Integrated Fly[1]-Control Program for Caged-Poultry Houses[2]

RICHARD C. AXTELL

Department of Entomology, North Carolina State University, Raleigh 27607

ABSTRACT

In 1967 and 1968, populations of house flies, *Musca domestica* L.; little house flies, *Fannia canicularis* (L.); black garbage flies, *Ophyra leucostoma* (Wiedemann), and predaceous manure-inhabiting mites (Parasitidae, Macrochelidae, and Uropodidae) at 3 poultry (caged laying hens) farms having a fly-control program were compared with 3 similar farms with no fly-control measures. Excellent fly control was demonstrated with a program based on early-season manure removal and adult fly control by insecticide-bait stations and 5 or 6 selective applications of insecticide to the inside upper parts of the poultry houses and the interior and exterior surfaces of the attached feed- and egg-storage buildings. Little house flies were controlled more easily than house flies. In the presence of a high population of black garbage flies at 1 farm in 1967, house flies and little house flies were rare.

Populations of mites were variable, and no deterimental effects of the insecticide treatments were detected. The order of abundance was Uropodidae > Macrochelidae > Parasitidae. Parasitids appeared earliest in the season followed by macrochelids and uropodids, in that order. Toward the end of the fly season, parasitids disappeared first followed later by macrochelid and then uropodid population declines.

A fly-activity index based on fecal spotting of white paper cards provided useful comparisons of farms, and development of that simple sampling tool is recommended.

Flies commonly develop in large numbers in poultry manure under caged hens, and their control is a serious problem. Excessive fly populations are obnoxious to the farm workers, and when there are nearby human habitations a public health problem is created. The most common flies are the house fly, *Musca domestica* L., and the little house fly, *Fannia canicularis* (L.). Other more erratically occurring fly species are: the black garbage fly, *Ophyra leucostoma* (Wiedemann); the black blow fly, *Phormia regina* (Meigen); the stable fly, *Stomoxys calcitrans* (L.); and green blow flies, *Phaenicia* spp.

Fly control in open-sided caged-poultry houses is often attempted after the fly population has increased to a nuisance level. Insecticide-bait mixtures, larviciding of the manure, and residual spray applications are used with only moderate success in this situation. Larviciding of the manure with nonselective insecticides is detrimental to the mite predators of the immature stages of the house fly, and selective application methods against the adult fly are preferable (Axtell 1968).

This report gives the results of a program for fly control in caged-poultry houses. This program was based on the following strategy: (1) selective applications of insecticides would be used against the adult flies, but no larviciding would be practiced, (2) insecticide control measures would be started early in the spring before flies appeared and repeated as frequently as needed throughout the warm months, and (3) the manure would be left undisturbed throughout the warm months when fly breeding may occur. Whenever possible, the manure would be removed once very early in the spring before any flies appeared.

MATERIALS AND METHODS.—The fly-control program was conducted during April–September 1967, and March–September 1968, at poultry farms in the vicinity of Pittsboro and Apex, Chatham and Wake Counties, N. C. The same farms were used both years. There were 3 farms with a fly-control program and 3 with no control measures of any kind. A 7th farm was used in 1968 to evaluate the effectiveness of control measures applied late in the season. The poultry houses were all of essentially the same design, although some had flat roofs while others had gable roofs. Each house (3m wide × 100–110m long) had open sides and 1 row 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 (Collins)–2; farm no. 2 (Malcolm)–3; farm no. 3 (Hilliard)–4; farm no. (Andrews)–4; farm no. 5 (Boone)–6; farm no. 6 (Lindley)–4; farm no. 7 (Cooper)–2.

All the poultry houses were treated at those farms included in the control program. Residual spray applications were made to the underside of the roof, supporting beams and cross supports, and side panels above the cages. The outside walls of the attached egg-sorting and feed-storage rooms were sprayed. A coarse spray was applied to minimize drift as much as possible. Applications were by hydraulic sprayer at 50 psi and a single 8004 nozzle tip at the rate of 25–30 liter of spray/house. The insecticides and formulations used were: ronnel, 2 lb/gal EC; naled, 1% oil solution; Gardona® (2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate), 75% WP and 2 lb/gal EC; dichlorvos 2 lb/gal EC. Inside the front entrance of each house, 2 dimetilan-impregnated strips (Snip®) were hung in a horizontal position.

[1] Diptera: Muscidae.

[2] This investigation was supported in part by U. S. Public Health Service Research Grant no. UI 000515 from the National Center for Urban and Industrial Health. Paper no. 2901 of the Journal Series of the North Carolina Agricultural Experiment Station. Received for publication June 19, 1969.

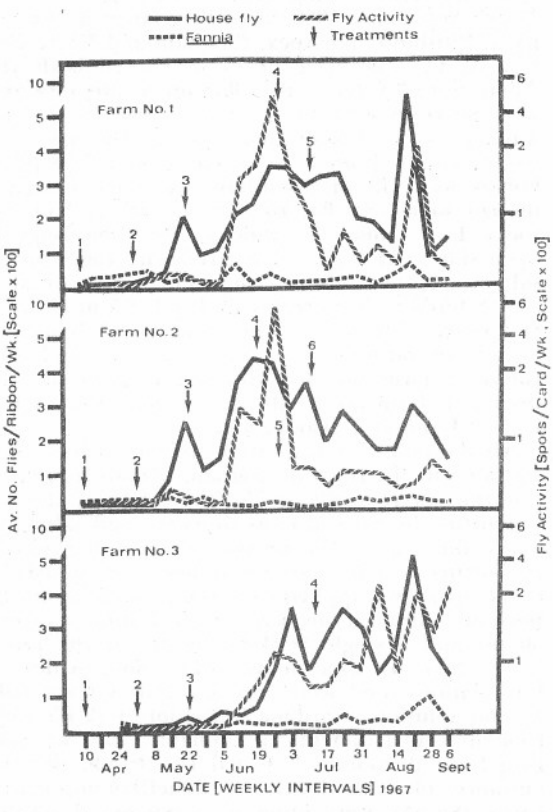
These were replaced once a month. At each end of a house a dish of insecticide-sugar bait mixture was placed on the floor. This was replaced each week. A commercially prepared 5% trichlorfon bait was used in 1967. In 1968 a 5% naled bait was freshly mixed each week.

The insecticide-spraying schedules for 1967 were: farm no. 1—1% ronnel, Apr. 10 and May 2, 2% ronnel + 1% Gardona around the entrance, May 24, 1% naled in oil June 29, and 2% Gardona July 12; farm no. 2—1% ronnel Apr. 10 and May 2, 2% ronnel May 24, 1% Gardona June 19, 2% Gardona June 30 and July 12; farm no. 3—1% ronnel Apr. 10 and May 2, 2% ronnel + 1% Gardona around entrance May 24, and 2% ronnel July 12. The 1% ronnel applications contained sugar (24 g/liter of spray). Gardona sprays were prepared from the wettable powder.

The insecticide-spraying schedules for 1968 were: farm no. 1—1% Gardona Apr. 2, 1% Gardona + 2% Gardona on exterior of egg and feed rooms May 28, 2% Gardona July 1, 2% Gardona Aug. 5 and 2% Gardona + 0.5% dichlorvos Aug. 26; farm no. 2—1% Gardona (WP) Apr. 12, 1% Gardona + 2% Gardona on exterior of egg and feed rooms May 28, 2% Gardona July 1 and Aug. 5; farm no. 3—2% ronnel Apr. 11 and May 28, 2% Gardona July 1, Aug. 5 and 26. The late-season treatments in farm no. 7 consisted of 3 applications of 1% ronnel by the operator to the inside overhead parts of the structure ca. June 1, 10, and 22, and 2 applications (July 8 and Aug. 5) of 1.5% Gardona + 0.5% dichlorvos by the author. All Gardona applications except the 1 indicated (WP) were prepared from the emulsifiable concentrate.

The time of manure removal varied from farm to farm in 1967. All the manure was removed from farms no. 1 and no. 2 during the 1st week of April. Farm no. 3 was cleaned a part at a time during the period May 21–June 15. Farm no. 4 had one house cleaned the 1st week of May and the remainder left uncleaned since the previous fall. Farm no. 5 was not cleaned since the beginning of operations the previous September. Farm no. 6 was cleaned and restocked with birds the 1st week of May after being idle for a month. In 1968 the manure was removed from all of the farms in the spring as follows: farm no. 1, 2nd week of April; farm no. 2, 1st week of March; farm no. 3, 1st week of April and again the 1st week of May; farm no. 4, 1st week of May; farm no. 5, 1st week of March; farm no. 6, 2nd week of April; farm no. 7 had not been cleaned since the previous August.

The fly populations were estimated by 2 methods. Eight sticky fly ribbons were hung from the overhead 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 the fly activity was obtained by counting fecal spots on white 7.5× 12.5-cm paper file cards fastened to the overhead rafters in the 7-m section of cage area nearest the entrance way. These cards were at what appeared to be sites of maximum fly resting, judged from the



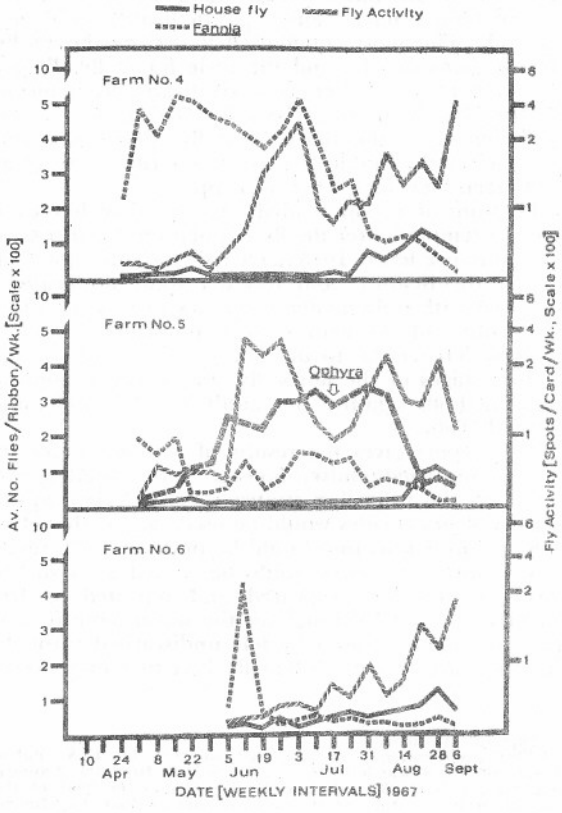


FIG. 1.—Fly populations in 1967 at 3 poultry farms with a fly-control program which included insecticide-bait stations and selective spraying (dates indicated by arrows) of insecticides on the buildings.

FIG. 2.—Fly populations in 1967 at 3 poultry farms with no fly-control program.

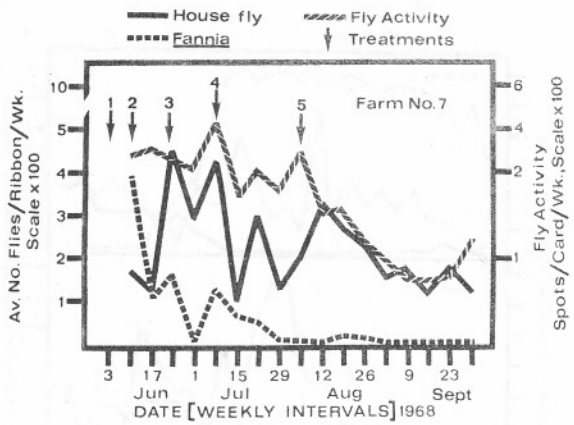


FIG. 5.—Fly populations in 1968 at a poultry farm with late-season selective spraying (dates indicated by arrows) of insecticides on the buildings.

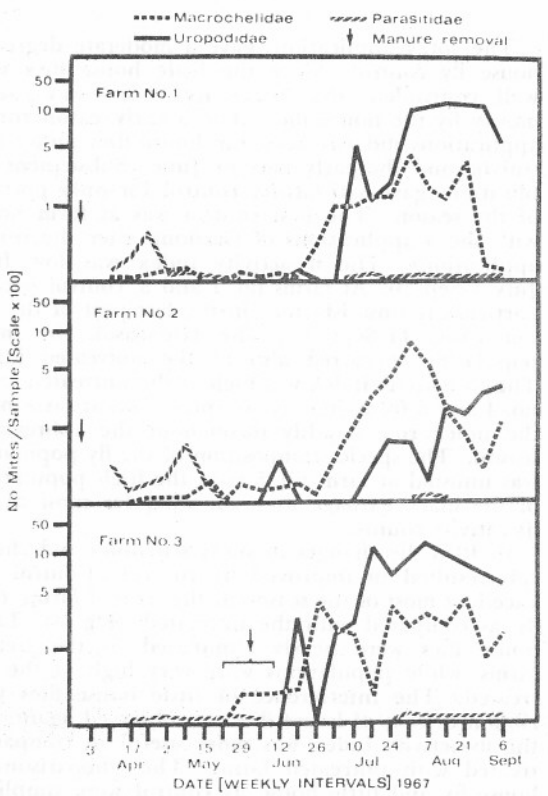
The first early-season spray held the fly population to near 0 until a very slight rise about May 20. The 2nd and 3rd applications gave excellent fly control until ca. July 29. Subsequent 1 or 2 applications were sufficient for excellent fly control for the remainder of the season. The brief period of ribbon counts greater than 200 at farm no. 1 was not serious. At the untreated farms the fly activity index was much higher throughout the season, although it tended to be erratic from week to week.

The late-spray applications at farm no. 7 did not give satisfactory overall fly control (Fig. 5). Little house flies were controlled fairly well by the ronnel applications, but house fly populations (and the fly activity index) continued at a high level. The 2 applications of the Gardona-dichlorvos mixture resulted in a gradual decline in the fly problem, reaching a satisfactory level of control about Sept. 1.

The fly larval counts were too erratic to add further information to that already obtained by the ribbon counts and fly-activity index.

Mite Populations.—The predaceous mite populations in the droppings under the caged hens varied among farms and between years. This variance appeared to be partially related to time of manure removal but not related to the presence or absence of the selective applications of insecticides.

In 1967, the parasitid mites appeared earliest at the treated farms (Fig. 6) and the untreated farm no. 4 (Fig. 7) from which the manure was left undisturbed since the previous October. They appeared only in low numbers late in the season at untreated farm no. 6 which was cleaned and restocked with birds rather late (early May). The macrochelid populations were similar at all these farms. These mites were most abundant during the period of about July 1–Aug. 21. The uropodids had essentially the same abundance curves at the treated farms (no. 1, 2, 3) and the untreated farms no. 4 and 6. These mites were seldom collected in April, May, and early June. After about the middle of June the numbers increased rapidly and remained at high levels for the balance of the season.



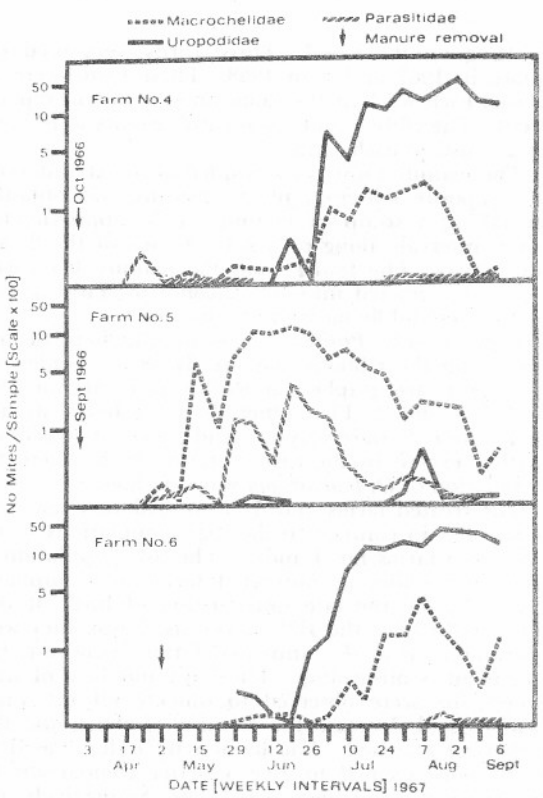


FIG. 6.—Mite populations in the poultry manure in 1967 at 3 farms with a fly-control program.
FIG. 7.—Mite populations in the poultry manure in 1967 at 3 farms with no fly-control program.

Farm no. 5 was substantially different from the other farms. Manure had not been disturbed since early September 1966, when the poultry were first introduced. The parasitid population was higher than at the other farms, and substantial numbers of parasitids were present throughout most of the season. Similarly, the macrochelid population was very high, reaching large numbers much earlier than at other farms. This high population existed for most of the season in contrast to its July–September peak for other farms. The uropodids were surprisingly low in numbers.

In 1968, the manure was removed in early spring from all the farms (Fig. 8 and 9). The parasitid and macrochelid populations were generally low at all of the farms. The parasitids were collected early in the season. The macrochelids occurred first in late May and in erratic numbers for the remainder of the season. The uropodid population resembled the pattern for 1967 in being high in the last half of the season (after about July 1). There were no consistent differences in mite populations between the treated and untreated farms.

DISCUSSION AND CONCLUSIONS.—The excellent fly control obtained with the 1968 program in comparison with the 1967 attempt probably resulted from the earlier manure removal and insecticide spraying, improved spacing of the sprays during the season, and use of the effective residual insecticide Gardona for most treatments. From the results of both years, it is apparent that control of the little house fly is easily accomplished, much more so than control of the house fly. Since the little house fly frequently constitutes a major part of the fly problem in caged poultry houses, particularly in the spring and early summer, an early-season selective application of insecticide should be routine. Satisfactory control of house flies as well should be expected when 4 or 5 additional applications are made at proper intervals throughout the fly season and insecticide-bait mixtures are provided.

There was no evidence that the selectively applied insecticides had any effect on the predaceous mite fauna in the droppings under the caged hens. Any effects that may have existed would have been undetectable in the presence of the great variation among farms and between years. That variation illustrates the difficulty in generalizing about the importance of predaceous mites in the natural control of fly populations in poultry houses. In most cases, ways to increase the populations of these mites are needed. One method for accomplishing an increase is more judicious removal of the manure, as suggested by the investigations of Anderson (1965), Axtell (1968), and Legner and Brydon (1966). Periodic removal of parts of the manure during periods of reduced fly activity has been suggested as a way to prevent the depletion of the predator population that occurs with total manure removal. However, practicality may prevent adoption of this procedure. Often the poultry farmer has many other activities and cannot, or will not, give priority to systematic manure removal. Sometimes extremely frequent manure removal is practiced during the warm months in the hope of solving the fly problem. This practice should be abandoned, for manure removal during this period of high fly activity results in fresh deposits of droppings which are very favorable for fly production. This is due to the physical consistency, high moisture level, and the absence of predators. The best alternative to a systematic partial manure removal program is a single cleaning per year done in the cooler period, at least

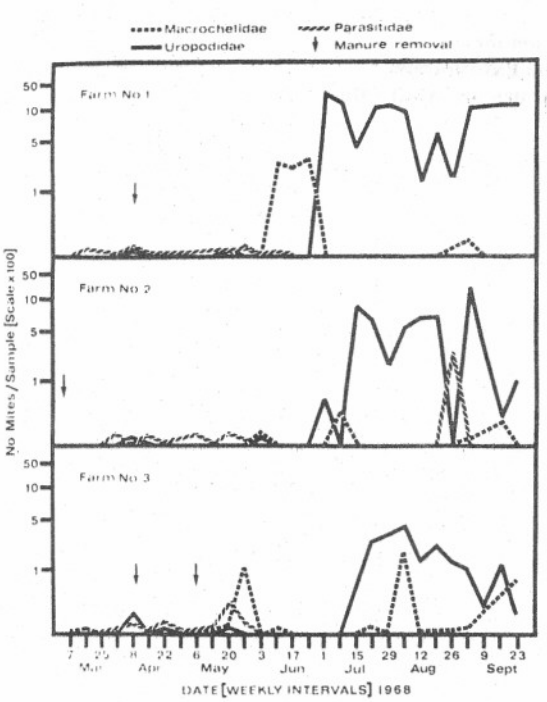


FIG. 8.—Mite populations in the poultry manure in 1968 at 3 farms with a fly-control program.

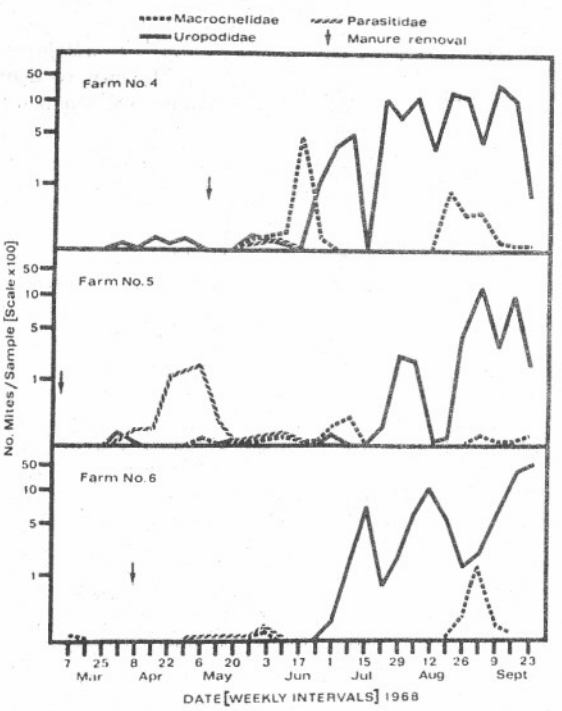


FIG. 9.—Mite populations in the poultry manure in 1968 at 3 farms with no fly control program.

1 month prior to the earliest probable date of fly activity in the poultry houses. The single clean-out should be (and usually in practice will be) not altogether thorough, so that some scattered manure is left that will hopefully preserve a part of the predator population.

Generalizations may be made in regard to the mite fauna in spite of the variations. The order of abundance was Uropodidae > Macrochelidae > Parasitidae. The order of appearance during the season was Parasitidae–Macrochelidae–Uropodidae. The order of decline and "disappearance" late in the season was Parasitidae–Macrochelidae–Uropodidae. Although the parasitids appeared earliest, they never reached great abundance. With early spring or *late* fall manure removal, the peak mite population was reached soon after mid-June. With manure accumulation since *early* in the fall, the peak mite population was reached earlier the following year (about mid-May) and a longer period of high mite populations occurred than when *late* fall or *early* spring manure removal was practiced.

The high populations of *O. leucostoma* in farm no. 5 in 1967 deserve comment. The larva of these flies are predaceous on other fly larvae and as such are natural control agents. They apparently controlled the house fly and little house fly at that farm, for we seldom found those fly larvae in the manure samples and rarely found an adult on the ribbons, resting on the structure, or on the manure. At the same farm in 1968 there were very few black garbage flies, and many house flies and little house flies. The removal of manure in early spring in 1968 created a more favorable house fly and little house fly breeding condition than the deep undisturbed manure accumulation in 1967. The effect of this difference in manure accumulation on black garbage fly populations is not known. However, it is not practical to consider *O. leucostoma* a useful biological control agent, since they are a severe nuisance when they occur in large numbers.

Possibly the 1968 fly control results were affected by the previous year's fly control program at the same farms. Although the fly control was less than desired in 1967 it was sufficient to give considerable reductions in populations. The resulting reduced population pressure could have lessened the degree of fly buildup the following spring. Data are needed on overwintering populations. Also, there may have been some residual insecticide activity continuing through the cool months, but the amount was probably negligible. Perhaps a fly control program, as presented in this report, will show increased efficiency in successive years (provided insecticide resistance doesn't develop too rapidly).

The usefulness of the fly activity index, obtained with "spot cards," suggests this as a convenient fly-control evaluation tool. Investigations are in progress to determine the correlation between the activity index and ribbon counts, the number of cards required for a given confidence level, and the relative contributions of the 3 fly species to the activity index.

REFERENCES CITED

Anderson, J. R. 1965. A preliminary study of integrated fly control on northern California poultry ranches. Proc. Calif. Mosquito Contr. Ass. 33: 42–44.

Axtell, R. C. 1968. Integrated house fly control: Populations of fly larvae and predaceous mites, *Macrocheles muscaedomesticae*, in poultry manure after larvicide treatment. J. Econ. Entomol. 61 (6): 245–9.

Legner, E. F., and H. W. Brydon. 1966. Suppression of dung-inhabiting fly populations by pupal parasites. Ann. Entomol. Soc. Amer. 59 (4): 638–51.

Reprinted from the
JOURNAL OF ECONOMIC ENTOMOLOGY
Volume 63, Number 2, pp. 400–405, April 1970