House Fly (*Musca domestica*) Control in Broiler-Breeder Poultry Houses by Pupal Parasites (Hymenoptera: Pteromalidae): Indigenous Parasite Species and Releases of *Muscidifurax raptor*^{1,2}

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ABSTRACT

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Seven species of house fly pupal parasites, *Spalangia cameroni* Perkins, *Muscidifurax raptor* Girault and Sanders, *S. endius* Walker, *S. nigroaenea* Curtis, *Pachycrepoideus vindemiae* (Rondani), *S. drosophilae* Ashmead, and *S. nigra* Latreille, were recovered from fly pupae exposed in broiler-breeder poultry houses. *S. cameroni* and *M. raptor* ranked first and second, respectively, in overall relative abundance and together both species accounted for 91% of all parasites collected.

Weekly sustained releases of an indigenous strain of *M. raptor* resulted in a significantly higher rate of house fly parasitism, concurrent with a significant reduction in the house fly population at the release farm in comparison to farms without parasite releases.

Broiler-breeder poultry facilities can produce large numbers of flies, particularly house flies (*Musca domestica* L.). Fly management in these facilities is very difficult because of the limited effective control methods available. Chemical control with the exception of misting or fogging is not very practical because the manure is inaccessible (under slats) for larviciding, and dust deposits could render residual adulticide treatments ineffective after a few days. Therefore, integrated cultural and biological fly control methods appear to be most promising.

Considerable information is available concerning the species composition and effectiveness of hymenopterous parasites as biological fly control agents at caged-layer poultry facilities in North Carolina (Rutz and Axtell 1980a,b). The efficacy of sustained releases of an indigenous strain of the fly pupal parasite *Muscidifurax raptor* Girault and Sanders for house fly control at caged-layer poultry houses has also been demonstrated (Rutz and Axtell 1979). However, little is known about house fly parasites and their effect on fly populations at boiler-breeder poultry facilities. Manure conditions in such facilities are considerably different from those at caged-layer facilities. Since habitat conditions can greatly influence house fly parasite effectiveness (Legner 1977), significant differences in parasite species composition might exist between the two facility types.

We systematically surveyed indigenous house fly parasite populations at several broiler-breeder poultry facilities during an entire fly season. In addition, we evaluated sustained releases of an indigenous strain of *M. raptor* for house fly control at a broiler-breeder poultry farm.

Materials and Methods

Five broiler-breeder poultry farms, all located in the Piedmont (Chatham County) region of North Carolina were included in the study. Broiler-breeder houses were open-sided structures, 90 to 120 m long by 9 to 12 m wide. Slatted platforms, 3 to 4 m wide and 0.8 m above the floor, ran the entire length of the house along each

wall. Feeders and waterers were positioned over the slats, and manure accumulated underneath. The center one-third of the house had a dirt floor covered with wood chips. Nests, suspended from the ceiling, were positioned 1 m above the dirt floor. Farm 1 had four houses, and farms 2 through 5 had two houses each. Each house had an average of 6,000 to 7,000 birds.

Parasite populations were monitored weekly from June through October 1979 by the pupal bag technique (Rutz and Axtell 1980a). Pupal bags were made of 14-mesh (ca. six openings per cm) screen, and each contained 25 laboratory-reared house fly pupae (<1 day old). The pupal bags, five at equidistant locations throughout each house, were lowered through the slats onto the surface of the manure by a wire which also held the bag in place on the manure. After being exposed for 7 days, the bags were collected and new bags were positioned similarly. The exposed pupae from the pupal bags were held in the laboratory for ca. 45 to 60 days at 26.6°C. and 60 ± 10% Rh to allow time for parasite development and emergence. Attempts were made to collect naturally occurring fly pupae from the manure under the slats but were discontinued because removal and replacement of the slats was impractical.

Baited traps were used to monitor fly populations at all farms. Baited traps were 3.8-liter plastic milk jugs with four holes (5 cm diameter) cut in the upper part of the sides to allow entrance of the flies which were attracted to 25 g of Improved Golden Malrin® (Zoecon Industries, Dallas, Tex.) fly bait placed on the bottom of the jug. The traps (five per house) were suspended with wire (30 cm) from the roof supports at equal intervals along the center of the house. The traps were left for 7 days, and then the number and species of flies collected were counted. The traps were then cleaned and fresh bait added. Sticky ribbons and spot cards were tried but proved unsatisfactory in this type of poultry house. Excessive dust from the birds moving freely in the houses caused a coating on the ribbons and cards rendering them ineffective.

Sustained releases of an indigenous strain of *M. raptor* were made at farm 1 beginning 19 June and were continued through October (18 weeks). These parasites

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Table 1.—Relative abundance of house fly pupal parasites recovered from fly pupae placed on the manure in broiler-breeder poultry farms with or without the weekly release of *M. raptor*

Species	% Relative abundance ^a					
	Farm 1 ^b ; parasite release	Farm 2; no release (check)	Farm 3; no release (check)	Farm 4; no release (check)	Farm 5; no release (check)	Mean; no release (check)
<i>Spalangia cameroni</i>	10.6	93.6	53.9	38.8	58.8	69.4
<i>Muscidifurax raptor</i>	81.4	5.6	33.6	39.6	14.4	21.3
<i>S. endius</i>	6.2	0.8	11.8	11.5	18.6	7.6
<i>S. nigroaenea</i>	0.1		0.1	7.2	1.0	0.8
<i>Pachycrepoideus vindemiae</i>	1.1			2.9	7.2	0.7
<i>S. drosophilae</i>	0.1		0.3			0.1
<i>S. nigra</i>	0.5		0.3			0.1
Total no. of parasites collected	2,531	664	696	139	97	1,596

^a Percentage of total number of parasites collected at each farm during June through October at farm 1, July through October at farms 2 and 3, and June through August at farms 4 and 5 by the pupal bag collection technique (25 laboratory-reared pupae per 14-mesh screen bag, five bags per house per week, four houses at farm 1 and two houses each at farms 2 through 5).

^b *M. raptor* (ca. 150,000 per week) released during July through October.

were from a colony established from several thousand house fly pupae collected from caged-layer poultry houses in both the Coastal Plain and Piedmont regions of North Carolina during 1977 and 1978. Parasites and their house fly hosts were reared by methods described by Rutz and Axtell (1979). The parasites were released as 14 to 16-day-old (3 to 4 days before adult emergence), parasitized house fly pupae which were poured through the slats onto the manure at 10 to 15 locations throughout each house. An average of 150,000 parasites was released each week (ca. five parasites per chicken per week).

Results and Discussion

Seven species of house fly pupal parasites were recovered from the fly pupae placed in the broiler-breeder poultry houses (Table 1). *Spalangia cameroni* Perkins, with an average relative abundance of 69.4%, was the most abundant parasite collected, followed by *Muscidifurax raptor*, *S. endius* Walker, *S. nigroaenea* Curtis, *Pachycrepoideus vindemiae* (Rondani), *S. drosophilae* Ashmead, and *S. nigra* Latreille. A few specimens of *Nasonia vitripennis* Walker, which are of questionable importance as house fly parasites (Legner 1967), were also collected.

These same house fly parasite species have been found previously in caged-layer poultry houses throughout North Carolina, but *M. raptor* was the predominant

parasite species with *S. cameroni*, generally ranking second or third in overall relative abundance (Rutz and Axtell 1980a). These differences in species predominance probably are due to the different manure conditions at caged-layer and broiler-breeder poultry facilities. Legner (1977) reported that *M. raptor* parasitized more pupae near the surface of the manure, whereas *Spalangia* were active deeper in the manure. Manure in caged-layer poultry houses is generally wet, with house fly pupation occurring near the surface on the drier periphery of the manure. These conditions, therefore, would favor parasitism by *M. raptor* and its subsequent predominance. In broiler-breeder houses, the manure is drier and the flies pupate at greater depths which favors *S. cameroni*. In addition, *Muscidifurax* has been reported to be competitively superior to *Spalangia* (Legner 1977, Markwick 1974). *Muscidifurax* superiority would probably be manifested to a greater extent at caged-layer houses where shallow house fly pupation commonly occurs.

Sustained releases of an indigenous strain of *M. raptor* resulted in a higher proportion of *M. raptor* in the parasite population at the parasite release farm (farm 1) than at the check farms (farm 2 through 5) receiving no parasite releases (Table 1). *M. raptor* accounted for 81.4% of all the parasites collected at the parasite release farm but only for 5.6 to 39.6% of all parasites recovered at the check (no parasite release) farms.

Table 2.—Parasitism of house fly pupae placed in manure at broiler-breeder poultry farms with and without (check) the weekly release of *M. raptor*

Location	% Parasitism ^{a,b}					
	June	July	August	September	October	Mean, July–October
Farm 1; parasite release ^c	0.1a	21.1a	27.0a	46.0a	32.5a	31.5a
Farm 2; no release (check)	—	21.6a	17.0ab	20.8b	8.9b	17.1b
Farm 3; no release (check)	—	4.8b	21.6a	24.6b	18.6b	17.4b
Farm 4; no release (check)	0.6a	5.4b	6.9bc	—	—	—
Farm 5; no release (check)	0.8a	6.1b	3.2c	—	—	—

^a Based on the total number of parasites recovered each month at each farm by the pupal bag collection technique (25 laboratory-reared pupae per 14-mesh screen bag, five bags per house per week, four houses at farm 1 and two houses each at farm 2 through 5).

^b Means in the same column followed by the same letter are not significantly different from each other (5% level) (Duncan's multiple range test).

^c *M. raptor* (ca. 150,000 per week) released during July through October.

Table 3.—House fly populations at broiler-breeder poultry farms with and without (check) the weekly release of *M. raptor*

Month	Farm 1; parasite release ^a		Farm 2; no release (check)		Farm 3; no release (check)	
	Flies/trap/wk ^{b,c}	% Reduction	Flies/trap/wk ^{b,c}	% Reduction (–) or increase (+)	Flies/trap/wk ^{b,c}	% Increase
July	239a		43ab		42a	
August	134b	–44	81a	+88	106b	+152
September	59b	–75	43ab	0	56a	+33
October	38b	–84	10b	–77	50a	+19

^a *M. raptor* (ca. 150,000 per week) released during July through October.

^b Values represent averages from five baited traps per house per week; four houses at farm 1 and two houses each at farms 2 and 3.

^c Means in the same column followed by the same letter are not significantly different from each other (5% level) (Duncan's multiple range test).

Parasitism of exposed house fly pupae at the parasite release farm and the check farms is presented in Table 2. Parasitism at the release farm during the release period (July through October) averaged 31.5%, which was significantly higher ($P = 0.01$) than the 17.1 and 17.4% observed at check farms 2 and 3, respectively. During the parasite release period, with the exception of one farm in July, parasitism at the release farm was higher than that observed at any of the check farms. These differences were most obvious during September and October, when parasitism at the release farm was nearly two times greater than that at the check farms.

Parasitism at the release farm increased from 21.1% in July to 32.5% in October, with a peak of 46.0% in September. At check farm 2, parasitism decreased from a peak of only 21.6% in July to 8.9% in October. Parasitism at check farm 3 increased from 4.8% in July to 18.6% in October, with a 24.6% peak in September. Parasitism at check farms 4 and 5 remained low (less than 7%) through August. Parasite monitoring was discontinued at these farms at the end of August because chickens were removed from the houses.

At the parasite release farm, concurrent with increases in parasitism attributed to sustained release of *M. raptor*, there was a significant reduction in the house fly population during August through October. (Table 3). At the check farms there was either no reduction or an increase in the fly populations during the same period, with the exception of a reduction in October at check farm 2.

In summary, *S. cameroni* was the most abundant and *M. raptor* ranked second in abundance of the seven species of house fly pupal parasites collected from broiler-breeder poultry houses. Together, *S. cameroni* and *M. raptor* accounted for an average of 91% of all parasites collected at these houses. These species also accounted for the majority of parasites previously collected at caged-layer poultry houses; however, at these houses

M. raptor predominated (Rutz and Axtell 1980a,b). Since these two parasite species are apparently well adapted to habitat and climatic conditions in North Carolina, they are excellent candidates for mass rearing and release as biological fly control agents. The effectiveness of sustained releases of an indigenous strain of *M. raptor* for house fly control has been demonstrated in this investigation and previously at caged-layer poultry houses (Rutz and Axtell 1979). Investigations to determine the efficacy of mass rearing and releasing an indigenous strain of *S. cameroni* are needed. Combined releases of *M. raptor* and *S. cameroni*, because of their reported differences in searching habits (Legner 1977), might prove to be highly effective in suppressing fly populations under the habitat and climatic conditions of North Carolina.

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