tobacco. *Table 1* includes the total catching results of the different sampling sites. According to the catching results, the highest level of thrips immigration into the tobacco plantation during the investigated three years was in Kunadacs (*Figure 1–3*).

Table 1

Cathing results by yellow sticky traps at the sampling sites (2015)

Location	Total number of *Thrips tabaci* individuals	Total number of *Aeolothrips intermedius* individuals
Kunadacs	3169	159
Pócspetri	1313	393
Hajdúhadház	1040	114
Apagy	592	511
Ófehértó	1114	456
Debrecen	1491	663
Encsencs	1187	989
Total catching data (n=15)	9906	3285

In 2015, the cathing results by yellow sticky traps at the sampling sites are shown in *Table 1*. The swarming and colonization of onion thrips into the sampling sites took place almost in paralell during the investigation period (*Figure 1*). The first immigrant *T. tabaci* individuals occured right after the traps were put out (14 April) in Apagy, Ófehértó and Encsencs. Until the beginning of June thrips were caught in lower numbers, probably because of the chemical treatments during the planting period and also due to the rather rainy weather.

Until the middle of June, the number of immigrants suddenly increased, partly due to the relatively low precipitation and partly because of the very high temperatures. In June, a total of 554 specimens were caught on 16 June at the sampling site of Debrecen. Due to the chemical treatments carried out in mid-June, the number of thrips declined until the end of June, then until mid-July the number of migrants rapidly increased again, primarily in Kunadacs orchard. The peak of the caught individuals' number was on 7 July. Based on the catching results, 1033 specimens were counted on the traps in Kunadacs orchard. In the other investigated places the specimen number did not increase significantly during this period. However, the next chemical treatments carried out in mid-July successfully reduced the onion thrips population in all sampling sites. The number of thrips adults began to rise again in late July (*Figure 1*), but due to the the harvesting of tobacco leaves, these individuals are expected to migrate towards new breeding plants.

Based on the catching results in 2015, the number of *A. intermedius* was one third of the total number of *T. tabaci* (*Table 1*). The predatory thrips occurred in high numbers in the orchards from the beginning of June to the end of July. The peak of the caught individuals' number was in the second third of July. The highest catching of *A. intermedius* was in Encsencs, Ófehértó and Apagy (*Figure 2*). Although the field observation finished on 28 July, according to the data of *Figure 2* it can be seen that *A. intermedius* may occur in the orchards in August as well. The proportion of predatory thrips was the smallest compared to onion thirps in Kunadacs, and in this location there was the highest number of onion thrips individuals in mid-July (*Figure 1–2*).

According to the data of *Figure 1–2* it can be seen that the number of *A. intermedius* individuals in July was three times higher than those counted in June, in paralell with this, the number of *T. tabaci* individuals in all sampling sites – except for Kunadacs – declined to half of the numbers counted in June.

Figure 1: **Population dynamics of *Thrips tabaci* based on the catching results at the sampling sites (2015)**

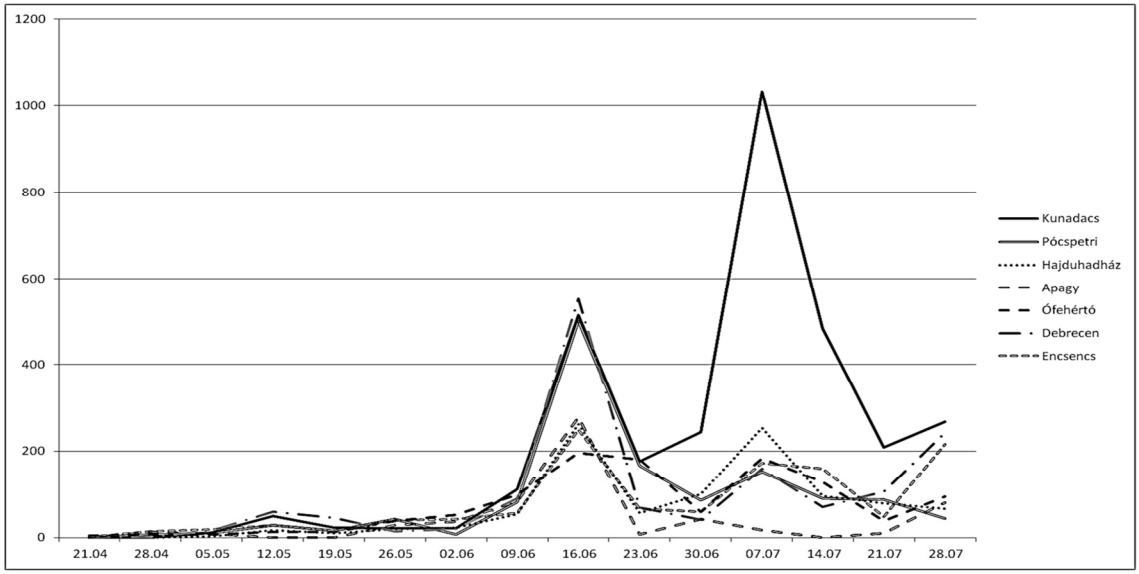
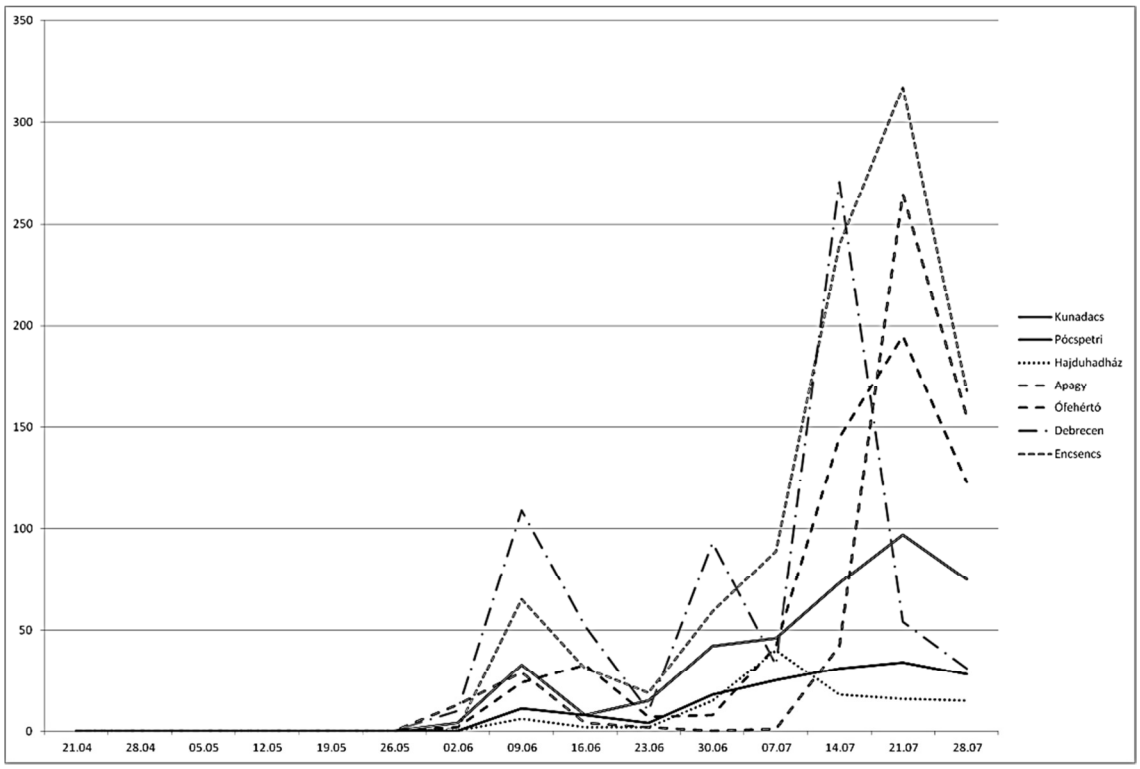


Figure 2: **Population dynamics of *Aeolothrips intermedius* based on the catching results at the sampling sites (2015)**



In 2016, 4450 *T. tabaci* adults were caught by the used 399 sticky traps from the seven tested locations (*Table 2*). The number of onion thrips individuals caught declined to one-third of the total counted number in 2015 due to the mild and rainy summer weather and the effective chemical treatments. The first immigrant *T. tabaci* adults occured right after the traps were put out (19 April) in Kunadacs and Encsencs. From the first days of May onion thrips occurred in all the sampling sites. The swarming and colonization of onion thrips into the sampling sites took place almost in paralell during the investigation period (*Figure 3*), according to the development of the species and due to the uniformly carried out chemical treatments. Following the field planting of seedlings, the number of onion thrips individuals started to increase in all sampling sites. The three peaks of the caught individuals' number were in the first weeks of June, July and August. In 2016, like in the previous year, *T. tabaci* colonization was the highest in Kunadacs as well. The number of migrants rapidly increased from the end of May only in Kunadacs, and its number was the highest here compared to the other sampling sites until the harvesting of tobacco leaves. In other sites of Nyírség, the number of *T. tabaci* immigrants was the highest in Debrecen and Pócspetri, the lowest was in Hajdúhadház and Ófehértó. The number of thrips adults began to rise again in all sampling sites in late August (*Figure 3*), but due to the the harvesting of tobacco leaves, these individuals are expected to migrate towards new breeding plants.

Based on the catching results in 2016, the number of *A. intermedius* was one sixth of the total number of *T. tabaci* (*Table 2*). The predatory thrips occurred in high numbers in the orchards from the beginning of June to the mid August. The peak of the caught individuals' number was in the second third of June. The highest number of *A. intermedius* was in Pócspetri. On the traps located in Pócspetri the proportion of predatory thrips compared to onion thirps was 1:1 at the end of June (*Figure 4*). This phenomenon could play an important role in the declining of onioin thrips individuals in Pócspetri from mid-July. Like in the prevoius year, the proportion of predatory thrips was the smallest compared to onion thirps in Kunadacs, and in this location there was the highest number of onion thrips individuals during June and July (*Figure 4*).

Table 2

Cathing results by yellow sticky traps at the sampling sites (2016)

Location	Total number of *Thrips tabaci* individuals	Total number of *Aeolothrips intermedius* individuals
Kunadacs	1563	78
Pócspetri	640	316
Hajdúhadház	251	40
Apagy	352	113
Ófehértó	274	75
Debrecen	935	105
Encsencs	435	29
Total catching data (n=19)	4450	756

Figure 3: **Population dynamics of *Thrips tabaci* based on the catching results at the sampling sites (2016)**

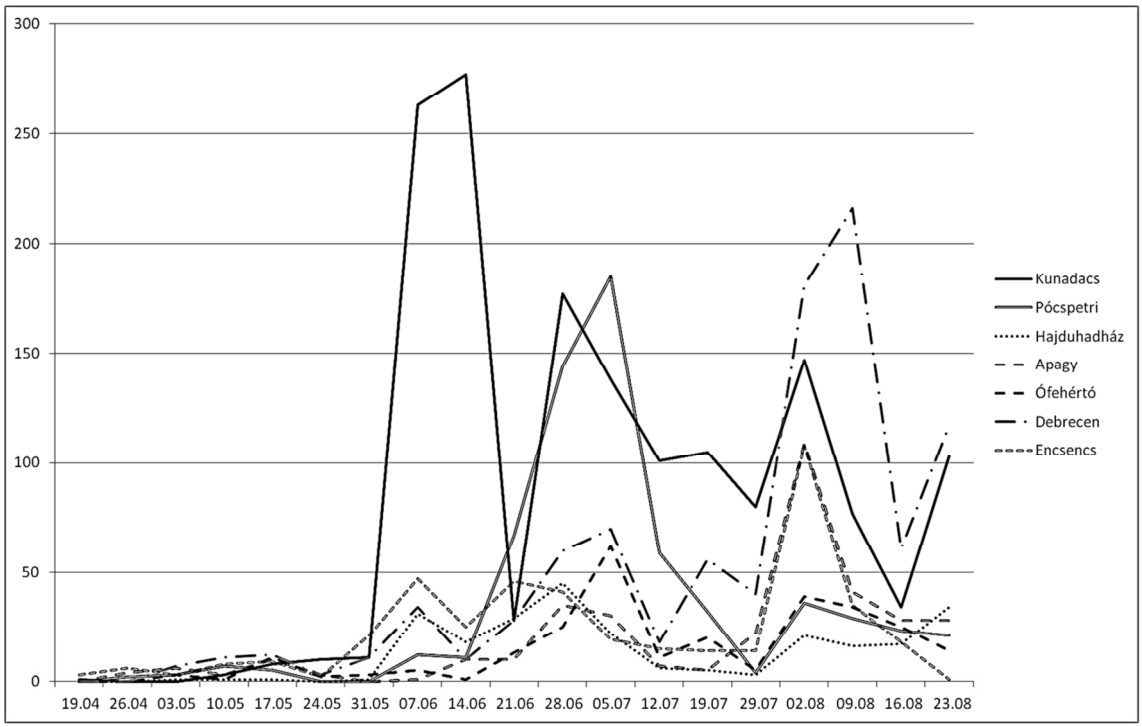
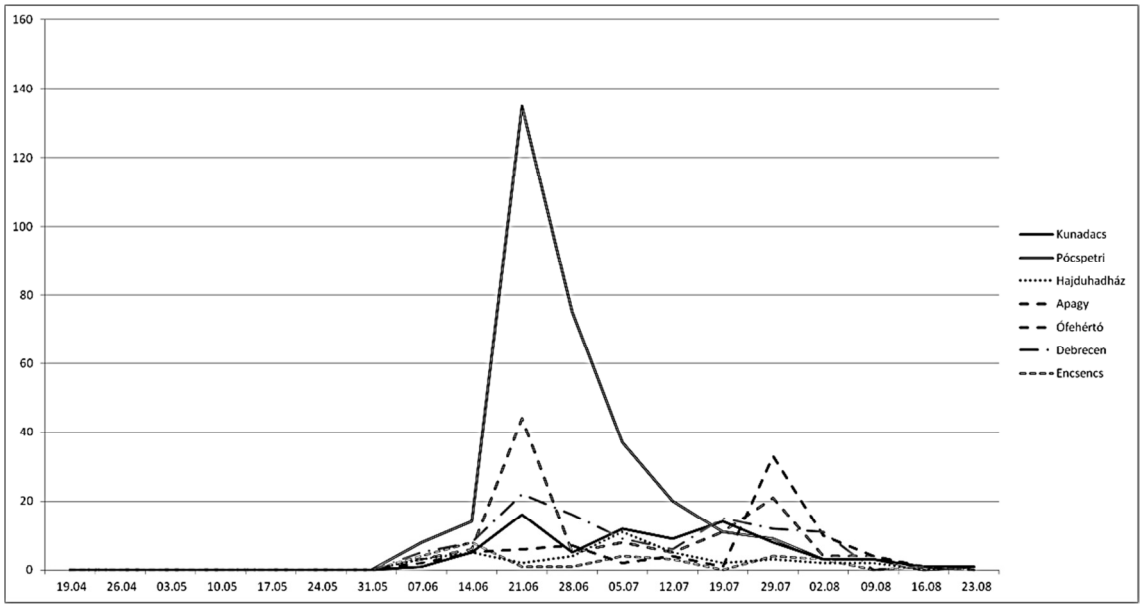


Figure 4: **Population dynamics of *Aeolothrips intermedius* based on the catching results at the sampling sites (2016)**



In 2017, 4648 *T. tabaci* adults were caught by the used 378 sticky traps from the seven tested locations (*Table 3*). The number of onion thrips individuals caught was higher than in the previous year due to the drier, warmer and less rainy weather that is favorable for thrips development.

The first immigrant *T. tabaci* adults occurred right after the traps were put out (25 April) in Kunadacs, Geszteréd and Encsencs. From the first week of May onion thrips occurred in all the sampling sites. The swarming and colonization of onion thrips into the sampling sites took place almost in paralell during the investigation period (*Figure 5*) according to the development of the species and due to the uniformly carried out chemical treatments. Following the field planting of seedlings, the number of onion thrips individuals started to decrease in all sampling sites. The three peaks of the caught individuals' number were in the first weeks of June, July and August. In 2017, like in the previous years, *T. tabaci* colonization

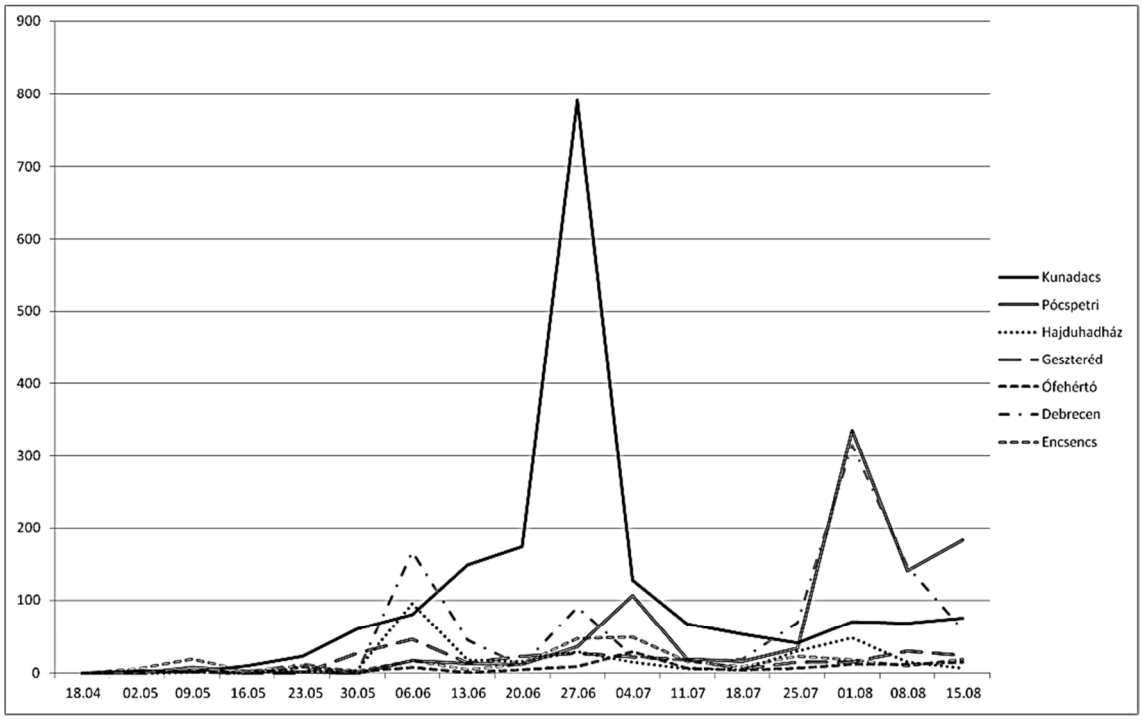
was the highest in Kunadacs as well. The number of migrants rapidly increased from 20 of July only in Kunadacs, and its number was the highest here compared to the other sampling sites until mid July. Then the number of *T. tabaci* individuals was the highest in Pócspetri and Debrecen until the harvesting of tobacco leaves. In other sites of Nyírség, the number of *T. tabaci* immigrants was the highest in Debrecen and Pócspetri, the lowest in Ófehértó. The number of thrips adults began to rise again in late July in all sampling sites (*Figure 5*), but due to the harvesting of tobacco leaves, these individuals are expected to migrate towards new breeding plants.

Table 2

Cathing results by yellow sticky traps at the sampling sites (2017)

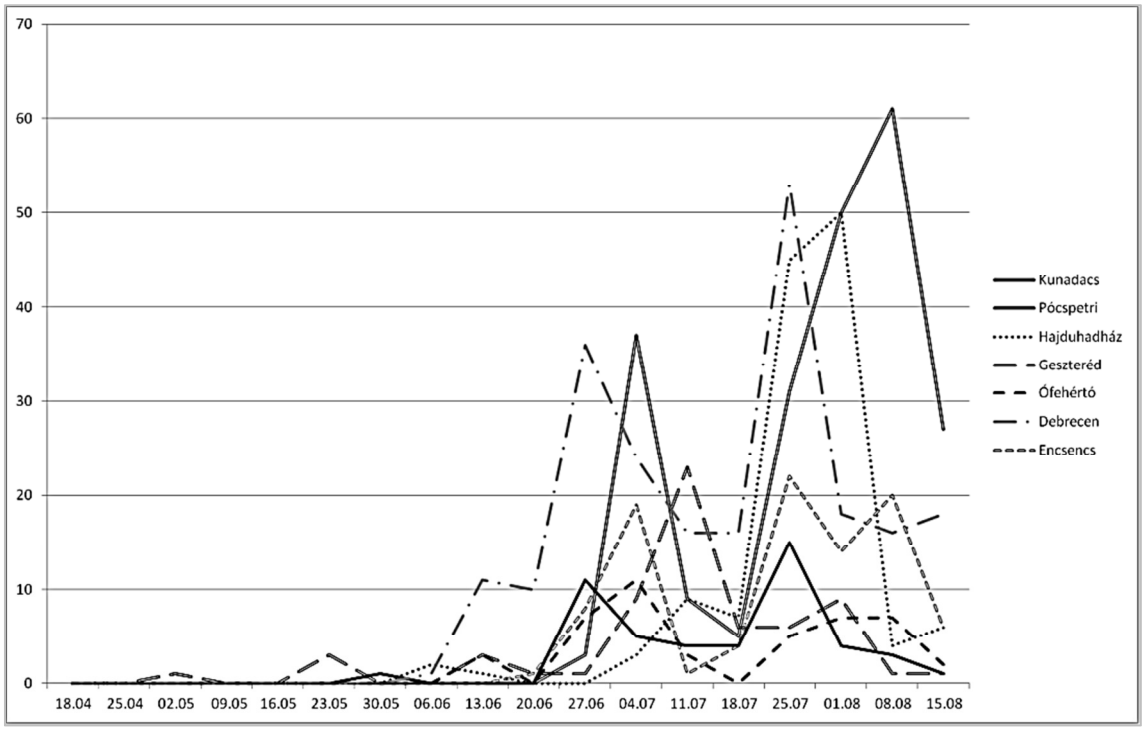
Location	Total number of *Thrips tabaci* individuals	Total number of *Aeolothrips intermedius* individuals
Kunadacs	1791	48
Pócspetri	924	223
Hajdúhadház	292	127
Geszteréd	271	64
Ófehértó	122	45
Debrecen	982	219
Encsencs	266	95
Total catching data (n=18)	4648	821

Figure 5: **Population dynamics of *Thrips tabaci* based on the catching results at the sampling sites (2017)**



In 2017 from June to August, the predatory *A. intermedius* immigrants settled into all the investigated orchards in high numbers, but mostly in Pócspetri, Debrecen and Hajdúhadház. Based on the catching results in 2017, the number of *A. intermedius* was one fifth of the number of *T. tabaci* (*Table 3*, *Figure 6*). The predatory thrips occurred in various numbers in the orchards from the beginning of June until the harvesting. The first peak of the caught individuals' number was at the end of June, the second one was from the end of July to the beginning of August. The second peak seemed to be more significant, during this time there were one and a half times more *A. intermedius* than during the first peak. The highest number of *A. intermedius* was in Pócspetri, Hajdúhadház and Debrecen. This phenomenon could play an important role in the declining of onion thrips individuals from the beginning of August at these sampling sites. Similarly to the prevoius years, the proportion of predatory thrips was the smallest compared to onion thirps in Kunadacs, and in this location there was the highest number of onion thrips individuals during the summer (*Figure 5–6*). In this place, the influence of predatory thrips could not prevaile, so besides the other weather factors, the low number of *A. intermedius* also contributed to the accumulation of onion thrips individuals in Kunadacs.

Figure 6: **Population dynamics of *Aeolothrips intermedius* based on the catching results at the sampling sites (2017)**



DISCUSSION

The immigrant onion thrips individuals can cause population reproduction in the plantations, hence it can lead to the expected direct and indirect damage by thrips in tobacco. However, on the other hand, the one important feature of thrips migration is that during the rainy period they look for shelter, so right before the rainy season is coming, the swarming could take place forcefully in the height of a few meters above the ground surface. As a result of this, not all individuals will become real pests settling into the plantations, they may not reproduce there, later they preferably continue to migrate and search for another food plant. Onion thrips is a highly polyphagous species, it means that this species has numerous breeding and food plants. The migration between the surrounding weeds or other breeding plants and the tobacco orchards is continuous during the entire vegetation period. This way the species sometimes can migrate in a very large number of individuals (Lewis 1973).

As mentioned above, it can be concluded that the increased number of onion thrips individuals on the traps does not necessarily mean the increased damage in the plantations. According to fact, although the lowest level of thrips abundance was on the traps in Apagy (*Table 1*), the visual study carried out there on 1 September shown that the direct damages on tobacco leaves caused by thrips was approximately 30–40%.

According to the catching results between 2015 and 2017, the highest level of thrips immigration into the tobacco plantation during the investigated three years was in Kunadacs (*Figure 1–3*). One of the possible reasons of this phenomenon is that the area of Kunság is much poorer in precipitation, and the surroundings of the sampling site there is highly neglected and weedy. These factors can cause a significant number of and damage caused by onion thrips. It is a very important reqirement to keep the surroundings of tobacco greenhouses free of weeds, in view of the fact that onion thrips can overwinter in ruderal areas and there is continouos immigration from the surrounding weeds to the tobacco plantations during the vegetation period (Jenser et al. 2005).

Predatory thrips (*A. intermedius*) settled into the tobacco plantation in the highest number in Encsencs during the entire growing season, compared to the other sampling sites. *A. intermedius* can feed on mostly thrips larvae, its preferable food on tobacco is onion thrips larvae. This species can immigrate to tobacco primarily from the surrounding weeds and other host plants. It is recommended to investigate the occurance and population dynamics of *A. intermedius* at the sampling sites, used by both trapping and knocking method next years. It is also worth examining what kinds of features can contribute to promoting the reproduction of this beneficial species in the tobacco plantations.

Based on our observations in the tobacco orchards, it is possible that the predator activity of *A. intermedius* also significantly contributes to the reduction of the number of *T. tabaci*. This statement is supported by Franco et al. (1999), according to this, *A. intermedius* is able to reduce the number of phytophagous Thysanoptera species exclusively under field conditions. However, several years of further observations are needed to prove this phenomenon

with our own data. In the next years during the vegetation periods, it is necessary to continue the monitoring with traps, and to supplement this work with regularly conducted direct plant investigation, at least twice a month, and to compare these results to the traps' catching data.

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