JUNE 2013 | ISSUE 7

PESTWEST NEWSLETTER

DID YOU KNOW...

Malaria mosquitos, Anopheles *gambiae*, utilize CO_2 from exhaled air to localize humans from a distance, and when near their host, alter their course to human feet. Researchers discovered how female malaria mosquitos use foot odors in the last few meters to guide them to their favorite biting place.

Mosquitoes carrying the malaria parasite are more attracted to human body odour than uninfected insects, a study suggests.

Researchers found that infected insects were three times more likely to be lured towards a human scent.

They believe that the deadly parasites are seizing control of their biting hosts and boosting their sense of smell.

Male houseflies have a special region, made up of specialised photoreceptive cells, in the centre of their eyes that allow them to detect the movement of female flies above all other movements.

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FLYING INSECT SCIENCE

THE SKY'S THE LIMIT

By: Joseph Diclaro, Phil Koehler, and Roberto Pereira
Entomology and Nematology Department, University of Florida

A social benefit of being an Entomologist is that people always like to ask questions about insects. Most of the time these questions are simple and have straight forward answers, but every once in a while someone will ask a question that requires a bit more thought. A good example is when the subject of house fly infestation is mentioned. When someone says, "I just put a fly trap up" the next question usually is

"How high should I hang it?"

A general response is: "how high is it most commonly placed" On the surface it seems like a simple question but if you sit back and think for a moment you may wonder; what is the optimal height for a fly trap to hang? In some cases the trap design does not leave any choices in height placement. For instance a conical hoop trap made in the early 1900's was constructed so that it had an entry point 1 inch (2.54 cm) above the ground.

In the past, fly traps have been evaluated extensively for the perfect design. Usually these evaluations are done on farms and other rural areas where filth fly populations are very high. It has been shown that, in this type of environment, the best placement of several different baited traps is with the entry opening 24 inches (60 cm) from the ground. Traps at 24 inches high caught more flies than traps that were placed directly on the ground. This makes good sense because on a farm the house fly attractant is on the ground (manure) and 24 inches leaves enough space for flies to not only fly around a trap but under the trap as well. Depending on the trap type this may allow the bait used in the trap to exert greater attraction to house flies.

Outdoors, 24 inches may be the best height for a fly trap, but most questions these days about fly traps are coming from homeowners and business owners. So what about hanging a fly trap in a building - what is the optimal height? More flies were caught near the rafters in a structure, at 110 inches (280 cm) from the floor, compared to traps at various other levels. However, the other levels tested showed no significant difference in the amount of flies caught between them, even the traps that were near the ground.

In order to get a clear answer on how high a fly trap should be hung inside a building, we needed more data, so we conducted a simple experiment. Pieces of white corrugated plastic with a piece of fly ribbon pinned across it (plastic target [3.94 x 3.94 inch;10x10 cm], Figure 1), were placed at different heights.

Figure 1: Plastic target with house flies stuck to it, hung from ceiling by fishing line.

Then we released ~300 house flies in a room 15'6" x 20' (4.72 x 6.1 m), (Figure 2), with four plastic targets

Figure 1: Visible plastic targets hung near window and cabinet (arrows). Flies were released on center of counter (box).

at 3 feet (.91 m). We repeated the procedure with targets at 6 feet (1.8 m) and 8 feet (2.44 m). After testing each height individually, all three heights were tested simultaneously. The flies were released in the center of the room on the existing counter and then left undisturbed for 24 hours with the lights left on.

THE SKY'S THE LIMIT continued...

The targets at 3 ft and 8 ft high caught the most flies (Figure 3), but there was no statistical difference in the number of flies caught at the three heights when they were tested individually.

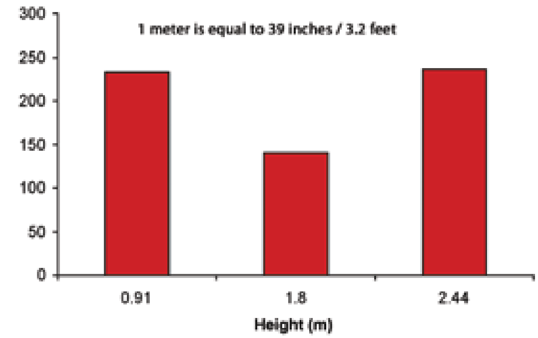


Figure 3: Average number of house flies caught at individual heights after 24 h. No significant differences were observed.

When the plastic targets were hung at all three levels at the same time, the lower plastic target caught half the fly population (Figure 4) but there were no significant differences in the three heights, even when they were tested together. From these preliminary results we can concluded that house flies in an indoor environment will travel to a trap no matter what height it is located, as long as it is attractive to the fly.

These results also tell us a couple of other things. First, that people who work in a room where this type of research is done do not appreciate when 300 flies are released.

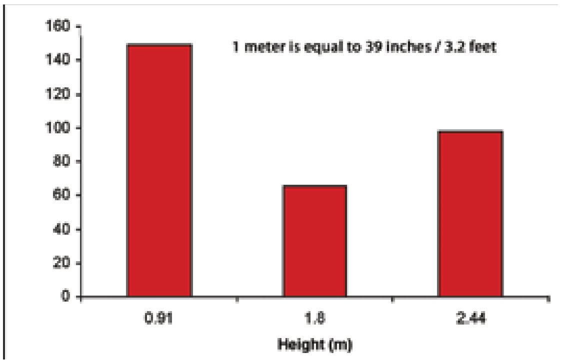


Figure 4: Average number of house flies caught at individual heights after 24 h. No significant differences were observed.

Second, in enclosed environments, such as a home, an office, or enclosed rearing facilities, the height of the fly trap may not matter much. On a farm, flies fly where the attractant (manure) is located, near the ground. In an enclosed environment house flies will go to the easiest accessible attractant no matter at what height.

The visual system of flies - Exploding the myths.

By Professor Moray Anderson

The visual process in flying insects is a complex and fascinating process.

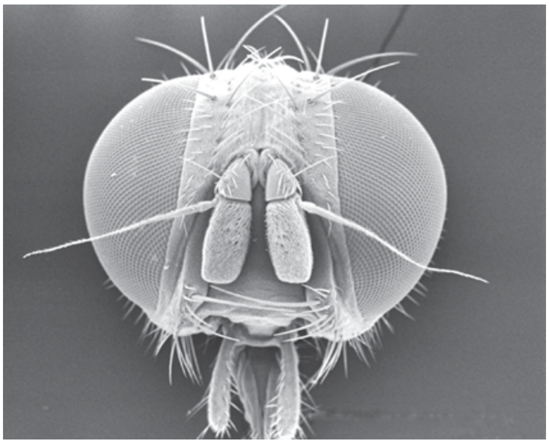
Having already established the need for flying insect control, the next thing to understand is fly vision. If we begin to understand the science behind fly vision, we can then separate fact from fiction and understand the importance of choosing the best UV tubes for fly control.

In order to better understand the visual process in flies let's follow the light from when it strikes the external surface of the eye to where it is converted to electrical signals within the optic lobes of the fly's brain.

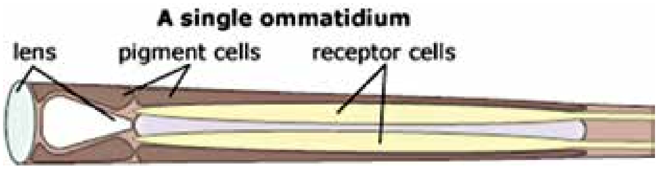
1. How does the eye of the fly "trap" the light?

The light is captured in the eyes of insects by structures called **ommatidia.**

Each adult housefly has around 3000 ommatidia in each eye. The outermost section of them can be seen in the eyes of the housefly in the picture below as hexagonal patterns.



In each of these 3000 ommatidia there are eight sensory receptor cells each of which contains the photopigments, which respond to particular wavelengths of light.



Source: University of California, Berkley.

3. Inside the cells

In most insects the regions of the cells, which contain the photopigments, the chemicals that react to the light rays, are fused and therefore all the cells sample the same point of light. In flies there is a **remarkable and unique modification.**

4. Inside the light trapping area of a fly's eye

Each of the light trapping zones in the sensory cells is **separated** from its immediate neighbors. The clever trick is that light from any point is collected by six different ommatidia and therefore the **intensity of the image on the retina is greatly enhanced** making the vision of the flies much more sophisticated than that of almost any other insects.

5. A special pigment

Within the sensory regions of the fly's eye the photopigment that traps the light is **a unique pigment** not like that found in any other animal.

Ultra violet light has a wavelength of between 216 and 400 nm. UV-A light has a wavelength of 315 – 400 nm, the eyes of flies are particularly sensitive to detection of light at these wavelengths.

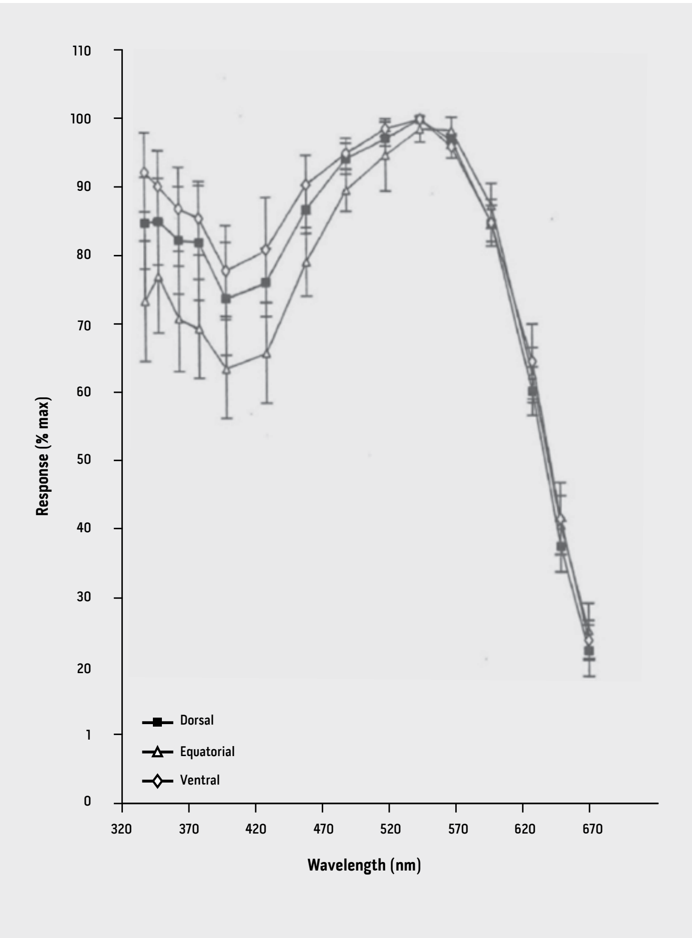
6. Response to UV light

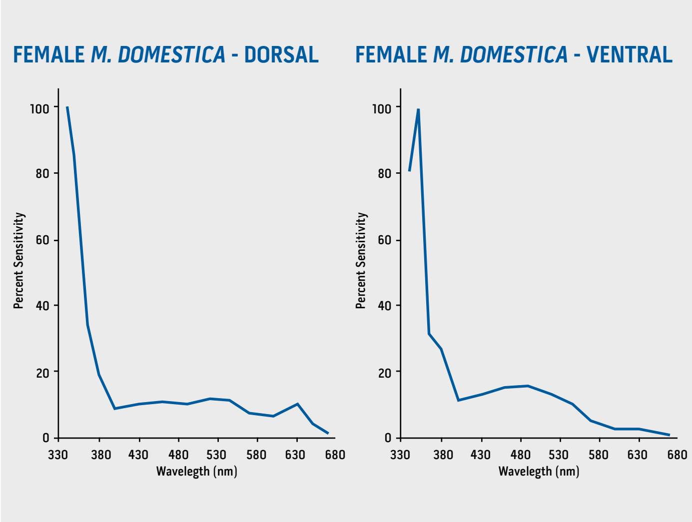
The flies' eyes are also very special in their response to **ultra-violet light**. The sensory cells referred to above, R1 to R8 each have different sensitivities to the various parts of the electromagnetic spectrum. Cells R1, R2, R3, R4 R5 and R6 are particularly sensitive to ultra-violet light. **These cells have a secondary and unique photopigment that reacts to the light in the ultra-violet range.** Ultra violet light is within the range of 216 – 400 nm.

The eyes of a fly respond to other wavelengths of light, green, blue etc. as can be seen in the graphs below, but the eyes are much less sensitive to these wavelengths of light than they are to ultra violet light.

It is interesting to compare the response of the eye of the housefly (above) to that of the Indian meal moth, *Plodia interpunctella* (see diagram below). The response of the Indian meal moth shows a peak in the green/yellow (around 500 – 600 nm) region of the spectrum, illustrating the origins of the moth as a plant feeder where green detection is of paramount importance.

While fly control systems within the pest control industry are produced predominately for the control of flies, in certain circumstances it is beneficial to have systems which produce a light source peaking in other areas of the spectrum. This is of particular importance in circumstances where insects like stored product moths may be the target for the control procedures being instigated.





7. The functional separation of the eyes.

Within the eyes of flies there are a number of other unique features.

a) First of all, within the eyes of male flies there is a **specialized zone** in the front of the eye, where the two eyes have there greatest area of binocular overlap, where the cells have lost their ability to see color. These spots are especially developed so that the **males can detect female flies** in flight in the immediate vicinity.

b) Another specialization is the ability of flies to detect **polarized light.** The ability is concentrated in certain zones of the eye, particularly around the margins. The cells that are sensitive to polarized light are also highly sensitive to ultra-violet light.

These specializations are linked to the complex behavior of the fly and the highly attuned UV and polarized light detection are thought to be **navigational aids**.

8. UV detection.

Ultra violet light has a wavelength of between 216 and 400 nm. UV-A light has a wavelength of 315 – 400 nm, the eyes of flies are particularly sensitive to detection of light at these wavelengths.

This sensitivity can be attributed to those cells within the ommatidia that have the appropriate pigment to detect the UV light described above.

These cells are sensitive to light within the UV range and the precise wavelength is not significant.

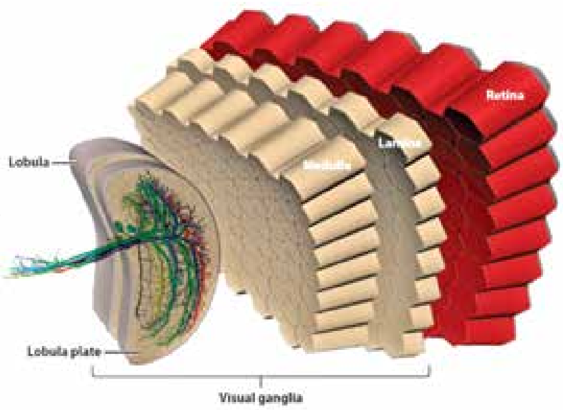
9. What does the fly see?

The physiological processes described above only reveal what the fly's eye is able to detect. It is possible to show by these electrical recordings what regions of the eye are sensitive to what wavelengths and that is all.

10. Can we ever know what the fly sees?

It is only by elaborate and detailed behavioral experiments that it is possible to obtain clues as to what the fly sees. The brain of the fly is highly evolved to processing visual information, with around 70% of it being devoted to visual processing.

Source: Borst, A. et al., 2012 Ann Rev Neuroscience 33, 42-70



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