Fly[1] Control in Caged-Poultry Houses: Comparison of Larviciding and Integrated Control Programs[2]

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ABSTRACT

Weekly larviciding of the manure under caged laying hens with 1% RaVap® (EC consisting of 2 lb/gal Rabon® (2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate) and 0.2 lb/gal dichlorvos) or with 1% Zytron® (*O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate) gave satisfactory control of the house fly, *Musca domestica* L., and the little house fly, *Fannia canicularis* (L.). An integrated control program based on selective adulticiding with RaVap at 2- to 5-week intervals gave control as satisfactory as the weekly larviciding.

The populations of manure-inhabiting mites, *Macrocheles muscadomesticae* (Scopoli) and *Fuscuropoda vegetans* (De Geer), which are predaceous on the immature stages of the house fly, were destroyed by larviciding but were unharmed by selective adulticiding.

It was estimated that, under conditions in North Carolina, the larviciding method would require 16–18 applications during the season of fly activity (May–October) for satisfactory control, while the integrated program would require 5 or 6 applications of insecticide. Larviciding would require 5 times as much insecticide and 2.5 times an many man-hours per season as would be needed for the integrated control program.

An integrated program for fly control in caged-poultry houses has been reported to give satisfactory relief from the nuisance of house flies, *Musca domestica* L., and little house flies, *Fannia canicularis* (L.) (Axtell 1970). The program is based on early-season manure removal, adult fly control by insecticide-bait stations, and selective applications of insecticides to the resting sites of the flies, primarily the inside upper part of the poultry houses. The populations of beneficial manure-inhabiting predaceous mites and manure-visiting parasites are encouraged by avoiding manure treatment with insecticides and by not disturbing the manure during the season of fly abundance. This integrated-fly-control program has evolved from extensive research by many workers on the ecology, behavior, and biological control agents of synanthropic Diptera. The literature has been cited in earlier publications (Anderson 1965; Anderson and Poorbaugh 1964; Axtell 1969, 1970; Legner 1966; Peck and Anderson 1969a,b, 1970).

Rather than an integrated fly control program, a common practice is larviciding of the manure for fly control in caged-poultry houses. Frequent retreatment is necessary, since the larvicides usually do not give fly control for more than 7 days (Bailey et al. 1968, Loomis 1969, Morgan et al. 1966). Larvicides which are effective against the flies are usually detrimental to predaceous mites in the manure (Axtell 1966, 1968, Willis and Axtell 1968).

The efficiency and practicality of these programs should be compared for long periods (at least for an entire fly season) under different climatic and managerial conditions. Results of one such comparison are given here.

MATERIALS AND METHODS.—Four farms in the vicinity of Apex and Pittsboro, N. C., were used in 1969. The poultry houses were all of essentially the same design and building materials. Each house (3 m wide × 100–110 m long) had open sides and 1 row

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[1] Diptera: Muscidae.

[2] Supported in part by U. S. Public Health Service Research Grant no. EC-246 from the Environmental Control Administration. Contribution from the Entomology Department, North Carolina Agricultural Experiment Station, Raleigh. Published with the approval of the Diretor of Research, Paper no. 3110 of the Journal Series. Received for publication Mar. 6, 1970.

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of 2-tiered wire cages on each side of a center concrete aisle. The cages, containing 2 or 3 birds each, were suspended 1–1.5 m above the compacted dirt floor. The number of houses per farm were: farm no. 1 (Lindley) 4, farm no. 2 (Hilliard) 4, farm no. 3 (Cooper) 3, and farm no. 4 (Andrews) 4.

Larviciding with 1% RaVap® (EC consisting of 2 lb/gal Rabon® (2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate) and 0.2 lb/gal dichlorvos, Shell Chemical Co.) was practiced at farm no. 1. Larviciding with 1% Zytron® (*O*-2.4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate, 3 lb/gal EC, Dow Chemical Co.) was practiced at farm no. 2. Selective adulticiding with 1% RaVap was practiced at farm no. 3 and consisted of spraying only the inside upper parts of the poultry houses. Fly bait (naled-sugar mixture) was placed in a pan at both ends of each house at farms 1, 2, and 3 and was replaced weekly. No fly control was done at farm no. 4.

All poultry houses on each farm were given the same treatment. Insecticides were applied by a gasoline-powered sprayer equipped with a Hypro® pump (Hypro, Inc., St. Paul, Minn.) operating at 40 psi. A single spray nozzle (Spraying System Co., Bellwood, Ill.) was used (no. 6520 for larviciding and no. 8004 for adulticiding.) Larviciding was accomplished by treating the manure under the caged hens at the rate of 400 ml of spray/m^2 (1 gal/100 ft^2) so that each house required about 75 liters (20 gal) of spray. Selective adulticiding was accomplished by overhead spraying to the point of runoff, and each house required about 30 liters (8 gal) of spray. The manure was removed from a few sections each week in May to preserve some of the manure fauna. Spraying was begun June 3 after completion of manure removal from all houses. Spraying was repeated as often as necessary to attempt to keep the fly indices below 50.

Indices of the fly population were obtained weekly by 2 methods (flies per ribbon and spots per card) beginning May 5. Eight sticky fly ribbons were hung from the roof supports at equal intervals along the midline of the house. The number and species of flies were counted on the ribbons at weekly intervals and new ribbons were installed. An index of fly activity was obtained by counting fecal and regurgitation spots on 4 white paper file cards (7.5×12.5 cm) fastened to the overhead rafters in the 7 m section of the cage area nearest the entranceway of each house. The cards were placed at what appeared to be sites of maximum fly resting as judged from spottings on the wood. The cards were replaced each week at the same time as the ribbons' replacement. Ribbons were installed in 2 houses at each farm and the cards in all houses. These were modifications of the sampling procedure described previously (Axtell 1970).

The manure fauna in 2 houses at each farm was sampled at biweekly intervals. A composite 4-liter sample of manure was obtained by taking aliquots of manure at 10 approximately equal intervals along each side of each of the 2 sample houses. The fauna from the manure from each side was extracted into 70% alcohol by Tulgren funnel. The mites and fly larvae were identified and counted. Other arthropods were rare in the samples.

RESULTS.—Since few flies other than *M. domestica* and *F. canicularis* were found on the ribbons, counts of these species only were used. The number of flies caught on the ribbons and the fly activity index for each farm are graphed by weekly intervals in Figs. 1–4. Subjectively, either count above 100 represents unsatisfactory fly control. Counts between 50 and 100 represent acceptable control, and counts below 50 represent excellent control.

Larviciding at biweekly intervals with either RaVap or Zytron gave unsatisfactory fly control. At farm 1 (Fig. 1), *F. canicularis* constituted most of the problem, while the house fly was the predominant pest left uncontrolled at farm no. 2 (Fig. 2). However, the house fly was more abundant in May and June at farm no. 1 than is apparent from the graph because of the tendency of large populations of *Fannia* to fill the ribbons quickly and cause a lower capture of house flies.

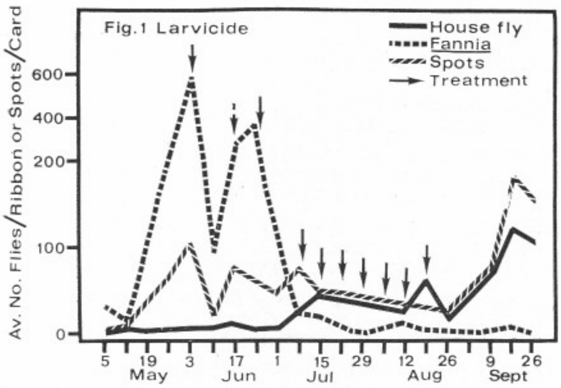
Larviciding at 1-week intervals, beginning July 8, resulted in satisfactory fly control with both RaVap and Zytron. The last larviciding was on Aug. 19. After Aug. 26, the fly population increased and reached a nuisance level during mid- to late September, when the experiment was terminated because of the advent of cold weather. Each farm received 10 larvicidal treatments during the season. If a weekly schedule had been followed during the entire season of fly activity, 16–18 treatments would have been required.

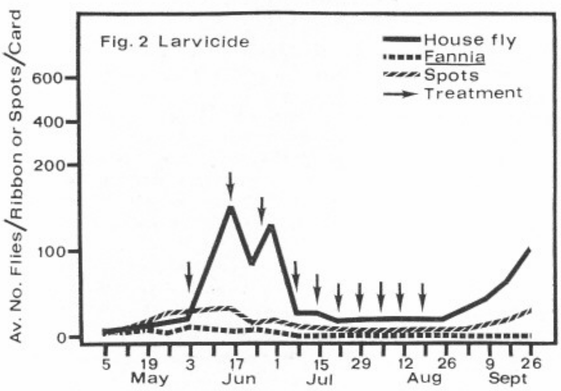
Adulticiding with RaVap at farm no. 3 (Fig. 3) gave satisfactory fly control with 4 treatments spaced 2–5 weeks apart. After the last spraying on Aug. 19, the fly population reached a nuisance level in mid- to late September, and a 5th treatment would have been justified.

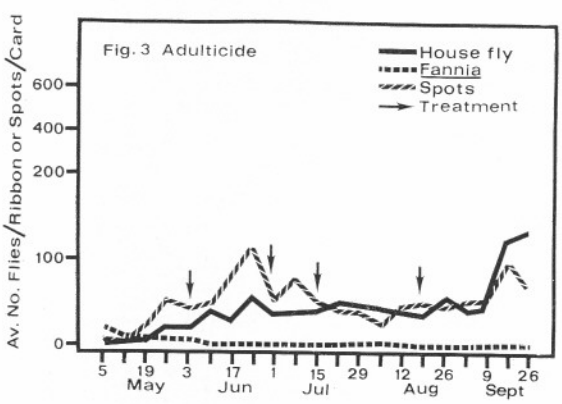
The fly population at the untreated farm (Fig. 4) followed the typical pattern encountered in these farms in past years (Axtell 1970). *F. canicularis* predominated in spring and early summer and declined rapidly as warmer weather prevailed in July. As the number of *Fannia* declined, the house fly increased in abundance and was the dominant species during July–September. For most of the 20 weeks of the season, one or more of the fly nuisance indices was above 100 indicating a substantial pest problem. A similar fly problem would presumably have existed at the other farms in the absence of a control program.

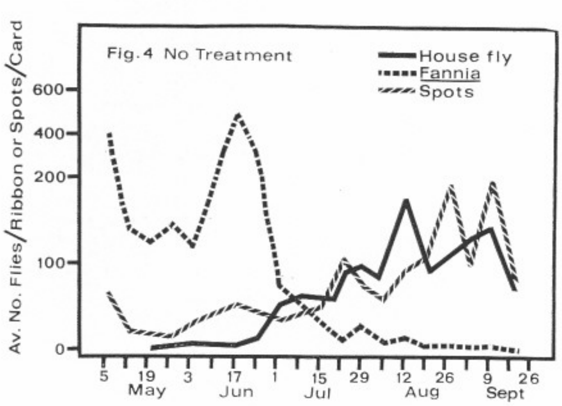
The most common mite predators of the immature stages of the house fly found in the manure were *Macrocheles muscaedomesticae* (Scopoli) (Macrochelidae) and *Fuscuropoda vegetans* (De Geer) (Uropodidae). As shown in Fig. 5, these were abundant at the untreated farm and the farm at which selective adulticiding was practiced. The mites were nearly totally absent from the 2 farms at which larviciding was practiced. Other arthropods were rare in the manure at the larvicided farms, although house fly and *F. canicularis* larvae could be found in occasional discrete pockets. Larvae of *Hemetia illucens* (L.) were rarely found at the larvicided farms but were present in moderate numbers in the manure of the adulticided farm. After the larviciding programs were stopped, the number of house fly larvae and *H. illucens* larvae increased rapidly, but there was very little increase in the number of mites.

The average time used for larviciding was 20 min/house and for adulticiding was 25 min/house. The amount of RaVap EC required for larviciding was 3.0 liters (0.79 gal)/house and for adulticiding was 1.7 liters (0.45 gal)/house. Two men were used in both









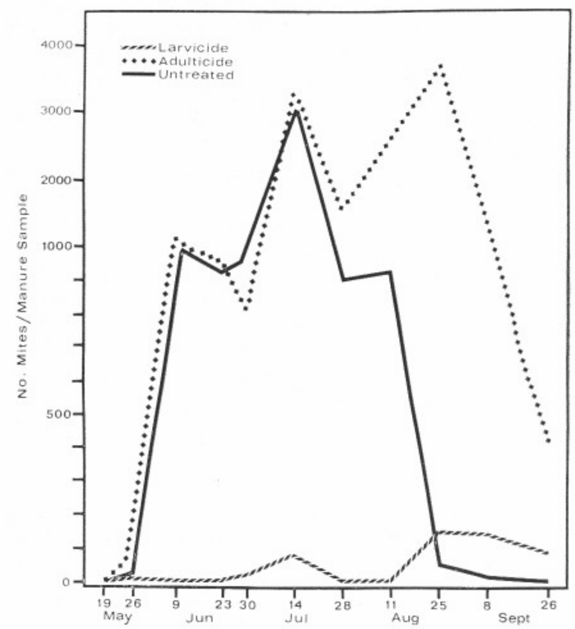


FIG. 5.—Effect of larviciding and selective adulticiding on abundance of manure-inhabiting predaceous mites, *M. muscaedomesticae* and *F. vegetans,* in caged-poultry houses.

procedures; one to spray and the other to manipulate the hose and pump. The times include the amount spent mixing the chemicals in the sprayer. The cost of using fly bait was not determined, but was a common factor, since bait was used with both the larviciding and selective adulticiding programs.

DISCUSSION AND CONCLUSIONS.—Weekly larviciding with 1% RaVap or 1% Zytron gave satisfactory fly control in caged-poultry houses. Unsatisfactory control should be expected with a longer period between treatments. With weekly treatments, 16–18 applications/season would be required for satisfactory fly control under the conditions in North Carolina. Larviciding usually kills nearly all of the fauna in the manure (Anderson 1965, Axtell 1968). Thus, the beneficial effects of predation on fly eggs and larvae by manure-inhabiting mites, especially *M. muscaedomesticae* and *F. vegetans,* is lost. With no biological control agents present, cessation of larviciding is followed by a rapid resurgence of the fly population. Once larviciding is begun it is necessary to continue treatments at frequent intervals for the remainder of the fly season.

Fly control at the farm treated with adulticides was satisfactory. This fact is in agreement with the results of previous field tests in North Carolina of the integrated control program (Axtell 1970). Selective

FIG. 1.—Effect of larviciding with 1% RaVap on abundance of flies in caged-poultry houses.

FIG. 2.—Effect of larviciding with 1% Zytron on abundance of flies in caged-poultry houses.

FIG. 3.—Effect of selective adulticiding with 1% RaVap on abundance of flies in caged-poultry houses.

FIG. 4.—Abundance of flies in untreated caged-poultry houses.

adulticiding gives satisfactory fly control with 5 or 6 properly spaced treatments per season in North Carolina. These treatments have no detectable detrimental effect on the beneficial manure-inhabiting predaceous mites, so those biological control agents continue to increase and to assist in suppressing the fly population.

A larviciding program is more expensive than an integrated control program. Larviciding required 1.7 times as much insecticide/application as did the integrated control program. For adequate fly control throughout the fly season, it is estimated that larviciding would require about 5 times as much insecticide and 2.5 times as many man-hours as would be needed for the integrated control program. It is possible that certain circumstances would justify the use of larviciding for fly control. In most cases, however, an integrated control program will give satisfactory fly control with less effort and expense.

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Reprinted from the
JOURNAL OF ECONOMIC ENTOMOLOGY
Volume 63, Number 6, pp. 1734–1737, December 1970