PARASITIZATION OF THE SECOND EUROPEAN CORN BORER GENERATION (*OSTRINIA NUBILALIS* HBN.) BY *LYDELLA THOMPSONI* HERTING AT THE LOCATION GABČÍKOVO

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ABSTRACT

This paper reports on parasitization of the second European corn borer (*Ostrinia nubilalis*) generation by the tachinid parasitoid *Lydella thompsoni* Herting. Our objective was to describe the incidence of the *Lydella thompsoni* adults able to attack the second generation corn borer larvae in autumn on maize plants in Slovakia. It is a first study that discussed occurrence of parasitoids attacking the second generation larvae of European corn borer (ECB). On October 7 in 2010 together 660 larvae of the pest were collected from maize plants at the location Gabčíkovo. Larvae were reared on simplified artificial diet in 200 ml glasses in laboratory conditions (22 °C, relative air humidity 60%).

Three parasitoid species, *Lydella thompsoni* Herting, *Sinophorus turionus* (Ratz.) and *Eriborus terebrans* (Gravenhorst), were reared from field-collected second generation ECB larvae in the region Gabčíkovo in south-western Slovakia. The level of parasitism was relatively low (3.03%) and the emerged parasitoids were fourteen individuals of *Lydella Thompsoni* (Diptera, Tachinidae), three females of *Sinophorus turionus and* three females of *Eriborus terebrans* (both Hymenoptera, Ichneumonidae). *Lydella thompsoni* was the most abundant parasitoid (2.1%) and represented 70% of all emerged parasitoid species attacking the second generation pest's larvae.

The pupation of *L. thompsoni* started on October 20 and the last pupa was found on November 17. More than 50% larvae of *Lydella thompsoni* pupated till November 12, twenty two days after the beginning of pupation.

The flight of the *Lydella thompsoni* adults started at the beginning of November in laboratory conditions. The last adults emerged on November 30 in 2010. The length of the flight period corresponded with the length of the pupation period. All pupae of the tachinid appeared in the period of twenty nine days and all the adults emerged within twenty eight days. The pupal stage lasted from ten to fourteen days and the average time for the pupal stage was 12. 21 days.

Important question is what adults of *L. thompsoni* did attack the larvae at the end of September or beginning of October? It is known, that about one-third of *L. thompsoni* adults emerge from first generation ECB larvae at the end of the growing season in Slovakia. The rest overwinter in host and emerge in spring in next year. Until now it was unknown what host did the “autumn generation” of *L. thompsoni* attack. According to our study, these adults parasitize larvae of second ECB generation and probably overwinter in these larvae in the field conditions. This is the first described occurrence of the second generation larvae of the ECB and their parasitoids in Slovakia.

Key words: *Ostrinia nubilalis;* European corn borer; bivoltine population; *Lydella thompsoni;* parasitoid

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INTRODUCTION

In Slovakia, Cagáň *et al.* (1995) studied the parasitization of the European corn borer larvae (ECB), *Ostrinia nubiallis* Hbn. for the first time and described the occurrence of larval parasitoids from *Tachinidae, Ichneumonidae* and *Braconidae.* Bokor (1998) described six species of the first generation ECB larval parasitoids. These were *Lydella thompsoni, Sinophorus turionus, Microgaster tibialis, Eriborus terebrans, Sympiesis viridula* and *Exeristes robotator*. Regular incidence of the parasitoids was recorded for two species only: *Lydella thompsoni* and *Sinophorus turionus.*

The works of these two authors are the only published information about larval parasitoid of ECB from Slovakia. They reported on the occurrence, bionomy, phenology and the parasitism rate of four parasitoid species gained from the first generation larvae of ECB from different locations in Slovakia (CAGÁŇ and BOKOR, 1998; BOKOR and CAGÁŇ, 1999a, b; CAGÁŇ *et al.*, 1999). Because there was no second generation of ECB described in former times, except the partial second generation in 1994, when two remnants of pupae were observed by Cagáň (1998) in maize stalks in autumn, there are no works discussing parasitism of the second ECB generation larvae by larval parasitoids.

However, due to changing climatic conditions in last 15 years, there was a possibility for bivoltine populations shifting northwards in central Europe. Kocmánková *et al.* (2008) used the meteorological data from Czech Republic from 1961 to 2000 to predict the potential geographical distribution of ECB populations. According to the study, the present area of the univoltine population will increase due to temperature increases even above 800 m a.s.l. In addition there is a risk of the establishment of a bivoltine population in the main agricultural areas and 38% of arable land in the Czech Republic before 2050. In Hungary the incidence of bivoltinism shifted northwards in years 1999-2001 due to the mild spring and the hot rainy summer (KESZTHELYI, 2006). During the year 2006, a second generation of the pest was detected for the first time in Saxony (Leipzig region) in Germany (PÖLITZ *et al.*, 2007). In Serbia (south-eastern Europe), the ratio between the first and the second generation has been changed in period 1987-2007 so that the larger number is the second generation: on the average 1 : 5.94 (first : second generation) (BAČA *et al.*, 2007). Despite of this knowledge, information about parasitism of the second European corn borer generation is missing in central Europe.

According to Thomson *et al.* (2008) the effectiveness of natural enemies in controlling pests will decrease if pest distributions shift into regions outside the distribution of their natural enemies, although a new community of enemies might then provide some level of control. On October 7 we observed larvae of second ECB generation generally in 3rd instar on maize ears and leaf axils at the location Gabčíkovo (south-western Slovakia). Our objective was to find out, if there are some adults of *Lydella thompsoni* able to attack the second generation ECB larvae in time of their incidence on maize plants in Slovakia.

MATERIALS AND METHODS

To define the parasitization by *L. thompsoni*, the second generation larvae of the pest were collected at the location Gabčíkovo (south-western Slovakia) on October 7 in 2010. Larvae of the 2nd, 3rd and 4th instar were recovered from the ears and leaf axils of the corn plants and than placed into 200 ml glasses. Together 660 larvae of the second generation were collected.

Each glass contained 20 larvae of the second ECB generation and few cubes of the artificial diet for feeding and water intake by the larvae. The composition of the simplified artificial diet described by Nagy (1974) is shown in the Table 1. The artificial diet has been changed once a week. Glasses were covered by two layers of cloth, which was damped periodically, and placed in wooden cages in laboratory temperature 22 °C and relative air humidity 60 %. The photoperiod was changed every 7 days to imitate the daylight in natural conditions. From October 7 to October 14 the photoperiod was set on 11 h 20 min., in October 15 – 22 the photoperiod was 11 hours, in October 23 – 30 it was 10 h 35 min., in October 31 – November 6 it was 10 hours, in November 7 – 14 the photoperiod was 9 h 35 min., in November 15 – 22 it was 9 hours, in November 23 – 30 the photoperiod was set on 8 h 42 min.

To monitor the development of the parasitoid, the glasses were checked daily and the appeared pupae and cocoons were inserted in the tubes separately. Tubes were enclosed with cotton wool and placed into same laboratory conditions as well as the glasses with larvae. The cotton wool was damped daily and the cocoons were checked for adult emergence every day.

The time of appearance of each parasitoid pupae and of emergence of the adult were recorded.

The emerged parasitoid adults were kept in the same laboratory conditions as aforementioned. After their death, they are kept in 70 % ethanol until the subsequent species identification.

Table 1. Composition of the simplified artificial diet for European corn borer larvae (Nagy, 1974)

Component	Volume/Weight
Water	2.6 l
Wheat sprouts	250 g
Granular Lucerne	200 g
Acetic acid	8 ml
Sorbic acid	4 g
Methylparaben	5 g
Agar	40 g
Ale yeasts	80 g

RESULTS

Table 2 shows the parasitization of the second generation ECB larvae. Total number of parasitoids emerged from host larvae was twenty and the rate of parasitization was 3. 03 %. There were fourteen individuals of *Lydella Thompsoni* (Diptera, Tachinidae), three females of *Sinophorus turionus* (Hymenoptera, Ichneumonidae) and three females of *Eriborus terebrans* (Hymenoptera, Ichneumonidae) emerged in autumn in laboratory conditions.

Table 2. The rate of ECB larvae parasitization by the different species

	ECB larvae	L. thompsoni	S. turionus	E. terebrans	Total
Number of samples	660	14	3	3	20
% of parasitization	-	2.1	0.45	0.45	3.03

Table 3 shows the pupation and adults' emergence time of the parasitoid *Lydella thompsoni*. The first pupa of *Lydella thompsoni* appeared on October 20 in 2010 in laboratory conditions and all the individuals finished their pupation till November 17. More than 50 % larvae of *Lydella thompsoni* pupated till November 12, twenty two days after the beginning of pupation. The most intensive pupation was taking place in the days within November 8 in 2010 and November 17 in 2010. In this period, nine of the fourteen pupae appeared and the average number of pupae was 0.9 per day.

The flight of the *Lydella thompsoni* adults started at the beginning of November in laboratory conditions. The last adults emerged on November 30 in 2010. The length of the flight period corresponded with the length of the pupation period. All pupae of the tachinid appeared in the period of twenty nine days and all the adults emerged within twenty eight days. The pupal stage lasted from ten to fourteen days and the average time for the pupal stage was 12. 21 days.

Table 3. Development of Lydella thompsoni (LT) emerging from the second generation ECB larvae in laboratory conditions

Sample number	Date of LT pupa appearance	Date of LT adult emergence
14.1	20.10.2010	03.11.2010
03.1	22.10.2010	04.11.2010
16.1	26.10.2010	08.11.2010
26.1	30.10.2010	10.11.2010
02.1	03.11.2010	15.11.2010
12.1	08.11.2010	18.11.2010
03.2	10.11.2010	24.11.2010
20.1	12.11.2010	24.11.2010
28.2	12.11.2010	22.11.2010
18.1	14.11.2010	26.11.2010
20.2	15.11.2010	28.11.2010
07.1	15.11.2010	26.11.2010
17.1	17.11.2010	30.11.2010
25.1	17.11.2010	30.11.2010

DISCUSSION

Three parasitoid species, *Lydella thompsoni* Herting, *Sinophorus turionus* (Ratz.) and *Eriborus terebrans* (Gravenhorst), were reared from field-collected second generation European corn borer larvae in the region Gabčíkovo in south-western Slovakia. The level of parasitism was low (3.03 %) which could be caused by the maize hybrid planted in the field (CLARK *et al.*, 2001), the local landscape structure without wooded edges needed by *E. terebrans* especially (LANDIS and HAAS, 1992; DYER and LANDIS, 1996, 1997) and relatively low number of collected host larvae. Clark *et al.* (2001) described three parasitoids, *Eriborus terebrans* (Gravenhorst), *Macrocentrus grandii* Goidanich, and *Lixophaga* sp. reared from second generation corn borer larvae in Nebraska. The ichneumonid, *Eriborus terebrans*, was the only parasitoid species reared from second generation host's larvae, with the exception of a single tachinid *Lydella thompsoni* in Ohio in 1988 and 1989 (PAVUK and STINNER, 1992). Studies on the parasites of Ostrinia nubilalis on maize in south-central Minnesota showed that the larvae of second generation were parasitized by *Macrocentrus grandii* and *Eriborus terebrans* (WINNIE and CHIANG, 1982).

The most abundant parasitoid of the second European corn borer generation larvae at the location Gabčíkovo was *Lydella thompsoni*. The rate of parasitism by this tachinid fly was 2.1%. This occurrence corresponds with parasitization of the first corn borer generation in Slovakia. Bokor (1998) stated that the parasitism rate by *Lydella thompsoni* was up to 22.10% in Slovakia in 1993 – 1995, which was the highest of all parasitoid species incident in Slovakia at the time. The emerged adults of *Lydella thompsoni* represented 70 % of all emerged parasitoid species attacking the second generation pest's larvae.

In the Friuli region of Italy, larvae of second generation were parasitized by the tachinid *Lydella thompsoni* and the ichneumonids *Eriborus terebrans*, *Sinohorus turionus* and *Eristicus clericus*, of which *L. thompsoni* was the most widely occurring species in all areas (BARBATTINI, 1986). The rate of parasitism by *L. Thompsoni* reached 30% and 8.6% in these areas in 1982 and 1983 respectively. In the north regions of Italy, the parasitism by *L. thompsoni* on overwintering (second generation) larvae ranged from 1.6 to 13.9% (MANACHINI, 2000). The observations in Somogy (Hungary) showed that a tachinid fly *Lydella thompsoni* (11.25%) and an ichneumon wasp *Sinophorus alkae* (*S. turionus*) (4.87%) were the most important parasitoids of the corn borer moth population in this area (KESZTHELYI, 2004). The most frequently found species on overwintering larvae was *L. thompsoni* (8.33-22.22%) in the province of Pontevedra in north-western Spain (MONETTI *et al.*, 2003). Also the researches conducted in the different regions all over France show the tachinid fly *Lydella thompsoni* to be the most frequently parasitoid species of the second generation corn borer larvae in this areas (FOLCHER *et al.*, 2008). Manojlovič (1989) reports *Lydella thompsoni* as the most abundant and most frequently occurred parasitoid in former Yugoslavia.

Whereas in Slovakia and many European regions with bi- or multivoltine ECB populations *Lydella thompsoni* plays a major role in attacking the second generation larvae, its importance decreased in compare with other parasitoid species in North America.

During observations in 1995 and 1996 there was described none emergence of *Lydella thompsoni* from larvae of the second ECB generation in Nebraska (CLARK *et al.*, 2001). According to Pavuk (1992) the ichneumonid *Eriborus terebrans* is the primary parasitoid (parasitism rate ranged from 2.1 to 29.1%) of the second European corn borer generation in Ohio which was also confirmed by observations of Landis *et al.* (1992) and Dyer (1996) in Michigan. Results from Michigan in 1992 showed that the rate of parasitism by *E. terebrans* ranged from 4.9 to 18.7% and from 9.1 to 10.2% on the first and second host's generation respectively. *Eriborus terebrans* accounted for 99.2% of the second generation parasitism during 1989; and for 99.1% during 1990 (LANDIS *et al.*, 1992). Our results show that the parasitism rate of *E. terebrans* was only 0.45% at the location Gabčíkovo in 2010 and accounted for 15% of parasitism. These results are similar to those of Bokor and Cagáň (1999b) who stated that 0-0.56% of the first ECB generation was parasitized by *E. terebrans* in Slovakia during 1993-95. Losey *et al.* (1992) reports that *Macrocentrus grandii* was the principal parasitoid, emerging from 17.4% of the overwintering larvae collected in Pensylvania in 1990. The other specimens, *Lydella thompsoni* and *Eriborus terebrans*, were recovered from less than 3% of the overwintering larvae. The most abundant parasitoid of ECB was *Lixophaga sp.* near *L. variabilis* in South Carolina during 1986-87 (WILSON and DURANT, 1991).

In our observation, first pupa of *Lydella thompsoni* appeared on October 20 in 2010 in laboratory conditions (22 °C and relative air humidity 60 %) and all the individuals finished their pupation till November 17. It is likely that in warm, suitable environmental conditions, larvae of *L. thompsoni* do not enter the diapause and continue with development. In natural conditions this individuals would probably overwinter as larvae inside the hosts and start their pupation in next year's spring. In laboratory conditions adults began to emerge from the second generation ECB larvae on November 3 and the last one emerged on November 30. The pupal stage lasted from ten to fourteen days and the average time for the pupal stage was 12. 21 days at 22 °C. Our observations confirm the results of Galichet *et al.* (1985) who stated the length of pupal stage at 12 – 12.2 days at 21 °C. Further, he reports that the larva needs 10.9 – 11.2 days for its development at 21 °C. Our results differ in this point markedly. If the larval stage would take even 12 days, all individuals had to pupate till October 19 at latest, because all the larvae of corn borer were collected on October 7. But in our research, pupae of the *L. thompsoni* kept appearing till November 17, forty days after sampling the host larvae. How is this possible? Most probably reason is that the corn borer larvae fed with simplified artificial diet had lower weight growth per day and their development was slowed down. Therefore the development of *L. thompsoni* larvae was influenced and retarded by development of the host.

Cagáň *et al.* (1999) observed a considerable number of *L. thompsoni* puparial cases during the autumn during 1994-96. This indicated that about one-third of *L. thompsoni* adults emerged from first generation ECB larvae at the end of the growing season in Slovakia. First empty puparial cases were found in field on August 25 and on August 27 in 1995 and 1996 respectively. Almost all collected pupal cases were empty at the end of September. But at that time there were no young ECB larvae available for parasitization, because there was only one ECB generation per year in Slovakia (CAGÁŇ, 1993). These adults could probably parasitize an alternate host, fifth instar of the ECB larvae or they died without parasitization on any host. Thompson and Parker (1928) discussed the improbability of successful attacking the thick-skinned late instar ECB larvae by *L. thompsoni* adults emerged in autumn. However, due to changing climatic conditions probably, we observed ECB larvae of second generation in Slovakia in 2010. These were most likely parasitized by that part of parasitoid adults that emerged from first generation larvae in autumn, described by Cagáň *et al.* (1999) aforementioned. According to Bokor (1998) the longevity of *L. thompsoni* imagos is more than 30 days and autumn-adults could, after the pre-larval stage, attack the host in the second decade of September. Based on this data we can enounce that the second generation corn borer larvae were parasitized by the autumn generation of *Lydella thompsoni* emerged from the first generation corn borer larvae and that there occurred better synchronization between this two species in autumn in Slovak climatic conditions during last fifteen years.

CONCLUSION

The most abundant parasitoid of the second European corn borer generation larvae at the location Gabčíkovo is *Lydella thompsoni*. However, the rate of parasitism is relatively low (2.1%) and its importance in suppressing the population of the second ECB generation is probably not significant. Our study provides the first information about incidence of the second ECB generation and its parasitoids in Slovakia. For more relevant results, the observations from more locations on more ECB larvae are needed.

REFERENCES

Bača, F. *et al.* (2007): European corn borer (Ostrinia nubilalis Hbn) population fluctuation at Zemun Polje between 1986 and 2005. Maydica, 52(3):325-328

Barbattini, R. (1986): Ostrinia nubilalis Hb. (Lepidoptera Pyralidae) on maize in Friuli. III. Study on entomophagous insects. Frustula Entomologica, 9: 63-75.

Bokor, P. (1998): Parazitoidy lariev vijačky kukuričnej (Ostrinia nubilalis Hbn.): Dizertačná práca. Nitra: Slovenská poľnohospodárska univerzita. 141 s.

Bokor, P. - Cagáň, Ľ. (1999a): Phenology, basic biology and parasitism of Microgaster tibialis (Hymenoptera, Braconidae), a parasitoid of the European corn borer, Ostrinia nubilalis, in Central Europe. Biologia (Bratislava), 54(5): 567-572.

Bokor, P. - Cagáň, Ľ. (1999b): Occurrence and bionomics of Eriborus terebrans (Gravenhorst) (Hymenoptera: Ichneumonidae), a parasitoid of the European corn borer, Ostrinia nubilalis Hbn. (Lepidoptera: Pyralidae), in central Europe. Plant Protection Science, 35(1): 17-22.

Cagáň, Ľ. (1998): Voltinism of the European corn borer, Ostrinia nubilalis Hbn., in Slovakia. Plant Protection Science, 34(3): 81-86.

Cagáň, Ľ. (1993): Vijačka kukuričná, *Ostrinia nubilalis* Hbn.- škodca kukurice na Slovensku: Habilitačná práca. Nitra: VŠP. 344 s.

Cagáň, Ľ. - Bokor, P. (1998): Sinophorus turionus Ratz, the parasitoid of the European corn borer, Ostrinia nubilalis Hbn. in Slovakia, Czech Republic and Southwestern Poland. Acta Phytopathologica et Entomologica Hungarica, 33(3/4): 435-445.

Cagáň, L. *et al.* (1995): Control of the European corn borer on maize. Acta Fytotechnica, 50: 53-55.

Cagáň, Ľ. *et al.* (1999): Lydella thompsoni Herting (Dipt., Tachinidae), a parasitoid of the European corn borer, Ostrinia nubilalis Hbn. (Lep., Pyralidae) in Slovakia, Czech Republic and south-western Poland. Journal of Applied Entomology, 123(10): 577-583.

Clark, T. L. - Witkowski, J. F. - Foster, J. E. (2001): Parasitism rates in European corn borer (Lepidoptera: Crambidae) larvae collected from six maize hybrids. Journal of Entomological Science, 36(4): 342-351.

Dyer, L. E. - Landis, D. A. (1996): Effects of habitats, temperature, and sugar availability on longevity of Eriborus terebrans (Hymenoptera: Ichneumonidae). *Environmental Entomology*, vol. 25, no. 5, pp. 1192-1201.

Dyer, L. E. - Landis, D. A. (1997): Influence of noncrop habitats on the distribution of Eriborus terebrans (Hymenoptera: Ichneumonidae) in cornfields. Environmental Entomology, 26(4): 924-932.

Folcher, L. *et al.* (2008): Parasitoids of Ostrinia nubilalis Hübner distribution in France - synthesis from 2001 to 2004. Unpaginated.

Galichet, P. F. - Riany, M. - Agounke, D. (1985): Bioecology of Lydella thompsoni Herting, (Dip. Tachinidae) within the Rhone Delta in southern France. Entomophaga, 30 (4): 315-328.

Keszthelyi, S. (2004): Insect parasitological researches on the population of European corn-borer (Ostrinia nubilalis Hbn.) in the years 2000-2001. Acta Agraria Kaposváriensis, 8(2): 51-56.

Keszthelyi, S. (2006): Comparative light trap studies in Hungary on the flight of the European corn borer (Ostrinia nubilalis Hübner) in 1999-2001. Archives of Phytopathology and Plant Protection, 39(1): 15-23.

Kocmánková, E. *et al.* (2008): Comparison of two mapping methods of potential distribution of pests under present and changed climate. Plant Protection Science, 44(2): 49-56.

Landis, D. A. - Haas, M. J. (1992): Influence of landscape structure on abundance and within-field distribution of European corn borer (Lepidoptera: Pyralidae) larval parasitoids in Michigan. Environmental Entomology, 21 (2): 409-416.

Losey, J. E. *et al.* (1992): Larval parasitoids collected from overwintering European corn borer (Lepidoptera: Pyralidae) in Pennsylvania. Journal of the Kansas Entomological Society, 65(1): 87-90.

Manachini, B. (2000): Lydella thompsoni Herting (Diptera, Tachinidae), parasite of Ostrinia nubilalis Hübner (Lepidoptera, Pyralidae) in North Italy. Phytophaga (Palermo), 10: 69-78.

Manojlovič, B. (1989): Distribution and importance of parasitoids of the corn borer Ostrinia nubilalis Hbn. (Lepidoptera: Pyralidae) in maize hybrids of different FAO maturity groups. Zaštita Bilja, 40(2): 115-130.

Monetti, L. *et al.* (2003): Parasitoids incidence and diversity on maize stem borers Sesamia nonagrioides Lefèbvre and Ostrinia nubilalis Hübner in NW Spain. Maydica, 48(2): 133-139.

Nagy, B. (1974): Rearing of the European corn borer (Ostrinia nubilalis Hbn.) on a simplified artifical diet. Acta Phytopathologica Academiae Scientiarum Hungaricae, 5: 73-79.

Pavuk, D. M. - Stinner, B. R. (1992): Influence of weed communities in corn plantings on parasitism of Ostrinia nubilalis (Lepidoptera Pyralidae) by Eriborus terebrans (Hymenoptera Ichneumonidae). Biological Control, 2(4): 312-316.

Pölitz, B. - Schnee, H. - Kühne, A. (2007): The infestation status of European corn borer in Saxony, occurrence of a second generation for the first time and some natural enemies of the pest. Nachrichtenblatt des Deutschen Pflanzenschutzdienstes, 59(11): 264-266.

Thompson, W. R. - Parker, H. L. (1928): The European corn borer and its controlling factors in Europe. U. S. D. A. . Techn. Bull.,(59): 63 pp.

Thomson, L. J. - Macfadyen, S. - Hoffmann, A. A. (2008): Predicting the effects of climate change on natural enemies of agricultural pests. Biological Control, In Press, Corrected Proof.

Wilson, J. A., Jr. - DuRant, J. A. (1991): Parasites of the European corn borer (Lepidoptera: Pyralidae) in South Carolina. Journal of Agricultural Entomology, 8(2): 109-116.

Winnie, W. V. - Chiang, H. C. (1982): Seasonal history of Macrocentrus grandii (Hym.: Braconidae) and Eriborus terebrans (Hym.: Ichneumonidae), two parasitoids of the European corn borer, Ostrinia nubilalis (Lep. Pyralidae). Entomophaga, 27(2): 183-188.