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# ULTRAVIOLET LIGHT TRAPS: DESIGN AFFECTS ATTRACTION AND CAPTURE

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**Abstract** Traps that use ultraviolet light as an attractant for flies are widely used in urban situations. To determine the differences in trap efficacy from design and lighting, pairs of traps were compared under laboratory conditions. Comparisons were made between traps with open fronts and with traps with restricted open fronts, black light bulbs, and black light blue bulbs, and glue boards with and without *z*-9-tricosene pheromone. In a windowless laboratory, pairs of traps were placed approximately 90 cm above the floor and 3 m apart. Fifty mixed-sex, 3- to 5-day-old house flies (*Musca domestica*) were released and counts of captured flies were made after 1, 4, 24 hrs. Traps with black light bulbs attracted and captured significantly more flies that those with black light blue bulbs. Black light bulbs increased the catch significantly in traps with open fronts but black light blue bulbsdid not. Glue boards with pheromone did not influence fly catch in either housing type when black light blue bulbs were used. In traps with closed fronts and black light bulbs, the fly catch was numerically higher with glue boards with pheromone. The type of trap housing plus the type of light can affect fly catch and the use of pheromones on glue boards can decrease fly catch.
**Key Words** *Musca domestica*, pheromones, trap comparisons

## INTRODUCTION

Traps using ultraviolet light as an attractant have long been used for management of house flies in indoor urban and agricultural situations (Lillie and Goddard, 1987; Miller et al., 1993a, b). Some traps kill the attracted insects by electrocution, others are fitted with glue boards that catch insects on contact. When traps have glue boards, insects must first enter the traps to contact the glue boards, which are mounted behind the fluorescent bulbs of open front models. Insects trapped on glue boards can be considered unsightly by some individuals. Therefore, on some traps the glue boards are partially or completely concealed from view. Some companies sell glue boards treated with the house fly sex pheromone, *z*-9-tricosene, putatively to increase fly attraction. Information describing the effects of modifying open-front housing to partially conceal glue boards cannot be found in the literature, and neither can those describing the effects from addition of *z*-9-tricosene to the glue board surface. These comparisons are made in the studies described here. The attractive effects of black light and black light blue light have been described previously using electrocutor grids. In this study, a comparison of these two lighting types was made using glue boards.

## MATERIALS AND METHODS

### Insects

House flies used in these studies were from the Gainesville Resistant Colony maintained under standard methods (Hogsette, 1992). The study room was without windows and 3.3 x 6.0 x 2.4 m high. Temperature was maintained at 23°C and overhead lights were illuminated during testing.

### Traps

Traps were modified open front commercial models. Because these models resemble many commercial traps with an open front design, and because they were of a modified form, it is not important or necessary to identify the manufacturer. Trap size was 52.1 cm long x 31.8 cm high x 6.4 cm deep, with two horizontally mounted 40-W fluorescent bulb midway between the upper and lower edges of the trap. A shiny wire grid with wires spaced 3.2-cm apart horizontally was mounted in front of the fluorescent bulbs on the standard

(open) trap. The grid was hinged at the top of the trap so it could be opened when necessary. The inside surface of the trap behind the bulbs was perpendicular to the bottom of the trap, however the surfaces just above and just below the bulbs angled towards the front of the trap and were channelled to accept the rectangular glue boards. To modify the trap, two rectangular metal plates, perforated in a 39.4 x 5.7 cm grid with 0.3 mm holes, were affixed to the grid so the bulbs remained exposed, but the glue boards were essentially blocked from view. The modified trap was referred to as the closed trap.

**Lights**

The fluorescent bulbs were all made by Sylvania. The blacklight (BL) and blacklight blue bulbs produced attractive peaks at 360-370 nm, although the intensity of the BLB bulbs was slightly less than that of the BL bulbs. Each trap was fitted with a pair of like bulbs.

**Glue Boards**

As mentioned above, the glue boards, black in color, were used in pairs, with one above and another below the fluorescent bulbs. One set of glue boards was treated with *z*-9-tricosene in the center of the board and the other was not. The amount of z-9-tricosene was not disclosed by the label on the label, but it was supposed to remain effective for 3 days.

**Evaluation**

A pair of traps was placed 90 cm above the floor on a counter, parallel to each other and the long axis of the study room. Traps faced into the room and were separated by 3 m. Before testing began, all bulbs used in the study were placed in traps and illuminated for 200 hours. This allowed phosphors in the bulbs to stabilize and ensured that maximum emission of wavelengths in the desired range (310-390 nm) was maintained throughout the test. To begin a test, traps having the selected combination of factors were put in place on the counter and illuminated. Overhead fluorescent lights in the room were on. A cage of 50 house flies was placed at the mid-point of the wall opposite the traps and the flies were released. The flies were left undisturbed except when counts of flies captured on glue boards were made at 1, 4, and 24 hr after release. After a 24-hour test, any remaining flies in the room were removed, glue boards were replaced, and traps were rotated from one position to the other.

**Data Analysis**

A factorial design was used for the experiment, with 2 levels of traps (open or closed), 2 levels of fluorescent bulbs (black light or black light blue), 2 levels of glue board (with or without pheromone), and 2 levels of position (left or right). Each pair of selected combinations was replicated 6 times. Data were analyzed with the General Linear Models (GLM) Procedure of SAS (2003) and means were separated with Duncan's Multiple Range Test (SAS, 2003). Unless otherwise stated, $P \leq 0.05$.

## RESULTS AND DISCUSSION

There was no significance in mean fly catch between the open and closed traps, all other factors discounted, however BL bulbs attracted significantly more flies than BLB bulbs ($F$= 6.58, df = 1, 47, $P$<0.0149). There was no significance difference in mean numbers of flies captured when the pheromone was added to the glue board, but the trap in the position on the left captured significantly more flies than the trap on the right ($F$= 8.21, df = 1, 47, $P$<0.0071) (Table 1). There was a significant trap by bulb interaction, indicating that the open trap captured significantly more flies when fitted with the BL bulbs ($F$= 6.36, df = 1, 47, $P$<0.0166) (Table 2).

The performance of the open and closed traps was to be expected since both housings allow a maximum amount of light to radiate directly into the room. This is supported by Thimijan and Pickens (1973), who also suggest that a trap with an open front should give the best results (Pickens and Thimijan, 1986).

**Table 1.** Main effects means (± SE) for house flies captured in light traps having two grid types, with two types of fluorescent bulbs, two types of glue boards and two placement positions

| Grid type | Bulb type* | Glue board type | Position |
|---|---|---|---|
| Open 15.3 ± 1.8a | BL 16.9 ± 1.8a | With pheromone 13.3 ± 1.3a | Left 17.2± 1.8a |
| Closed 13.5 ± 1.5a | BLB 11.9 ± 1.3b | Without pheromone 15.5 ± 1.9a | Right 11.6±1.3b |

*BL = Black Light; BLB = Black Light Blue. Means in columns followed by the Same letter are not significantly different ($P \leq 0.05$).

Comparisons made between BL bulbs and BLB bulbs have previously shown that BL bulbs alone attract more flies than BLB bulbs alone or to the combination of BL and BLB bulbs operated together in traps (Pickens et al., 1969; Thimijan and Pickens, 1973; Pickens, 1989). Thus, our results were not unexpected and were well supported by previous studies. Although this difference in attraction is generally recognized in the industry, many commercial customers still prefer to use traps with BLB bulbs because they make the traps less conspicuous.

**Table 2.** Factorial presentation of means (± SE) for house flies captured in light traps with two grid types, with two types of fluorescent bulbs, two types of glue boards, and two placement positions.

| Grid type | Bulb type | Glue board type |
|---|---|---|
| Open 15.3 ± 1.8a | BL 20.2 ± 2.6a | With pheromone 7.7 ± 1.8a<br>Without pheromone 22.7±4.2a |
| | BLB 10.3±1.7b | With pheromone 17.7 ± 1.8a<br>Without pheromone 13.0±2.6a |
| Closed 13.5 ± 1.5a | BL 13.6 ± 2.3a | With pheromone 15.8 ± 2.5a<br>Without pheromone 11.3 ± 3.6a |
| | BLB 13.5 ± 1.9a | With pheromone 12.2 ± 1.2a<br>Without pheromone 14.8 ± 3.7a |

*BL = Black Light; BLB = Black Light Blue. Means in columns followed by the same letter are not significantly different ($P \leq 0.05$).

Pheromone inclusion in traps did not enhance numbers of flies caught except when it was used in the closed trap with the BL bulbs (Table 2); and this numerically greater catch was not statistically significant. In all other cases, the glue boards with pheromone actually captured numerically fewer flies. The air conditioning and heating systems in my laboratory simulate those found in many commercial establishments in the U.S. in that the air in the buildings is completely replaced with fresh outside air several times per hour. Thus, the presence of pheromone might be difficult for the flies to detect. Similar results have been recorded in large discount stores and super markets (unpublished data).

There was a difference in fly capture because of trap position, with the more favorable position being close to the circulating air exit vent in the study room. This air movement, although not noticeable to

humans, is apparently detected by the flies because this positional difference exists in both of the study rooms used for fly testing. This effect is minimized by the rotation of traps between the left and right positions after each 24 hr testing period.

## CONCLUSIONS

There is no significant difference in performance between the open and closed trap housings, but the open trap is significantly more efficacious at collecting flies when paired with the BL bulbs. The closed trap captures numerically fewer flies than the open trap with the BL bulbs, but more than the open trap with the BLB bulbs. The addition of pheromone to the glue board was not beneficial. The most efficacious trap is the open trap with the BL bulbs and the glue boards without pheromone.

## REFERENCES CITED

**Hogsette, J.A. 1992.** New diets for production of house flies and stable flies (Diptera: Muscidae) in the laboratory. J. Econ. Entomol. 85: 2291-2294

**Lillie, T.H. and Goddard, J. 1987.** Operational testing of electrocutor traps for fly control in dining facilities. J. Econ. Entomol. 80: 826-829.

**Miller, R. W., Pickens, L.G., and Potts, W.E. 1993a.** Comparison of traps and an integrated program to manage house flies and stable flies on dairy farms. J. Agric. Entomol. 10: 189-196.

**Miller, R. W., Rutz, D.A, Pickens, L.G, and Geden, C.J. 1993b.** Evaluation of traps and the parasitoid *Muscidifurax raptor* Girault and Sanders to manage house flies and stable flies on dairy farms. J. Agric. Entomol. 10: 9-19.

**Pickens, L. G. 1989.** Relative attractiveness of paired BL and BLB fluorescent bulbs for house and stable flies (Diptera: Muscidae). J. Econ. Entomol. 82: 535-538.

**Pickens, L. G., Morgan, N.O. and Thimijan, R.W. 1969.** House fly response to fluorescent lamps: influenced by fly age and nutrition, air temperature, and position of lamps. J. Econ. Entomol. 62: 536-539.

**Pickens, L. G. and Thimijan, R. W. 1986.** Design parameters that affect the performance of UV-emitting traps in attracting house flies (Diptera: Muscidae). J. Econ. Entomol. 79: 1003-1009.

**SAS Institute. 2003.** SAS version 9.1 for Windows. SAS Institute, Cary, NC.

**Thimijan, R. W. and Pickens, L.G. 1973.** A method for predicting house fly attraction of electromagnetic radiant energy. J. Econ. Entomol. 66: 95-100.