

Response of the House Fly, *Musca domestica* L., to Electric Lamps

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Experiments to determine the response of the house fly (*Musca domestica* L.) to electric lamps emitting different intensities, wavelengths and types of spectra of electromagnetic energy were conducted in 1952 and 1953. In 1953 and 1954 experiments were conducted to determine the time of day the house fly is most attracted to a 15-watt fluorescent 360 BL blacklight lamp. All experiments were conducted in the veterinary science and the swine nutrition barns at Purdue University.

TABLE 1. Spectral energy distribution of various lamps¹

Lamps	Kind of Spectrum	Energy output in watts					
		Ultraviolet			Visible		
		Below 2800A	2800-3200A	3200-3800A	3800-5000A	5000-6000A	6000-7600A
Glow Lamp							
Argon (4-w) ³	Divided		about 85% emitted here		about 8% here	about 7% here	
Mercury							
Germicidal (4-w)	Line	0.5	0.01	0.01	0.04	0.02	0.001
Germicidal (15-w)	Line	3.0	0.06	0.05	0.17	0.09	0.005
Fluorescent							
360 BL Blacklight (15-w)	fluorescent	0.0	—	2.10	0.31	0.09	0.000
Blue (40-w) ²	fluorescent	0.0	0.02	0.50	6.50	2.20	0.150
Daylight (40-w) ²	fluorescent	0.0	0.08	0.22	2.50	3.50	1.800
Gold (40-w) ²	fluorescent	0.0	0.00	—	0.00	2.70	1.800
Green (40-w) ²	fluorescent	0.0	0.10	0.15	1.40	6.30	0.100
Pink (40-w) ²	fluorescent	0.0	0.02	0.08	0.70	1.30	3.700
Red (40-w) ²	fluorescent	0.0	0.00	—	0.00	0.03	0.970
Incandescent							
Standard (100-w) ²	Continuous	0.0	0.00	0.06	0.90	2.25	6.800

¹ Data from Publication LS 125 and LS 135, Engineering Division, Lamp Department, General Electric Company, Cleveland 12, Ohio.

² Size shown not used in experiment, but spectral distribution of the lamps used should be similar. N oquantative data were available for lamps used but not shown in above table.

³ No completely comparable quantitative data available. Information computed from graphs.

The following lamps, the approximate energy distribution of some of which are given in Table 1, were used in the experiments: 4- and

15-watt germicidal Mercury (line spectrum); 15-watt blue, gold, pink, red, 360 BL blacklight and filtered Blacklite fluorescent (fluorescent spectrum); 15-watt clear, blue and red, 25-, 60-, 200- and 300-watt inside-frosted incandescent (continuous spectrum); and a 2-watt argon glow lamp (divided spectrum: 3100-4700 Å and 6800-7600 + Å).

Two types of traps were used: a fan-type cylindrical trap known as the New Jersey mosquito trap and an 18" x 18" electrocutor grid.

Response of House Flies to Various Lamps

Experiments Using Electrocutor Grids:

In preliminary tests it was found that some flies came to a charged electrocutor grid when the lamps were not lighted. It was not determined whether these flies were attracted by the coronal discharge at the end of the grid wires, by the electromagnetic and/or electrostatic field around the charged grid or by the ozone produced, or whether they just blundered into the grid.

The electrocutor grids were used in two separate experiments. The objective of the first experiment was to determine if house flies are attracted to a 15-watt 360 BL blacklight fluorescent lamp. In this experiment two 18" x 18" electrocutor grids, one equipped with a 360 BL lamp and the other without a lamp, were used. The experiment ran for 14 days and the lamp was moved daily from one trap to the other to eliminate differences due to location. The electrocuted flies dropped into a basket suspended beneath each grid and were counted daily. The average daily catch of house flies (238) by the trap equipped with the 360 BL lamp was over five times the number (43) caught at the trap without a lamp.

The objective of the second experiment was to compare the attractiveness of the following lamps to that of a 15-watt 360 BL blacklight fluorescent lamp that had burned for over 100 hours: 25-, 200- and 300-watt inside frosted incandescent lamps; 15-watt germicidal; 15-watt blue, gold, green, pink, red, filtered Blacklite, and new (unburned) 360 BL blacklight fluorescent lamps. Two grids were used in each test, one being equipped with the "burned-in" 360 BL lamp and the other with one of the lamps being compared. Each test was repeated six times and the traps were rotated daily. The results, as shown in Table 2, were recorded as per cent of the catch by the "burned-in" 360 BL lamp.

As shown in Table 2 the "burned-in" 15-watt 360 BL blacklight fluorescent lamp attracted more house flies than any of the other kinds of lamps tested except the new 360 BL lamp. The amount of energy emitted by 360 BL blacklight lamps decreases about 10% during the first 100 hours of burning. Therefore, the 10% difference in attractiveness between the "new" and the "burned-in" 360 BL lamps can be logically attributed to the 10% difference in energy out-put. As the intensity of the white inside-frosted incandescent lamps increased from 25-watt up to 300-watts their relative attractiveness increased from 35.5 to 49.9 per cent when compared with the trap equipped with a 15-watt 360 BL lamp. A 15-watt germicidal lamp proved to be less attractive than the 360 BL and the filtered Blacklite fluorescent, as attractive as the

300-watt incandescent, and more attractive than any of the other lamps tested.

TABLE 2. Per cent of house flies caught by traps lighted with various lamps when compared with the catch at a trap lighted with a 15-watt 360 BL lamp. Lafayette, Indiana, July 21-September 23, 1953.

Flies caught at 360 BL lamp	Size and Type of Lamps Tested	Per cent of 360 BL catch
140	15-w gold fluorescent	15.7
300	15-w red fluorescent	16.7
325	15-w green fluorescent	16.9
395	15-w blue fluorescent	17.7
130	15-w pink fluorescent	23.1
335	15-w daylight fluorescent	25.4
155	25-w incandescent	35.5
454	200-w incandescent	37.0
295	15-w germicidal	49.1
1910	300-w incandescent	49.9
330	15-w filtered Blacklite fluorescent	78.7
350	15-w 360 BL, blacklight fluorescent (new)	110.0

From the results of these tests it may be stated as a general conclusion that wavelengths of electromagnetic energy between 3200 and 3800 Å in length are more attractive to the house fly than shorter or longer wavelengths, and that the higher the energy out-put in lamps with the same type of spectrum and energy distribution, the more attractive they are.

Experiments Using Fan-type Traps:

The objective of these experiments was to determine the attractiveness of lamps of different intensities, wavelengths and types of spectra to house flies. The following lamps were tested: a 2-watt argon glow; a 4-watt germicidal; a 15-watt clear, a 20-watt blue, a 20-watt red, and a 15- and a 60-watt inside-frosted incandescent.

The traps used in these tests are known as New Jersey Mosquito traps. They are equipped with a fan which draws the insects down into a killing chamber. In preliminary tests it was found that a few flies were caught in these traps when the lamps and the fans were not operating and that when the fan was operated in an unlighted trap the number of flies caught increased about nine times.

In each of the tests in this series of experiments three traps were used. The traps were rotated daily so as to eliminate the effect of position. Five tests, using different combinations of lamps, were run. Each test was carried out for six days. The lamps were kept lighted at all times.

The lamps used in each test and the results obtained are given in Table 3.

TABLE 3. Average number of house flies caught with fan-type traps equipped with various lamps. Lafayette, Indiana, July 21-September 2, 1953.

Test No.	Ave. No. Flies Caught Per Day			L.S.D. At 5 per cent
1	60-w Frost. Incan. 2675	25-w Frost Incan. 2480	No Lamp 1430	980
2	25-w Frost. Incan. 432	15-w Clear Incan. 338	No Lamp 253	114
3	60-w Frost. Incan. 542	25-w Frost. Incan. 469	2-w Argon 376	87
4	25-w Frost. Incan. 367	20-w Blue Incan. 298	20-w Red Incan. 320	66
5	25-w Frost. Incan. 191	20-w Red Incan. 238	4-w Germicidal 318	60

Both a 25-watt and a 60-watt inside-frosted incandescent lamp proved to be attractive to house flies (Test 1) and both proved to be more attractive than a 2-watt argon glow lamp (Test 3); however, the difference in the attractiveness of these two lamps (Tests 1 and 3) was not significant at the 5% level.

Although a trap equipped with a 15-watt clear incandescent lamp caught more flies than did one without a lamp, the difference in the numbers caught was not significant.

The 25-watt inside-frosted incandescent lamp was more attractive than a 20-watt blue incandescent (Test 4), but it was not more attractive than a 20-watt red incandescent one (Tests 4 and 5). The difference between the number of flies attracted to a 20-watt blue and a 20-watt red incandescent lamp was not significant (Test 4).

As shown in Test 5, a 4-watt germicidal lamp, which has a line spectrum and which emits most of its energy below 2800 Å, was much more attractive than either a 25-watt inside-frosted or a 20-watt red incandescent lamp which have a continuous spectrum and emit but little or no energy in the ultraviolet region of the spectrum.

Time of Day House Flies Attracted to 360 BL Lamp

Three experiments were conducted in 1953 to determine whether the house fly is more attracted to a 360 BL lamp at night or during the daytime. Two electrocutor grids were used in each of these tests and each test was run for six days. In all of the tests one grid was illuminated continuously with a 15-watt 360 BL lamp. In the first test the other grid was illuminated with a 15-watt 360 BL lamp from sundown to sunrise (6:45 P.M. to 4:30 A.M. C.S.T.): in the second test the second grid was illuminated from 6:00 P.M. to 6:00 A.M.; and in the third test

the second grid was illuminated from 6 A.M. to 6 P.M. The grids were alternated daily.

In the first test the trap which was illuminated from 6:45 P.M. to 4:30 A.M. caught on a daily average 64.6 per cent as many flies (278 to 430) as did the trap which was illuminated for 24 hours. In the second test the trap which was illuminated from 6:00 P.M. to 6:00 A.M. caught 64.3 per cent as many flies (360 to 560) as the continuously illuminated one. The trap which was illuminated from 6:00 A.M. to 6:00 P.M. caught but 41.8 per cent as many flies (140 to 335) as did the one which was illuminated continuously. All of these results agree that more flies are attracted to a 15-watt 360 BL lamp at night than during the daytime.

In 1954 a test was conducted to determine when, within the limits of one hour, houseflies are most attracted to an electrocutor grid equipped with one 15-watt 360 BL lamp. This test was conducted in the swine nutrition barn which was screened. This screening insured that the population of flies was fairly constant throughout any 24-hour period and that the results were not complicated by the migration of flies to and from the building. The test was conducted for eight 24-hour periods between September 23 and October 13. The time of sunset varied from 5:44 P.M. (Sept. 23) to 5:10 P.M. (Oct. 13), a total of 34

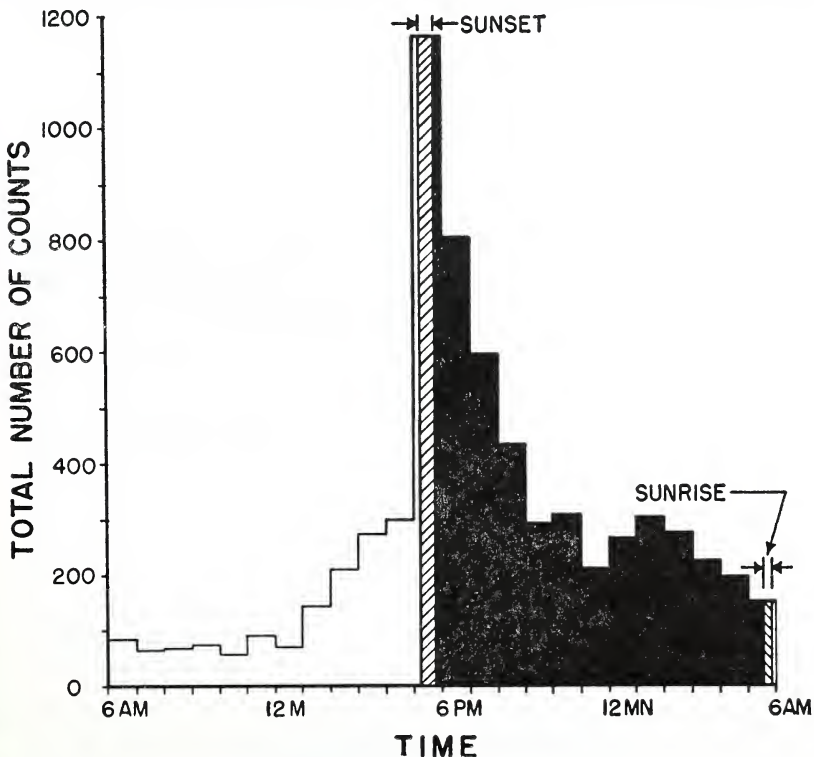


Figure 1

minutes. The number of flies electrocuted by the grid was automatically recorded on an accumulative digital counter. This was operated by current impulses caused by the grid being momentarily shortened when the flies contacted it. A new counter was switched automatically into the circuit at the end of each hour.

As shown in Figure 1, few flies came to the trap from sunrise until 1:00 P.M. There was a gradual increase from then until 5:00 P.M., one-half hour before sunset. During the hour in which the sun set, 5:00 to 6:00 P.M., the flies came to the trap in great numbers, 17 per cent of the total being caught during this time. After sunset there was a rather sharp hourly decrease until 9 o'clock. As in the 1953 experiments, over 60 per cent of the flies came to the traps at night.