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EVALUATION OF SYNERID™ AND SYNERID-100 AS A TOPICAL SPRAY FOR CONTROLLING HOUSE FLIES IN POULTRY MANURE

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Commercial egg production necessitates confining chickens in cages at high densities which often results in high house fly, Musca domestica Linnaeus, populations developing in the manure. If development is allowed to proceed unchecked, egg producers often are confronted with complaints from neighboring residences where the flies create a public nuisance.

Organophosphate larvicides have been utilized in house fly control programs on caged-layer facilities for many years. Larvicides are generally not recommended, however, due to accelerated development of insecticide resistance and their devastating effects on beneficial arthropods in the manure community. Larvicides do have an advantage over adulticides, in that they kill flies early in their life cycle, before they become a nuisance.

A new class of house fly larvicide is the halogenated xanthene dye group, particularly Synerid™ and Synerid-100 (Hilton-Davis Chemical Co., Cincinnati, Ohio). The active ingredient in Synerid is erythrosin B, which is currently registered in several states in the U.S. for use as a house fly larvicide. Synerid-100 contains sodium fluorescein in addition to erythrosin B and is still an experimental compound. Synerid-100 is currently being developed as a house fly larvicide due to the purported synergistic activity of the erythrosin B and sodium fluorescein mixture. The following paper describes the results of field tests with Synerid and Synerid-100, applied as a surface spray on manure in caged-layer chicken houses to control house fly larval development.

Material and Methods

All work was conducted on a commercial caged-layer ranch near Ramona, California. The entire ranch contained 20 contiguous houses, with each house containing 8,000 - 9,000 laying hens. The lay-houses were typical California-style houses, with a gable roof and ventilated sides to allow for good air movement. The cages were single deck, 18" deep x 24" wide with nine birds per cage. Each house was 30' x 336'; cage rows were 304'. Each house contained four rows of back-to-back cages providing a manure surface area of 912 ft^2 per row or 3,648 ft^2 per house. All experimental work was conducted in three adjacent houses, which contained 40-week-old (at the start of the test) Shaver strain, White Leghorn pullets.

Prior to the study, the entire ranch was on a weekly manure cleanout schedule. The procedure seemed to provide adequate adult fly control, as few were observed on the initial visit; the house fly larval population in the less-than-week-old manure was substantial, however. For the purposes of our study, the ranch owner agreed to allow the manure to accumulate after a scheduled cleanout on 9/30/84. Two houses were selected to receive whole-house treatments with either Synerid (3.67 oz/2000 ft^2) or Synerid-100 (6.00 oz/2000 ft^2) and the third was utilized for small plot evaluation of various rates of each product.

Small Plots--Each treatment was replicated eight times except for the controls which were replicated 16 times. The small plot house was divided into eight blocks (two per row). Within each block, treatments were randomly allocated to eight 16' plots (randomized complete block design). Treatments were applied weekly for a total of seven treatments beginning on October 5.

Treatments in each block consisted of three levels of Synerid (3.67, 5.50, 7.34 oz/2000 ft^2) and Synerid-100 (3.00, 4.50, 6.00 oz/2000 ft^2), plus two control plots. Each treatment was applied in water at the rate of one gal/200 ft^2 of manure surface. Each treated plot was sprayed with a three-gallon CO_2-propelled B&G sprayer at approximately 40 psi.

Sampling methods for whole-house treatment were identical to those for small plots. All manure samples were taken from the approximate center of ten, 16' plots located in identical positions within each house. Ten of the 16 control plots in the small plot house were utilized for comparison of whole-house treatments.

All data were entered into a computer and analyzed with analysis of variance (ANOVA). An F-test was utilized to determine the overall significance of treatments in influencing fly development. Duncan's Multiple Range Test was utilized to compare differences between treatment averages.

Results and Discussion

Small Plots--Table 1 shows the results of each treatment on house fly larval development. Each value represents the average of 16 samples (8 randomized complete blocks, 2 subsamples per plot). The average values of total larvae from each treatment were lower than the control average. However none of the treatments was shown to significantly reduce larval counts, as determined by an overall F-test ($P>0.05$).

Table 1. Average number of house fly larvae recovered from 3.4 oz samples of poultry manure, as influenced by weekly treatments with Synerid or Synerid 100[1].

Date		Control	Synerid (oz/2000 ft^2)			Synerid-100 (oz/2000 ft^2)		
			3.67 oz	5.50 oz	7.34 oz	3.0 oz	4.5 oz	6.0 oz
Oct 12	#[2]	55.5	52.9	35.8	31.3	32.9	28.6	46.0
	% tint[3]	0.0	17.2	38.9	27.5	1.5	6.4	6.4
Oct 19	#	43.4	19.1	48.3	51.8	28.7	27.9	54.6
	% tint	0.0	58.8	65.0	69.7	66.7	50.6	59.9
Oct 26	#	29.0	35.3	33.3	15.8	14.6	26.6	18.2
	% tint	0.0	39.1	52.4	28.4	38.9	60.9	40.9
Nov 2	#	27.8	37.0	17.6	20.0	12.4	27.1	19.2
	% tint	0.0	53.9	47.3	35.5	33.3	38.9	46.9
Nov 9	#	48.4	10.3	28.2	33.9	20.1	20.0	26.6
	% tint	0.0	41.1	47.7	55.4	39.9	34.2	44.3
Nov 16	#	24.0	29.8	18.6	8.6	17.8	25.9	9.2
	% tint	0.0	25.8	26.4	12.7	27.3	27.3	10.8
Nov 23	#	28.4	15.5	7.6	26.8	24.3	15.4	10.5
	% tint	0.0	26.4	19.0	36.3	39.2	20.4	27.9
Average	#	36.6A[4]	28.5AB	27.1AB	26.8AB	21.5B	24.5B	26.3AB
	% tint	0.0b[4]	37.5a	42.4a	37.9a	35.2a	34.1a	33.8a

[1] Each number represents an average number of larvae recovered from samples taken from 8 treated plots, 2 subsamples per plot.

[2] Refers to average number of total larvae per 3.4 oz sample.

[3] Average percent of total larvae showing signs of treatment (tint).

[4] Averages in each row with the same letter are not significantly different ($P>0.05$).

All of the treatments were effective in contacting a variable portion of the larvae, as demonstrated by the percent tint values in Table 1. The percent tinted larvae found in each treatment were all significantly larger than the control (0.0%), as shown by an F-test and Duncan's. However, the effect did not appear to be related to increasing concentrations of Synerid or Synerid-100, since average values for each treatment were statistically identical.

The same general trend observed for the effect of each treatment on house fly larvae (Table 1) was seen in adult emergence of house flies (Table 2). The overall F-test for treatments was barely insignificant (P=0.054), indicating that the reductions might be related to treatments. Duncan's Mean Separation showed Synerid (7.34 oz/2000 ft^2) and Synerid-100 (3.00 oz/2000 ft^2) influenced significantly lower adult house fly emergence, as compared to controls. The reductions amounted to approximately 37% and 39%, respectively.

Table 2. Average number of adult <u>Musca domestica</u> and <u>Fannia femoralis</u> emerged from 3.4 oz poultry manure samples, as influenced by weekly treatment of either Synerid or Synerid 100[1].

		Synerid (oz/2000 ft^2)			Synerid-100 (oz/2000 ft^2)		
Date	Control	3.67 oz	5.50 oz	7.34 oz	3.0 oz	4.5 oz	6.0 oz
Oct 12 Md[2]	30.9	34.8	26.0	27.8	22.0	31.1	22.3
Ff[3]	4.9	5.9	2.4	5.2	4.3	3.7	1.3
Oct 19 Md	23.8	29.6	44.9	22.2	34.9	25.9	46.7
Ff	7.3	7.1	4.4	4.4	5.9	3.8	6.9
Oct 26 Md	37.9	15.3	22.9	14.9	13.9	22.7	27.5
Ff	5.4	2.3	5.1	3.5	5.2	4.6	2.9
Nov 2 Md	44.6	36.2	20.1	8.4	16.7	30.4	18.8
Ff	1.6	1.6	2.1	2.8	2.5	2.4	0.8
Nov 9 Md	22.5	32.4	35.5	27.0	13.6	15.4	10.9
Ff	3.0	3.1	1.0	1.9	2.6	2.3	2.1
Nov 16 Md	1.1	0.8	0.8	2.2	1.0	3.6	1.1
Ff	0.3	1.2	0.3	1.4	0.9	3.7	0.5
Nov 23 Md	31.5	18.0	11.5	18.9	14.0	6.9	12.9
Ff	4.1	2.8	1.5	2.9	3.3	1.6	0.6
Average Md	27.4A[4]	23.9AB	23.1AB	17.3B	16.6B	19.4AB	20.0AB
Ff	3.8a[4]	3.4ab	2.4ab	3.2ab	3.5ab	3.2ab	2.2b

[1] Each number represents an average number of larvae recovered from samples taken from 8 treated plots, 2 subsamples per plot.

[2] Refers to the average number of <u>Musca domestica</u> adults emerged from 3.4 oz.

[3] Refers to the average number of <u>Fannia femoralis</u> adults emerged from 3.4 oz.

[4] Averages in each row with the same letter are not significantly different (P>0.05).

A small number of Fannia femoralis adults emerged from the samples, in addition to house flies. ANOVA (F-test) determined that the treatments had no overall impact on F. femoralis.

Whole-House Treatments--Whole-house treatments with Synerid and Synerid-100 both influenced significant reductions of house fly larvae, as compared to control samples ($P<0.05$), (Table 3). Both whole-house treatments (Synerid, 3.67 oz/2000 ft^2 and Synerid-100, 6.00 oz/2000 ft^2) were equally effective in reducing house fly larval counts, as shown by Duncan's Multiple Range Test. Synerid and Synerid-100 reduced larval counts by approximately 55% and 60%, respectively. Tinted larvae were encountered in almost identical proportions for each treatment.

Table 3. Average number of house fly larvae recovered from 3.4 oz samples of poultry manure, as influenced by weekly treatments with Synerid or Synerid 100[1].

	Control		Synerid (3.67 oz/2000 ft^2)		Synerid-100 (6 oz/2000 ft^2)	
Date	#[2]	% tint[3]	#	% tint	#	% tint
Oct 12	47.7	0.0	38.1	42.5	7.1	12.8
Oct 19	39.9	0.0	19.9	57.9	26.8	44.2
Oct 26	23.5	0.0	6.7	9.4	4.8	28.1
Nov 2	22.2	0.0	7.6	25.7	11.6	25.6
Nov 9	42.5	0.0	18.3	40.6	22.5	45.9
Nov 16	29.6	0.0	1.6	5.4	9.8	14.2
Average	34.2A[4]	0.0a[4]	15.4B	30.3b	13.8B	28.5b

[1] Each number represents an average number of larvae recovered from manure samples taken from 10 plots, 2 subsamples per plot.

[2] Refers to average number of total larvae per sample.

[3] Average percent of total larvae showing signs of treatment (tint).

[4] Corresponding averages with the same letter are not significantly different ($P>0.05$).

Adult emergence from manure samples was significantly reduced by treatments ($P<0.05$), (Table 4). Synerid-100 (6.00 oz/2000 ft^2) was the only treatment which influenced a reduction significantly less than the control, corresponding somewhat with the results obtained for the larval samples (Table 3). The overall reduction of adult fly emergence was about 20% and 40% for Synerid and Synerid-100, respectively.

A small number of *Fannia femoralis* adults emerged from whole-house samples, as they did from the small plot samples. Average values of *F. femoralis* that emerged from each treatment appear to be significantly lower than controls (Table 4), but again, the overall F-test of treatments was not significant ($P<0.05$). Synerid and Synerid-100 may very well have had a significant impact on *F. femoralis*, but actual fly numbers were probably too low to make a valid assumption.

Table 4. Emergence of *Musca domestica* and *Fannia femoralis* from poultry manure samples as influenced by weekly whole-house treatments with either Synerid or Synerid 100[1].

	Control		Synerid (3.67 oz/2000 ft^2)		Synerid-100 (6 oz/2000 ft^2)	
Date	Md[2]	Ff[3]	Md	Ff	Md	Ff
Oct 12	30.8	4.1	9.6	0.4	12.8	1.0
Oct 19	23.3	6.5	37.1	0.6	31.7	0.6
Oct 26	34.3	4.9	33.3	1.0	3.3	1.8
Nov 2	39.2	1.7	21.4	1.4	28.1	1.3
Nov 9	19.7	2.4	13.7	2.3	13.1	2.4
Nov 16	1.2	0.6	3.6	1.3	0.1	1.1
Average	24.7A[4]	3.4a[4]	19.8AB	1.2b	14.8B	1.4b

[1] Each number represents an average number of adult flies recovered from samples taken from 10 plots, 2 subsamples per plot.

[2] Refers to average number of total *Musca domestica* adults emerged from manure samples.

[3] Refers to average of total *Fannia femoralis* adults emerged from manure samples.

[4] Corresponding averages with the same letter are not significantly different ($P>0.05$).

Discussion

A general trend throughout the small plot and whole-house treatments was that Synerid-100 performed better as a larvicide than Synerid. Although the small plot results (Tables 1 and 2) are not definitive statistically, average larval numbers were generally lower for the Synerid-100 treatments.

The difference in results between small plot and whole-house treatments raises several questions as to the validity of the small plot test. First of all, about 1500 ft^2 of manure surface had to be left untreated through control plots, ends of rows, etc. These untreated areas produced massive numbers of house flies, in addition to what was emerging from the treated plots. The fly pressure created by these numbers seemed to be somewhat overwhelming for the treatments to handle. Also, the house selected for the small plot work may have had drier manure than the other houses. The small plot house was fully exposed on the south side, which allowed more sun and air movement.

Of the 333 moisture determinations made over the course of the study, approximately 70% ranged between 55% and 65% moisture. It stands to reason that a water-soluble product would penetrate deeper in a wet medium as opposed to a dry one. The probable poor penetration of Synerid and Synerid-100 through the manure could be related to the less than adequate control achieved. No estimate of product penetration through the manure was made, but bands of tint could be detected during sampling, which indicates that movement within the manure was restricted.

The only other previous field study with Erythrosin B was conducted by Pimprikar et al. (1980) in Mississippi. They made no determinations of manure moisture, but they did discuss the effects of the treatments on the soldier fly, *Hermetia illucens*. It is a well-known fact that soldier flies develop in manure of very high moisture content, probably between 75% and 85%. This observation would help explain the much more positive results obtained during the Mississippi study, assuming manure moisture is a critical factor.

Light intensity, a supposedly critical factor in the mode of action of Synerid and Synerid-100, was variable throughout the two houses receiving whole-house treatments. On sunny days, row four in each house received much more sunlight than did the other rows. However, no statistical difference was measured in terms of adult or larval numbers recovered from each sampling area in the houses; this implies that the light intensity variation within the house did not influence the results.

A correlation of total larvae and percent tinted larvae from whole-house treatments showed a positive correlation of 0.67, indicating that increases in total larvae were accompanied by increases in treated larvae. This is encouraging, since it seems that Synerid and Synerid-100 treatments were effectively coming in contact with a portion of the developing house fly larval population.

Future work with each product should center on determining how much water is needed to apply a given lethal concentration of the product to a given surface area. It is likely that the overall effectiveness of the product could be improved for southern California if application methods were altered.

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