Survey of Parasitoids of the European Corn Borer (Lepidoptera: Pyralidae) in Southwestern Kentucky[1]

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Abstract The European corn borer, *Ostrinia nubilalis* (Hübner) (Lepidoptera: Pyralidae), is a major maize pest throughout the maize-growing regions of the U.S. A survey was conducted to determine the parasitoids of European corn borer in southwestern Kentucky, the major maize producing region in the state. Two species, *Lixophaga variabilis* (Coquillett) (Diptera: Tachinidae) and *Eriobus terebrans* Gravenhorst (Hymenoptera: Ichneumonidae), were found. The most abundant species was the native *L. variabilis*. Only one *E. terebrans* was collected.

Key Words *Ostrinia nubilalis*, parasitoid, Tachinidae, Ichneumonidae

Native parasitoids are generally not sufficient to effectively regulate the European corn borer, *Ostrinia nubilalis* (Hübner), an introduced species, across the U.S. corn belt where this insect is a major pest (Baker et al. 1949). Consequently, for more than 70 years U.S. entomologists and governmental agencies have tried to establish additional parasitoids of the pest (Clausen 1978). Twenty-four species have been introduced thus far, but only six have become established. These include *Eriborus terebrans* Gravenhorst [= *Horogenes punctorius* (Roman)] and *Phaeogenes nigridens* Wesmail which are ichneumonids, and *Chelonus annilipes* Wesmail and *Macrocentrus grandii* Goidanich [= *Macrocentrus gifuersis* Ashmead] which are braconids. The others are a eulophid, *Sympiesis viridula* (Thomson) [= *Eulophus viridulus* Thomson] and the tachinid, *Lydella thompsoni* Herting [= *Lydella stabulans grisescens* Robineau-Defroidy] (Baker et al. 1949, Clausen 1978). Clausen (1978) asserted that only *E. terebrans, M. grandii* and *L. thompsoni* are capable of suppressing European corn borer populations. Other studies support this assertion (e.g., Hill et al. 1973, Hill et al. 1978, Burbutis et al. 1981, Mason et al. 1994). However, *L. thompsoni* has not been recovered in many states since the late 1960's (Hill et al. 1973, Mason et al. 1994).

Lydella thompsoni and two hymenopterans, *Inareolata punctoria* Roman and *Sympiesis viridula* Thomson, were released in the bluegrass region of Kentucky between 1944 and 1946. A total of 15,879 individuals was released during this time frame, but only progeny of *L. thompsoni* and *L. punctoria* were recovered in the bluegrass region in 1946. Mortality of 40% of an *O. nubilalis* population in a maize field in Lexington, KY, was attributed to *L. thompsoni* in 1946 (Ritcher 1947). How-

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ever, no other studies have been conducted on parasitism since that time. Therefore, a survey was conducted in 1993 and 1994 to determine the current status of native and introduced parasitoids of *O. nubilalis* in the southwestern region of the state.

Materials and Methods

European corn borer larvae and pupae were collected during July and August in 1993 and 1994 from 20 counties in the maize-growing region of Kentucky. These counties included Ballard, Breckinridge, Caldwell, Christian, Daviess, Fayette, Fulton, Graves, Hardin, Henderson, Hickman, Hopkins, Logan, McCracken, McLean, Simpson, Todd, Trigg, Union and Webster. Thirty-seven individual fields in which post-emergence insecticides had not been used were located by agricultural agents with the University of Kentucky Cooperative Extension Service. They provided a listing of farmers with early-planted fields that are known to be most attractive to first-generation female moths, which preferentially oviposit on taller corn (Everly 1959). Individual fields ranged in size from 8 ha to 101 ha.

Sampling began approximately 1 month after an *O. nubilalis* degree-day model (Brown 1982) indicated probable onset of first and second generation *O. nubilalis* flight. In 1993 larvae were collected between 2 and 14, July and 28 July and 6 September. In 1994, the survey was conducted between 1 and 7 July, and 8 and 23 August. At this time most *O. nubilalis* would have been susceptible to parasitization. Samples were collected while walking in a U-shaped pattern through the field. Larvae were located by finding stalks that had characteristic borer openings or frass present in and around leaf axils or stalk joints. Each stalk identified was cut down and split longitudinally. If a larva was present, it was placed back into the split stalk and returned to the lab. At least 10,000 stalks were observed per field. Additionally, a number of unknown dipteran puparia were found in the stalks and also were collected. In 1993, the larvae were held at room temperature (27°C) in 28.3 g diet cups with pieces of a maize stem upon which the larvae could feed and pupate. In 1994, larvae were placed in a 28.3 g diet cup with artificial diet (BioServe, Frenchtown, NJ) in an effort to increase larval survivorship. They were maintained at 27°C with a photoperiod of 16:8 (L:D)h in a growth chamber (Perceival, Boone, IA). During both years, the larvae were held until larval death, parasitoid emergence or adult *O. nubilalis* emergence.

Results and Discussion

Only two species of parasitoids were collected during the 2-yr survey. The most common was a tachinid identified as *Lixophaga variabilis* (Coquillett). *Lixophaga variabilis,* a native species (Allen 1962), attacks lepidopteran larvae that tunnel in stems, fruits and nuts (Stone et al. 1965, Arnaud 1978). Superparasitism was observed from several counties (Table 1) in that multiple *L. variabilis* emerged from a single larvae. A single specimen of *Eriborus terebrans,* an introduced ichneumonid, emerged from a larva collected in 1994 in Simpson Co., KY. In addition, the sarcophagid *Boettcheria cimbicis* (Townsend) was collected in the pupal stage in an *O. nubilalis* tunnel. This species is believed to be saprophytic (Stone et al. 1965), therefore it may not have parasitized an *O. nubilalis* larva, but rather have fed upon a dead larva or decaying plant tissue.

This survey suggests that the native *L. variabilis* is the primary parasitoid of *O.*

Table 1. Cumulative results of first generation 1993-1994 survey of parasitism of *O. nubilalis in selected Kentucky counties**

County	# fields surveyed	# larvae collected	Diptera puparia in field	*L. variabilis* reared	Percent parasitized larvae**
Caldwell	3	6	1	5	83%
Christian†	1	4	0	0	0
Daviess	2	8	0	0	0
Hardin	2	17	0	2	12%
Henderson	2	3	1	1	0.33%
Hickman†	1	4	0	0	0
Hopkins	2	29	3	14 (3w/multiple)	48%
Todd	2	11	0	0	0
Trigg†	2	8	2	7 (2w/multiple)	87%
Union	2	11	2	0	0
Webster†	3	10	0	0	0

* Percent parasitism a cumulative percentage over years, not on a per year basis unless noted.
** Reared parasitoid divided by the number of larvae collected.
† Sampled only in 1993.

nubilalis larvae in southwestern Kentucky maize fields. Overall, rates of parasitism in Kentucky maize fields were low (Table 1, 2), as has been reported elsewhere (e.g., Hudon and LeRoux 1986, Mason et al. 1994). However this might be due, in part, to the size of *O. nubilalis* populations during sample years. In both 1993 and 1994, *O. nubilalis* populations were greatly reduced compared to average years (D. Johnson, pers. observ.).

Reintroduction of *L. thompsoni* into Kentucky might result in higher rates of biological control of *O. nubilalis* larvae. The earlier decline in abundance of *L. thompsoni* may have resulted from fluctuations in availability of alternate hosts (Sparks et al. 1963) or from pathogens of the host and the fly (Hill et al. 1978). Reintroduction of improved strains of the fly have been successful (Burburtis et al. 1981) and should be considered in Kentucky.

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Table 2. Cumulative results of second generation 1993-1994 survey for parasitism of *O. nubilalis in selected Kentucky counties**

County	# fields surveyed	# larvae collected	Diptera puparia in field	*L. variabilis* reared	Percent parasitized larvae**
Ballard	2	38	3	1	12%
Breckinridge	2	66	1	1	1%
Caldwell	3	92	0	7	7%
Daviess	2	87	2	2	2%
Fayette	1	74	0	0	0
Fulton	1	26	0	0	0
Graves	1	24	0	3	12%
Hardin	2	95	0	0	0
Henderson	2	57	1	0	0
Hopkins	2	63	12	5	8%
Logan	1	44	2	2	4%
McCracken	2	19	0	1	5%
McLean	4	45	0	0	0
Simpson	1	95	0	0	0
Todd	2	63	4	2	3%
Trigg	2	58	1	3	5%
Union	2	247	3	2	0.1%

* Percent parasitism a cumulative percentage over years, not on a per year basis unless noted.
** Reared parasitoid divided by the number of larvae collected.

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