New attractants, baits for controlling GNATS *and* FLIES

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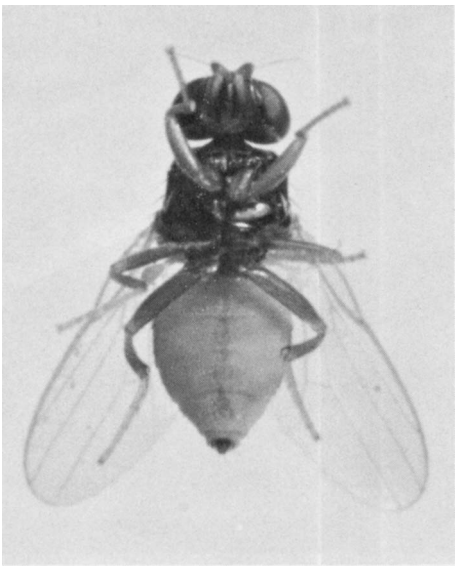
A formulation containing volatile attractants has been developed against pestiferous and disease-carrying flies—such as eye gnats, houseflies, blowflies, and flesh flies. The material, known as UC fly attractant, or Lursect, when mixed with standard fly killing toxicants, has shown considerable promise for the suppression of pest fly populations. The attractants show greatest activity when the preparation is dispensed on moist soil or other damp substrates. Efficacy is greatest when the production potential of flies is at a low to medium level. The attractant proved far superior to commercial fly baits against centric and pericentric populations of a number of species of synanthropic flies.



Female eye gnat Hippelates collusor, ventral view, a severe pest of man and animals in southwestern United States and Mexico. Actual size equal to that of a pin head.

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SYNANTHROPIC FLIES belong to the order Diptera, and are closely associated with man. They are dependent on him for propagation, and derive shelter and food from his activities in the pursuit of food production, and leisure. Among these flies, the eye gnats belonging to the genus *Hippelates* (Family Chlorpidae) are extremely abundant in certain valleys of southern California, where sandy soils are subjected to intensive irrigation and cultivation practices. In some communities in the wilderness and mountain areas, these pesky gnats also pose a serious nuisance problem affecting the economic picture and quality of living in the heavily infested recreational developments. In addition to being highly pestiferous, the eye gnats are also implicated in the transmission of pathogenic organisms to man and domestic animals.

The economic and public health importance of other synanthropic flies, such as the common housefly (*Musca domestica* L.), is well known. Some other flies belonging to the families Calliphoridae (blowflies) and Sarcophagidae (flesh flies) are also closely associated with man or his domestic animals, but the economic and public health role of some of these flies is not well understood at this time.

Most of the synanthropic fly species orient and detect their hosts by means of a variety of physico-chemical stimuli possessed by or emanated from the hosts. Among these, chemical odors constitute by far the most important space stimuli by which flies locate their hosts. Most of these stimuli activate sense receptors in the flies, inducing feeding responses in

TABLE 1. ATTRACTANCY OF UC FLY ATTRACTANT AND A COMMERCIAL FLY TOXICANT-SUGAR BAIT (GOLDEN MALRIN) AGAINST H. COLLUSOR IN THE FIELD, USING ROTARY OLFACTOMETER[a]

UC fly attractant	Golden Malrin[b]	Other additives	Gnats/cup[e]	% of total
%	%		avg. no.	%
20	80	none	66 c	14
50	50	none	168 a	36
80	20	none	128 a b	27
0	100	none	0 d	0
50	none	1% dichlorvos sugar (50%)[c]	110 b	23
0	0	2% dichlorvos resin[d]	1 d	0

[a] Standard open cup method employed (200 gm sand, 50 ml H_2O, 0.5 gm of formulation).
[b] Golden Malrin contained 0.1% dichlorvos, 0.25% ronnel, and 99.65% sugar (Thuron Industries, Dallas, Texas).
[c] From 2% dichlorvos sugar (Alco Chemical Company, Artesia.
[d] From 20% dichlorvos resin mixed with granulated sugar to give 2% dichlorvos sugar formulation.
[e] Based upon 8 replicates.

TABLE 2. ATTRACTANCY OF SCATTER BAIT (SHELL CHEMICAL CO) AND UC FLY ATTRACTANT AGAINST PESTIFEROUS FLIES AS TESTED IN AN OLFACTOMETER ON A CATTLE FEED YARD

	Average no. flies attracted[b]					
	Houseflies		Blowflies		Others[c]	
Formulation[a]	5-hr. catch	26-hr. catch	5-hr. catch	26-hr. catch	5-hr. catch	26-hr. catch
Scatter Bait	17 a	64 a	0 a	1 a	0 a	1 a
UC fly attractant with 30% sugar-tox	86 b	172 b	9 b	14 b	10 b	19 b

[a] 5.0 gm of formulation placed in a loose pile in center of olfactometer units. Each formulation contained 2% dichlorvos as the toxicant.
[b] Based upon 8 replicates. Significance of data is based on the comparison of means of each group of insects for each period for the two formulations.
[c] Others consisted mostly of Sarcophagidae and Atherigona (Muscidae).

Rotary olfactometer employed in investigating the potency of tele-attractants against eye gnats and flies in the field.

TABLE 3. ATTRACTANCY OF UC FLY ATTRACTANT AND A COMMERCIAL SUGAR-TOXICANT FLY BAIT (SCATTER BAIT—SHELL CHEMICAL CO.) AGAINST PEST FLIES AS TESTED IN AN OLFACTOMETER ON A CATTLE FEED YARD[a]

		Hourly average no. flies attracted[c]					
		Houseflies		Blowflies		Others	
Time	Formulation[b]	Sta. 1	Sta. 2	Sta. 1	Sta. 2	Sta. 1	Sta. 2
9–10	Scatter Bait	1 a	.....	0 e	.....	0 x	.....
	UC fly attractant	.....	10 b	.....	13 f	.....	2 x
10–11	Scatter bait	.....	6 a	.....	0 f	.....	1 y
	UC fly attractant	14 a	.....	7 e	.....	3 x	.....
11–12	Scatter bait	13 a	.....	0 e	.....	1 x	.....
	UC fly attractant	.....	41 b	.....	48 f	.....	21 y
12–13	Scatter bait	.....	15 b	.....	0 f	.....	2 x
	UC fly attractant	22 a	.....	15 e	.....	5 x	.....
13–14	Scatter bait	7 a	.....	0 e	.....	0 x	.....
	UC fly attractant	.....	39 b	.....	28 f	.....	15 y
14–15	Scatter bait	.....	14 a	.....	0 f	.....	1 y
	UC fly attractant	10 a	.....	3 e	.....	3 x	.....

[a] The units containing the formulations were alternated between two stations every hour.

[b] 5.0 gms of the formulation/unit. Each formulation contained 2% dichlorvos as the toxicant.

[c] Based upon 4 replicates. Blowflies were about 75% Phoenicia Sp., 25% C. macellaria. Others consisted mostly of Antherigona and Physiphora. Statistical analysis is carried out for each group of insects for each period at the two stations for the two formulations.

TABLE 4. ATTRACTANCY OF UC FLY ATTRACTANT AND SUGAR-TOXICANT BAIT (GOLDEN MALRIN) AGAINST FILTH FLIES ON A POULTRY RANCH[a]

	Muscina stabulans[b]				Musca domestica[b]			
	Attr-tox-sugar		Tox-sugar		Attr-tox-sugar		Tox-sugar	
Location	♂	♀	♂	♀	♂	♀	♂	♀
Ground below empty cages	4	7	1	0	1	1	1	0
Under tree, 30 m from chickens	51	146	4	2	0	0	0	0
Between egg room and chickens	10	17	0	0	1	0	0	1
Near pig pen 15 m from chickens	1	3	1	1	54	33	24	6
Subtotal:	66 a	173 b	6 b	3 b	56 a	34 a	25 a	7 a
Total:	239 a		9 b		90 a		32 b	

[a] Pans placed about 2 m apart on ground. Exposed in field for approximately four hours.

[b] Data analyzed for significance between sexes of same species and for the two formulations.

one or both sexes of the pest. It is partly by means of this communication system that flies find and select sources of food.

Volatile chemicals, similar or closely related to the host odors, are also produced by microbial fermentation of complex proteinaceous substances. Fermented aqueous suspension of whole chicken egg solids has been found to be highly attractive to many species of *Hippelates* eye gnats, houseflies, blowflies, and flesh flies. Although these aqueous baits have been employed in assessing population activity of these insects, they have not been employed in the management of fly populations. The aqueous baits possess highly objectionable odors, are short-lived, and difficult to apply to infested areas.

To overcome these difficulties, research at Riverside, was initiated to develop dry solid formulations of tele-attractants (distant or space attractants) to be used for the management of eye gnat populations. The liquid baits, being the starting material, were prepared by fermenting or putrefying concentrate suspensions of whole egg solids (inedible batches) not fit for human consumption, thus recycling a cheap product back to the farm, but in this case for the control of noxious flies. Fresh cull eggs, as well as other proteinaceous materials, also yielded good attractive baits. In order to turn the liquid bait into a dry and less objectionable product, the liquid bait slurries were subjected to spray drying, freeze drying and other processes. The freeze drying technique yielded the most potent attractive preparation against eye gnats.

It was soon observed that the attractant not only lured female eye gnats but also attracted large numbers of houseflies, blowflies and flesh flies. Additionally, other groups of insects, such as vinegar flies, ants and earwigs were also observed to respond positively to baits utilizing these attractants. The material developed in this manner was named UC (University of California) fly attractant, and its proprietary designation is Lursect (McLaughlin Gormley King Company, Minneapolis, Minnesota).

Eye gnats

The attractant formulation was evaluated in a rotary olfactometer (photo) against field populations of *Hippelates* eye gnats and filth breeding flies. The olfactometer consists of a head carrying 40 arms which move around in a horizontal plane on a vertical shaft—coupled with a gear box and an electric motor operated by a portable generator. The speed of the unit is usually set at 1 revolution per 4 to 5 minutes. Cups containing a standard amount of damp soil are attached to the arms. A small quantity (0.5 or 5 g) of the attractant-toxicant formulation is placed over the top of the damp soil in each cup. The olfactometer is placed in the field in locations where test insects prevail in good numbers.

Attractive formulations lure the insects to the cups where they die quickly on contact with a quick knock-down poison. Once flies are pulled into the area of the formulation, they persistently hover over the attractant and make physical contact. The data obtained in these studies were analyzed for significance by transforming individual values to log $(x+1)$, and ranking the treatments for variability by the Duncan's multiple range test. Means followed by the same letters are not significantly different from each other at the 5% probability level.

The UC fly attractant, when tested and compared with commercially-available sugar-toxicant baits, proved highly attractive against female eye gnats. Only the female flies (photo) attack humans and animals. The highly pestiferous females disseminate pathogenic organisms. From the data, it was apparent that the commercially-available sugar-toxicant bait induced no positive response in the eye gnats (table 1). The best combination was the one that contained 50 to 80% attractant and 20 to 50% sugar-toxicant formulation. Without the attractant none of the toxicant-sugar fly baits attracted eye gnats.

Flies

The housefly (*Musca domestica*), on the other hand, due to its random search and landing behavior found the sugar-toxicant formulation; the first few dead flies in the units acted as attractants luring more flies to the units. But the numbers attracted to the formulation containing UC fly attractant were significantly higher (table 2).

Blowflies (mostly *Callitroga macellaria*) (Fabricius); flesh flies, other muscids (*Atherigona* species); and picture-wing flies, mostly *Physiphora* species (Otitidae) were rarely attracted to the sugar-toxicant formulation. The behavioral responses of blowflies (Calliphoridae), flesh flies (Sarcophagidae), and some other scavenger flies were similar to those of *Hippelates* eye gnats. None of these flies have been observed to respond to formulations not containing UC fly attractant.

TABLE 5. ATTRACTANCY OF UC FLY ATTRACTANT AND SUGAR-BAIT (GOLDEN MALRIN) TO PEST FLIES (MUSCINA STABULANS AND MUSCA DOMESTICA) ON A POULTRY RANCH[a]

Station	NO. FLIES/UNIT: Attr-tox-sugar (50:50)	Golden Malrin
Suspended survey units end of cage rows		
1	14	1
2	75	18
3	55	20
4	59	4
5	55	0
6	35	2
Avg.	48.8 a	7.5 b
% ♀	54	51
32-oz cup units on floor end of cage rows		
1	9	6
2	23	4
3	36	27
4	22	15
5	8	2
6	20	2
Avg.	19.7 a	9.3 b
% ♀	63	53

[a] Duration of experiment 24 hours. Damp vermiculite in units.

TABLE 6. ATTRACTANCY OF A MIXTURE OF UC FLY ATTRACTANT AND A COMMERCIAL DICHLORVOS SUGAR BAIT (FLY FIGHTER, 1% DICHLORVOS-SUGAR, ALCO CHEMICAL COMPANY) TESTED IN 1-GAL. PLASTIC BAIT UNITS AGAINST PERICENTRIC POPULATIONS OF HOUSE FLIES[a]

	No. of house flies attracted per 48-hor period			
	Site I		Site II	
September 1972	UC fly attractant[b]	Fly Fighter	UC fly attractant[b]	Fly Fighter
8	506	0	55	0
13	142	2	45	3
15	834	0	117	2
20	331	0	80	0
22	647	0	118	1

[a] Formulations placed on top of damp vermiculite in one-gallon plastic jars suspended in pairs, 1.5 m above ground, 40 m apart. The two units were alternated at each setting. 5 g formulation placed in each unit.

[b] Contained 50% UC fly attractant and 50% 1% dichlorvos sugar formulation (Fly Fighter). In every test the attractant catch was significantly higher at 0.1% level of probability.

In another study the positional effects of sugar-toxicant baits and UC fly attractant formulations were studied. Four units of each of the two formulations were located on one of each of two olfactometers situated 100 meters apart on a cattle feed yard. The units of each formulation were alternated hourly on the two olfactometers. In each case, the UC fly attractant formulation (containing 30% sugar-toxicant) attracted greater numbers of houseflies (table 3).

The ratio of houseflies attracted to the attractant formulation was consistently greater and much higher when the attractant was run at Station II, the most active site for flies. This indicates that the efficacy of sugar-toxicant baits against pericentric populations (stray flies away from their main activity and breeding centers or sites are termed here as pericentric flies) of houseflies is

lower than situations where centric populations (near center of high breeding, resting and feeding activity) prevail. Blowflies and flesh flies and *Atherigona* (Muscidae) were again found to be scarcely attracted to the sugar-toxicant formulation.

The efficacy of UC fly attractant and sugar-toxicant bait (Golden Malrin, containing 0.1% dichlorvos and 0.25% ronnel) was evaluated in 7-inch square aluminum pans filled with 600 gm soil dampened with 150 ml water. A small quantity of each formulation (2 gm of 50% UC fly attractant and 50% Golden Malrin, and 1 gm of 100% Golden Malrin, keeping toxicant concentration constant) was placed on top of the damp soil. Pairs of treated pans were set for four hours at various locations on a poultry ranch. The UC fly attractant formulation attracted much greater numbers of the false stable fly *Muscina stabulans* (Fallen) than the sugar-toxicant formulation alone (table 4). False stable flies occurred in large numbers in the tree shade during the period of this experiment.

Houseflies were also attracted in larger numbers to the attractant than the sugar-toxicant formulations. Houseflies prevailed more abundantly near the pig pen than in any of the other locations at the time the experiment was conducted. This could be due to the prevalence of physiological stages more responsive to the attractant in the area at that time of the day.

In another experiment at the same poultry ranch, empty pint- and quart-size juice cans, filled part way with damp vermiculite, were used as test units. The small survey units were suspended from ends of cage rows, while the larger quart-size units were placed on the floor at the ends of cage rows. About 2 gm of 50% UC fly attractant-50% Golden Malrin and 1 gm of the latter alone were placed in each unit. The toxicant concentration was thus kept the same for the two formulations.

The UC fly attractant formulation again attracted greater numbers of false stable flies and houseflies. The percentage of females attracted was also greater (table 5) in the units supplied with the attractant.

It has been observed that sugar-toxicant baits produce a good kill of centric populations of houseflies. A centric population is defined as one which is highly aggregated, and manifesting high activity and breeding potential in localized situations. Under these conditions the probability of random contact between flies and sugar bait is very high. On the other hand, pericentric flies away from their center of activity and breeding sites, respond quite differently to baits with and without attractants.

To document this phenomenon, sugar bait, with and without UC fly attractant, was placed on damp vermiculite kept in 1-gallon plastic jars suspended near horse corrals 100 m from a heavily fly-infested poultry ranch. The jar was provided with several 1-inch holes to facilitate entry of flies attracted. There was little or no breeding of flies in the horse corrals and most of the flies in the area flew out of the poultry ranch.

The units containing attractant were the only ones which attracted very large numbers of flies (table 6). The sugar-toxicant bait alone did not attract any appreciable number of flies. It is thus apparent that preclusion of physical contact with the sugar-toxicant bait renders these baits ineffective for the control of pericentric populations. Most of the rural and urban problems are caused by pericentric populations of flies, and sugar-toxicant baits without a tele-attractant will prove useless.

From these studies, it is concluded that UC fly attractant (prepared from putrefied proteinaceous materials) can provide a promising approach for behavioral control of synanthropic flies. Formulations containing this attractant, when used in large scale eye gnat control programs, have resulted in significant reduction of eye gnat populations in certain areas in the Coachella Valley. It also holds promise for the control of filth and flesh breeding flies prevailing at low to moderate levels of production under good farming management practices. Since this attractant is used as a spot-treatment, adverse environmental effects and hazards to natural enemies of flies in general, are greatly diminished. It is possible that the use of these tele-attractants, plus insecticides, will prolong the life expectancy of chemical control agents, such as dichlorvos, naled, trichlorfon, and many others, against pest flies.

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Watery breakdown of BARTLETT PEAR

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A senescent type of watery breakdown of Bartlett pears, comparable to one that had caused serious losses to processors in 1972, was induced in laboratory tests. Prompt, thorough cooling and low storage temperatures reduced the incidence of the disorder. Precise definition of temperature relationships and the possible effect of other seasonal, climatic, cultural or handling variations must await further studies. The methods and results reported here will provide guides to these studies.

BARTLETT PEAR processors sustained serious losses from a watery breakdown of fresh fruit during the 1972 season. This breakdown developed during