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THE SUBCOLONIZATION AND BUILDUP OF *TETRASTICHUS JULIS*, (HYMENOPTERA: EULOPHIDAE) A LARVAL PARASITOID OF THE CEREAL LEAF BEETLE, (COLEOPTERA: CHRYSOMELIDAE) IN THE LOWER PENINSULA OF MICHIGAN[1]

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ABSTRACT

Following initial establishment of the parasitoid, *Tetrastichus julis* (Walker), at a carefully managed field nursery, releases of parasitized *Oulema melanopus* larvae were made by Michigan county agents at preselected sites throughout the lower peninsula during 1970-74. A follow-up recovery program during 1971-75 revealed continued dispersion and population increase for *T. julis.* An independent census verified the increasing rates of parasitism.

INTRODUCTION

The cereal leaf beetle, *Oulema melanopus* (Linnaeus) of Eurasian origin, is a univoltine, economically important pest on small grains. It was found in southwest Michigan in the 1950's, but was not identified until 1962 (Castro, Ruppel, and Gomulinski, 1965). A biological control program involving releases of larval and egg parasitoids was begun by the United States Department of Agriculture in 1963 (Dysart, Maltby, and Brunson, 1973).

The larval parasitoid, *Tetrastichus julis* (Walker), was established at the Michigan State University W. K. Kellogg Farm by 1969 (Stehr, 1970). This parasitoid is bivoltine, with a facultative diapause. Some of the offspring of the first generation emerge in mid-season as a second generation, and the rest enter diapause. Diapausing first generation parasitoids and all of the second generation winter in the soil in the pupal cells of the host. There are usually four to six parasitoids per host larva.

METHODS

Tetrastichus julis was the subject of an extensive subcolonization program throughout the lower peninsula in 1971-74. County agents from the Michigan Cooperative Extension Service collected parasitized larvae from the Kellogg Farm area and released them at preselected "nursery sites" within their counties. Sites chosen were those which were unlikely to be disturbed before mid-season the following year (e.g. unplowed oat stubble or oats underseeded with alfalfa), in order to maximize survival.

A follow-up Extension recovery program in 1972-75 revealed widespread establishment and dispersal (Fig. 1). In 1972-73, county agents were asked to collect and rear larvae in units patterned after one developed by Gruber, Rivet, and Pietro (1972). They then returned pupal cells to Michigan State University for analysis of the rate of parasitism. In 1974-75, agents were provided sweepnets and preservatives with which to collect three samples over a two week period near the time of peak cereal leaf beetle larval density. These samples were returned to Michigan State University for dissection and analysis. Results and an interpretation of findings were sent to each agent.

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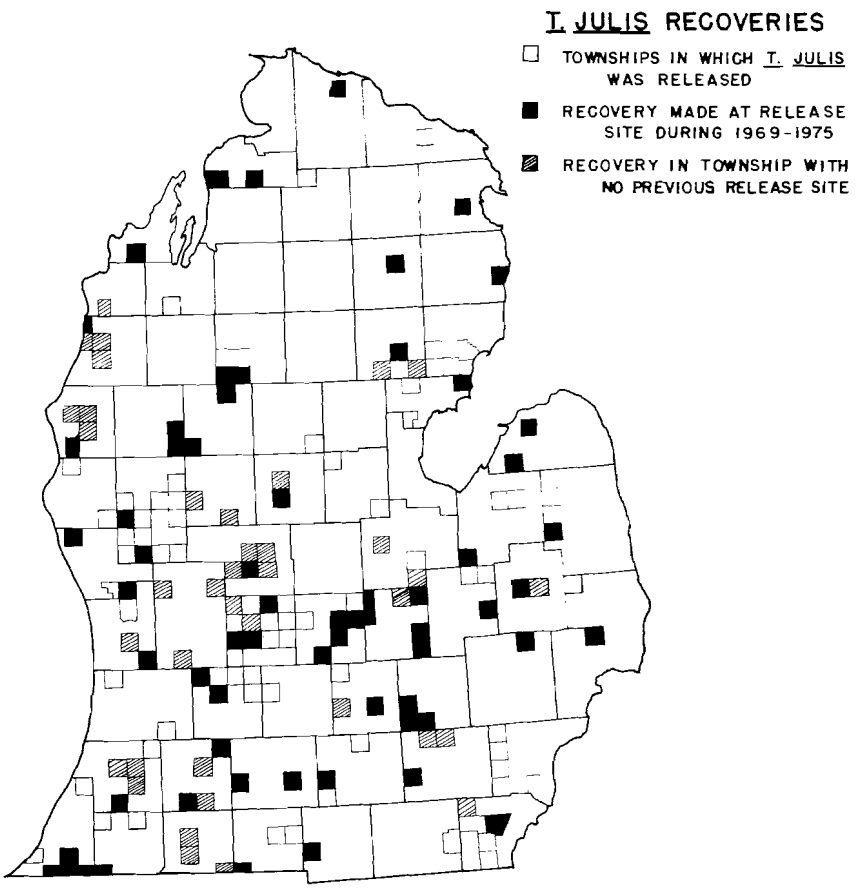

Fig. 1. Michigan townships in which *T. julis* has been released and/or recovered, 1966-75.

Table 1. Summary of county agent recovery program 1974-1975.

	1974	1975
Counties/townships represented	35/59	24/51
Number of samples	188	133
Total larvae, $\Sigma\, l_i$	35,806	11,089
Larvae dissected, $\Sigma\, d_i$	7,064	4,178
Dissected larvae that were parasitized, $\Sigma\, p_i$	1,632	1,246
Weighted percent parasitism, $\Sigma\left(\frac{p_i}{d_i}\, l_i\right)/\Sigma\, l_i$	15.6	26.9

Table 2. Parasitism rates in samples from MSU Department of Entomology cereal leaf beetle state census, 1973-1975.

1973					1974					1975				
Date	D-D[1]	No. of Fields	Mean CLB's[3]	Mean % Parasitism[2]	Date	D-D[1]	No. of Fields	Mean CLB's[3]	Mean % Parasitism[2]	Date	D-D[1]	No. of Fields	Mean CLB's[3]	Mean % Parasitism[2]
Allegan County–Dorr Township														
6/12	755	12	81	18	6/10	625	20	145	27	6/8	560	24	49	40
6/20	935	13	85	2	6/20	750	25	232	8	6/16-7	700	26	33	50
6/26	1050	13	24	37	6/27	830	26	310	7	6/22	840	27	33	31
Barry County–Thornapple Township														
6/14	810	21	220	12	6/12	700	30	213	28	6/8	560	13	114	45
6/20	960	21	116	11	6/20	810	26	207	15	6/16	690	21	33	20
6/26	1080	21	13	62	6/27	920	29	215	13	6/22	840	3*	89	73
Emmet County–Resort Township														
					6/16	455	19	342	15	6/24	670	19	150	16
					6/26	576	19	71	25					
					7/5	751	21	28	23					
Jackson County–Pulaski Township														
6/11	592	30	45	21	6/5	576	23	6	49	5/31	515	25	6	50
6/18	771	29	99	4	6/12	720	22	31	31	6/6	590	26	6	60
6/25	945	29	13	42	6/21	869	24	30	19	6/12	690	26	5	37
					6/27	948	21	37	10					
Lake County–Chase/Pinora Townships														
6/12	631	11	95	3	6/16	606	14	96	17					
6/22	820	11	108	0	6/27	746	17	166	11					
7/2	987	10	23	20	7/5	911	19	8	8					
Oscoda County–West Comins Township														
6/14	598	5	310	17	6/16	594	3	19	26					
6/19	674	4	860	38	6/25	701	7	11	61					
6/27	824	5	33	36	7/7	937	7	11	57					
Shiawassee County–New Haven Township														
6/13	731	30	363	17	6/12	690	29	506	44	6/4-5	575	30	40	58
6/22	926	29	167	2	6/17	770	23**	389	38	6/12	690	30	20	52
6/28	1044	6*	7	67	6/25	886	29	708	31					
					7/3	1060	29	50	61					

[1]Degree-days, base 48°F, accumulated from 1 April, at nearest NOAA weather station.
[2]Σ (parasitism rate for field i)/Σ i, given there were any larvae found.
[3]Mean per 100 sweeps.
*Samples lost in lab accident.
**Samples lost in lab accident; figure known to underestimate mean CLB's/100 sweeps.

RESULTS

Table 1 summarizes the Extension Service sweepnet survey for 1974-75. Agents from 33 counties out of 68 in the lower peninsula sent in pupal cells in 1972. Eighteen of these showed *julis* establishment. In 1973, 17 counties returned pupal cells, all samples showing parasitism by *julis*. The apparent rate of parasitism varies considerably depending on the time of sampling, due to the bivoltine nature of *julis*. The overall parasitism rate, adjusted for sample size, from 1974 may be compared to the 1975 rate if one assumes samples were made near the same physiological times in both years. We attempted to justify this assumption by roughly bracketing the time of the peak larval density by sampling a week before peak, during peak, and a week after peak. Thus, northern county samples were taken starting about two weeks later than southern counties. Starting dates were set at approximately 600 accumulated degree-days (base 48°F) (Gage 1974).

During 1973-75, larvae collected from several selected Michigan townships as part of the annual Michigan State University Department of Entomology cereal leaf beetle census were also analyzed for parasitism rate. This cereal leaf beetle census was repeated three times during mid-season at seven to ten day intervals. Up to 30 oat fields per township were sampled, using 100 sweeps with a 15-inch net as a standard sample (Ruesink and Haynes, 1973). Table 2 lists results from the Department of Entomology cereal leaf beetle census from 1973-75. The average parasitism rate per field in these areas generally increased over the three year period.

DISCUSSION

The data obtained through Extension Service and Department of Entomology activities indicate a rising rate of parasitism by *julis*. The increase in 1975 over 1974 could be due to a widely observed concurrent decline in beetle density caused by unknown factors such as weather or insecticide use. However, the net result is still a higher proportion of the cereal leaf beetle larval population being parasitized.

The parasitism rates in Table 2 are generally higher than those in Table 1. We do not know the reason for this, but the townships selected by the Department of Entomology for their survey were chosen because they contained above average acreages of oats. This abundance of oats from one year to the next provides a greater chance for both *julis* and cereal leaf beetles to find their respective hosts in proximity to overwintering sites, and may be a contributing factor to the higher rates of parasitism observed.

Parasitism by *julis* is becoming substantial only four years after its first subcolonizations. This parasitoid's capacity for survival and increase in typical farm systems, despite damaging operations such as plowing and disking which destroy many overwintering parasitoids, is a positive factor for cereal leaf beetle management programs.

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