Occurrence and Bionomics of *Eriborus terebrans* (Gravenhorst) (Hymenoptera: Ichneumonidae), a Parasitoid of the European Corn Borer, *Ostrinia nubilalis* Hbn. (Lepidoptera: Pyralidae), in Central Europe

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Abstract

BOKOR P., CAGÁŇ Ľ. (1999): **Occurrence and bionomics of** *Eriborus terebrans* (Gravenhorst) (Hymenoptera: Ichneumonidae), **a parasitoid of the European corn borer,** *Ostrinia nubilalis* Hbn. (Lepidoptera: Pyralidae), **in Central Europe.** Pl. Protect. Sci., **35**: 17–22.

Eriborus terebrans (Gravenhorst), the parasitoid of the European corn borer, *Ostrinia nubilalis* Hbn., was studied at four locations in central Europe during 1993–1995. Regular parasitism of *O. nubilalis* was found only at Blatnice in Moravia (eastern part of Czech Republic). At this location, the parasitism was 2.22% in 1993, 0.47% in 1994 and 0.06% in 1995. In 1994 and 1995, low parasitism (0.56 and 0.12% ,respectively) was found at Kráľovský Chlmec (eastern Slovakia). The records are the first from Czech Republic and Slovakia. The parasitoid was not found at Nitra (south-western Slovakia) and Wroclaw (south-western Poland). The first cocoons of *E. terebrans* developed in the first half of June. Parasitoid adults emerged from mid June to mid July. Results showed complete coincidence between bionomics of *E. terebrans* and bionomics of its host *O. nubilalis*.

Key words: *Ostrinia nubilalis*; *Eriborus terebrans*; parasitism; parasitoid; bionomics

The aim of this study was to assess how the parasitoid influences *O. nubilalis* populations, to investigate the phenology of *E. terebrans,* and to link the phenology of the parasitoid to the phenology of the host insect. This paper presents a report on the occurrence and bionomics of *Eriborus terebrans* (Gravenhorst), the parasitoid of the European corn borer, *Ostrinia nubilalis* Hbn., in central Europe. This parasitoid is also known under the following synonyms: *Dioctes punctoria* Roman (THOMPSON & PARKER 1928), *Inareolata punctoria* Roman (DUDICH 1928; HERGULA 1929,1930; CLARK 1934), *Angitia* (*Inareolata*) *punctoria* Roman (GOIDANICH 1931), *Horogenes punctorius* (Roman) (BAKER *et al.* 1949; MANOJLOVIĆ 1984), *Eriborus terebrans* (Gravenhorst) (WINNIE & CHIANG 1982) or *Diadegma terebrans* (Gravenhorst) (MAINI 1974; PLATIA & MAINI 1975; MANOJLOVIĆ 1989).

In Europe, this parasitoid was recorded in south-western France (THOMPSON & PARKER 1928; RIFFIOD 1976), northern Italy (MAINI 1974; PLATIA & MAINI 1975; BARBATTINI 1986), former Yugoslavia (HERGULA 1929, 1930; MANOJLOVIĆ 1984, 1989; MANOJLOVIĆ *et al.* 1994), Hungary (THOMPSON & PARKER 1928; SACHTLEBEN 1930), Russia (ELLINGER 1930), and Romania (SACHTLEBEN 1930; PISICA *et al.* 1982), as well as in Japan, Korea and China (CARTWRIGHT 1933; CLARK 1934).

In 1920, *E. terebrans* was introduced into the United States from Europe and Asia for the control of *O. nubilalis* (THOMPSON & PARKER 1928), and became established throughout the maize production areas of Northern America (WRESSEL 1973; HILL *et al.* 1978; ANDREADIS 1982; LEWIS 1982; WINNIE & CHIANG 1982; GOODFREY *et al.* 1991; LOSEY *et al.* 1992; LANDIS & HAAS 1992; MASON *et al.* 1994; DYER & LANDIS 1997).

E. terebrans overwinters in larval stage within diapausing larvae of *O. nubilalis*. Females mate soon after emergence and they can lay eggs the day after eclosion (BAKER *et al.* 1949). Peak activity of *E. terebrans* is in synchrony with the peak occurrence of its host *O. nubilalis* (WINNIE & CHIANG 1982).

MATERIAL AND METHODS

During 1993–1995 the larvae of *Ostrinia nubilalis* were collected at four locations in Central Europe: Nitra in south-western Slovakia, Kráľovský Chlmec in eastern Slovakia, Blatnice in Moravia (eastern Czech Republic, district Uherské Hradiště) and Wroclaw in south-western Poland.

The larvae of *O. nubilalis* were collected at the end of maize growing season in September and October.

After the dissection of maize stems the larvae were removed and placed in 200ml glass containers. In each container 20 larvae were kept together with two pieces of corrugated paper (3 × 5 cm), which were covered with transparent plastic foil. Larvae would move to the tunnels and crawl in between the corrugated paper and the plastic foil. This allowed observation of the development of the larvae. Containers were covered with two layers of cloth and placed in wooden cages. Cages with the larvae were placed outside and exposed to natural weather conditions, but were protected against rainfall. Larvae from all locations were brought to Nitra and observed under the same conditions in order to compare the development of parasitoids originating from different places. Cubes of 1.5% agar containing water were added to the glass containers every two weeks in autumn and spring to maintain humidity and to provide water for the *O. nubilalis* larvae.

To monitor the development of *E. terebrans*, containers with the *O. nubilalis* larvae were usually first checked at three day intervals and then daily after the first parasitoid cocoons was recovered. The time of parasitoid cocoon appearance and emergence of adults was recorded. Overall parasitism was estimated from the number of *E. terebrans* cocoons. The number of *E. terebrans* cocoons plus the cocoons of other parasitoids collected in autumn was added to the number of collected *O. nubilalis* larvae to yield the 100% value for the calculation of the parasitism percentage.

RESULTS

Table 1 shows the number of collected *O. nubilalis* larvae and percentage of parasitism caused by *E. terebrans* during the three year period under study. The highest amount of parasitism (2.22%) was found at Blatnice in Czech Republic in 1993. At this location, the parasitism of the *O. nubilalis* larvae reached 0.47% in 1994 but only 0.06% in 1995. In 1994 and 1995, low parasitism (0.56 and 0.12% respectively) was found at Královský Chlmec (eastern Slovakia). Thousands of host larvae (Table 1) were collected at Nitra in south-western Slovakia and Wroclaw in south-western Poland during 1993–1995, however, no parasitoids were found.

In 1994, four cocoons of *E. terebrans* developed from *O. nubilalis* larvae which originated from Blatnice. The adults emerged on June 17, June 22 and July 16.

Fig. 1 shows pupation of *E. terebrans* originated from Blatnice and Kráľovský Chlmec in 1995. First cocoon of the parasitoid developed on June 9 and the last new cocoons were observed at the end of June.

The first adults of *E. terebrans* emerged from the cocoons in the second half of June. Fig. 2 shows that new adults were observed until mid July. Parasitoid adults originating from Blatnice emerged during June 21–July 13. Those from Kráľovský Chlmec developed during June 16– July 11.

On June 13, 1996, one parasitoid cocoon developed from *O. nubilalis* larvae collected at Blatnice. An adult was found on July 18, 1996. Similarly, on June 10, 1996,

Table 1. Parasitization of *Ostrinia nubilalis* (ON) larvae by *Eriborus terebrans* (ET) in 1993–1995 at four locations in Central Europe

	Location			
	Nitra south-western Slovakia	Kráľovský Chlmec eastern Slovakia	Blatnice Czech Republic (Moravia)	Wroclaw south-western Poland
1993				
ON larvae collected	2 434	176	172	413
ET cocoons	0	0	4	0
Cocoons of other parasitoids	62	8	8	3
% parasitization by ET	0	0	2.22	0
1994				
ON larvae	5 020	1 138	1 653	1 265
ET cocoons	0	7	8	0
Cocoons of other parasitoids	91	111	50	2
% parasitization by ET	0	0.56	0.47	0
1995				
ON larvae	3 737	837	1 707	940
ET cocoons	0	1	1	0
Cocoons of other parasitoids	47	9	40	3
% parasitization by ET	0	0.12	0.06	0

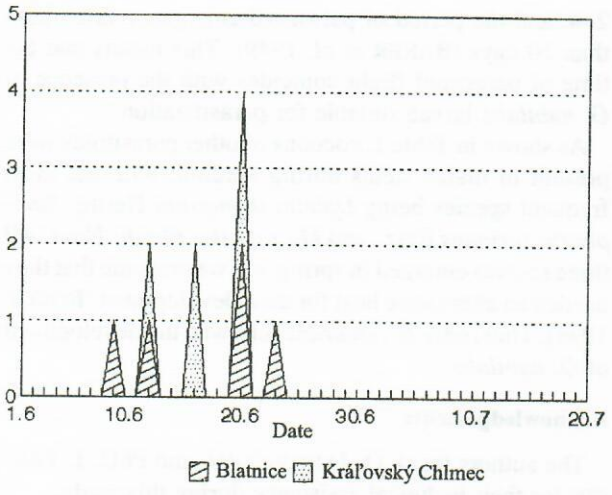

Fig. 1. Number of *Eriborus terebrans* cocoons that developed from *Ostrinia nubilalis* larvae that originated from locations Blatnice (eastern Czech Republic) and Kráľovský Chlmec (eastern Slovakia) during 1995

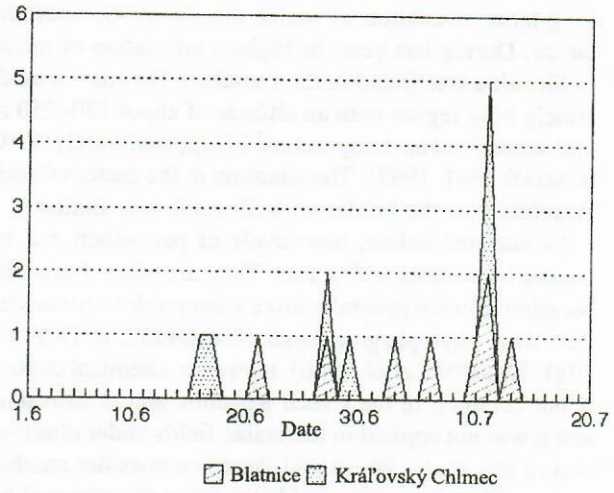

Fig. 2. Number of *Eriborus terebrans* (Gravenhorst) adults emerged from cocoons that originated from *Ostrinia nubilalis* Hbn. larvae collected at Blatnice (eastern Czech Republic) and Kráľovský Chlmec (eastern Slovakia) during 1995

one parasitoid cocoon developed from larvae originated from Kráľovský Chlmec. On June 26, an adult emerged from this cocoon.

Fig. 3 shows the phenologies of *E. terebrans* and its host *O. nubilalis*. Pupation and flight of both species were in a very high coincidence.

DISCUSSION

Average parasitism of *O. nubilalis* larvae caused by *E. terebrans* was 4.6% in south-western France and 6.7% in northern Italy (THOMPSON & PARKER 1928). Later on, parasitism by *E. terebrans* reached 0.63% in the province of Bologna (MAINI 1974) and 0.20% in the province Forli (PLATIA & MAINI 1975). Percentage of parasitism was 9.4% or 10.35% during 1960 and 1961 in Yugoslavia (BJEGOVIĆ & LAZAREVIĆ 1963), later on 1.07 and 5.1% (MANOJLOVIĆ 1989). In the U.S.A. average parasitism was from 0 to 9% in Iowa and Nebraska (HILL *et al.* 1978; LEWIS 1982), or 2.04 and 2.90% in Nebraska (GOODREY *et al.* 1991). PAVUK and STINNER (1992) found 20.0–29.1% of parasitism during 1989 in Ohio. The highest number was 55.8% of parasitism during 1938 near Boston in Massachusetts (BAKER *et al.* 1949). Our records are probably the first from the Czech Republic and Slovakia.

From the above data it is difficult to determine the main reason for the incidence of *E. terebrans*. In Europe, the parasitoid was found mainly in the areas with bivoltine *O. nubilalis* populations. Our results show that *E. terebrans* is very rare in relatively warm areas of south-western Slovakia and, on the other hand, it was regularly found in a very cold maize growing region in the eastern Czech Republic. We assume that such a situation developed because of the very high percentage of the maize crop in this region (according to personal communication with maize growers), and as a result of a very high

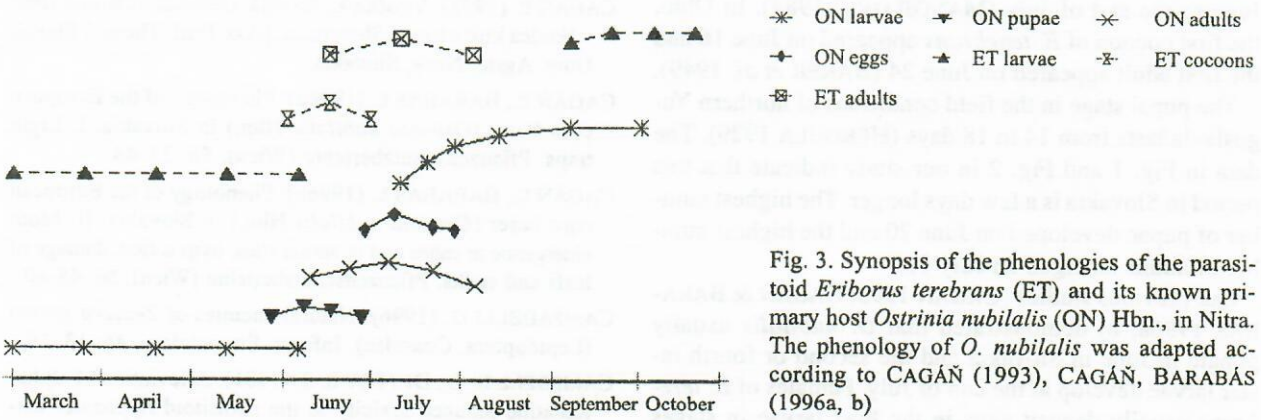

Fig. 3. Synopsis of the phenologies of the parasitoid *Eriborus terebrans* (ET) and its known primary host *Ostrinia nubilalis* (ON) Hbn., in Nitra. The phenology of *O. nubilalis* was adapted according to CAGÁŇ (1993), CAGÁŇ, BARABÁS (1996a, b)

long-term infestation of maize caused by *O. nubilalis* larvae. During last year the highest infestation of maize in Slovakia was found in the Danubian Downs – a moderately hilly region with an altitude of about 170–250 m and annual mean temperature of approximately 9 °C (CAGÁŇ 1991, 1993). The situation in the eastern Czech Republic near the border with Slovakia was similar.

As outlined below, low levels of parasitism can be caused by a variety of factors. They are often due to the parasitoids being generally more susceptible to pesticides than their phytophagous hosts (CAMPBELL & DUFFEY 1981; BARBOSA *et al.* 1986). However, chemical control is not common in the Czech Republic and in Slovakia, and it was not applied in the maize fields under observation in this study. We should therefore consider another reason – that many parasitoids are primarily attracted by the crop (VINSON 1976; MA *et al.* 1992). This could explain the low parasitism of *O. nubilalis,* which is a pest of a variety of crops and weeds.

Furthermore, literature survey reveals that *Eriborus terebrans* has a number of other hosts apart from *O. nubilalis*. In Japan it is *Sesamia inferens* (Wlk.) (NAGATOMI 1972), in China *Chilo suppressalis* (SHE & HE 1988), *Ostrinia furnacalis* (YIN *et al.* 1996), *Paranthrene tabaniformis* and *Saperda populnea* (LING *et al.* 1997), in Bulgaria *Paranthrene tabaniformis* (GEORGIEV & TSANKOV 1995), and in Italy *Zeuzera pyrina* (CAMPADELLI 1996). The second generation of *E. terebrans* parasitised 61.6% of *Paranthrene tabaniformis* larvae but only 4.1% of *O. nubilalis* larvae at the same location in Italy (LAPIETRA 1967). These findings suggest that there is probably a more suitable host for *E. terebrans* than *O. nubilalis*, especially when one considers that maize has not been a host plant for *O. nubilalis* for very long.

Seasonal histories of *E. terebrans* correspond to those of *O. nubilalis*. In our study the pupation of *E. terebrans* was recorded during June and adults emerged during the second half of June and first half of July. SACHTLEBEN (1930) obtained similar results in Hungary. In northern Yugoslavia the parasite pupated from mid May to the beginning of July, and adults emerged from the beginning of June to mid July (HERGULA 1929). In surroundings of Beograd the adults were found from the end of June to the end of July (MANOJLOVIĆ 1984). In Ohio, the first cocoon of *E. tenebrans* appeared on June 16 and the first adult appeared on June 24 (BAKER *et al.* 1949).

The pupal stage in the field conditions of northern Yugoslavia lasts from 14 to 18 days (HERGULA 1929). The data in Fig. 1 and Fig. 2 in our study indicate that this period in Slovakia is a few days longer. The highest number of pupae developed on June 20 and the highest number of adults emerged on July 11.

Our previous studies (CAGÁŇ 1993; CAGÁŇ & BARABÁS 1996a, b) demonstrated that *O. nubilalis* usually pupate in June in Slovakia and the second or fourth instar larvae develop at the end of July. Females of *E. terebrans* usually deposit eggs in the host larvae in stages 2–4, and the period of parasitoid emergence lasts more than 20 days (BAKER *et al.* 1949). This means that the time of parasitoid flight coincides with the presence of *O. nubilalis* larvae suitable for parasitization.

As shown in Table 1, cocoons of other parasitoids were present in maize stems during autumn, with the most frequent species being *Lydella thompsoni* Hertig, *Sinophorus turionus* Ratz., and *Microgaster tibialis* Nees. All three species emerged in spring and we presume that they needed an alternative host for their development (BOKOR 1998). Thus, only *E. terebrans* followed the development of *O. nubilalis*.

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Súhrn

BOKOR P., CAGÁŇ Ľ. (1998): **Výskyt a bionómia** *Eriborus terebrans* (Gravenhorst) (Hymenoptera, Ichneumonidae), **parazitoida vijačky kukuričnej**, *Ostrinia nubilalis* Hbn., **v strednej Európe**. Pl. Prot. Sci., **35**: 17–22.

V rokoch 1993–1995 bol sledovaný parazitoid vijačky kukuričnej (*Ostrinia nubilalis* Hbn.) *Eriborus terebrans* (Gravenhorst) na štyroch lokalitách v strednej Európe. Pravidelná parazitácia vijačky kukuričnej sa zistila len na lokalite Blatnice na Morave (východná časť Českej republiky). Na tejto lokalite bola parazitácia 2,22 % v roku 1993, 0,47 % v roku 1994 a 0,06 % v roku 1995. V rokoch 1994 a 1995 sa našla nízka parazitácia (0,56 a 0,12 %) na lokalite Kráľovský Chlmec (východné Slovensko). Údaje o parazoidovi sú pravdepodobne prvé v Českej Republike a na Slovensku. Parazitoid sa nepozoroval na lokalitách Nitra (juhozápadné Slovensko) a Wroclaw (juhozápadné Poľsko). Prvé kokóny *E. terebrans* sa vyvinuli v prvej polovici júna. Imága tohto parazitoida sa liahli od polovice júna do polovice júla. Výsledky ukázali úplnú zhodu v bionómii parazitoida (*E. terebrans*) a hostiteľa (*O. nubilalis*)

Kľučová slová: vijačka kukuričná; *Ostrinia nubilalis*; *Eriborus terebrans;* parazitácia; bionómia parazitoidov

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