INSECT-O-CUTOR

‘GREEN LIGHT’ A HOLISTIC VIEW

A REVIEW OF THE LITERATURE AND RESEARCH ON THE ATTRACTION OF INSECTS TO LIGHTS OF DIFFERENT WAVELENGTHS

By Dr Peter Cottee

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ABSTRACT

- Insect eyes show spectral sensitivities to light in both the UVA and green spectrums.
- Different insects show behavioural preferences to light in the UVA and green spectrums.
- Sensitivity to light in insects is impacted by a range of environmental and physiological factors including sex, light intensity, eye adaptation, age and temperature.
- Synergetic lamps caught 30% more house flies than UVA lamps in a given time period.
- Synergetic lamps were more effective in attracting mosquitoes than other lamps.
- Total UVA light output depends on the quality of the lamp.
- UVA phosphor degradation reduces attractant output to around 40% of initial output after 12 months.
- Green light phosphors hardly degrade with time.
- Synergetic lamps increase in effectiveness relative to UVA lamps with time and caught 82% more house flies in a given period after 12 months.
- Green only lamps did not prove effective against house flies.

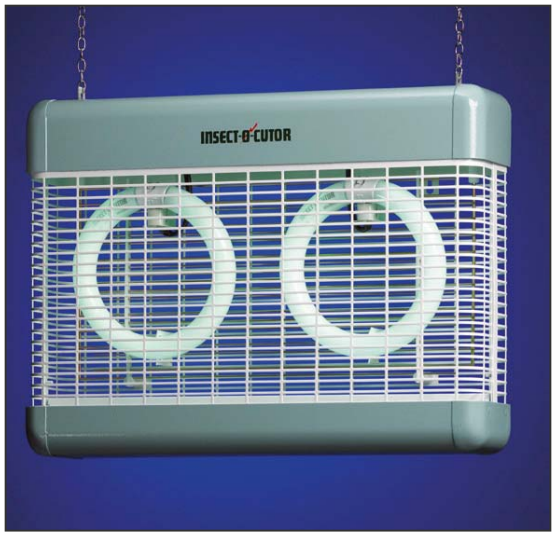
In summary: Different insect species are variably attracted to UVA and green light leading to the development of the Synergetic lamp by Insect-O-Cutor that emits both UVA and green attractant spectral ranges and is therefore attractive to the broadest range of insect species. Tests showed that a combination of these phosphors was more effective than UVA alone in catching flying insects and that relative efficacy increased over the 12 month life of the lamp as the UVA phosphor degraded relative to the green..

INTRODUCTION

Insect-O-Cutor was the first company in the UK to manufacture commercially available flying insect traps utilising UVA light to attract insects with an electric grid to kill them. Since the company's inception in the early 1950's there has been on-going research looking at more effective ways to attract, kill and collect flying insects.

In the early 90's, scientists at Insect-O-Cutor carried out a review of the literature on the attraction of insects to lights of differing wavelengths. There is a vast amount of research on the subject in which many studies have shown insects to be sensitive to light between 350nm and 700nm with peaks at around 360nm and 550nm (the UVA and green spectral peaks).

This paper examines the development of the Synergetic ™ lamp by Insect-O-Cutor and looks at its properties relative to traditional UVA lamps.



LITERATURE REVIEW

Work has been carried out on a broad range of different insect species. A review by Rees (1985) covers work on the spectral and behavioural responses of 22 stored product insects to lights of different wavelengths with specific reference to fly killer designs.

There have been many other studies on non-stored product insects. Crescitelli and Jahn (1938) showed the electrical response of the grasshopper eye was maximally stimulated with light in the green spectrum. Mote and Goldsmith (1970) discovered that there are separate UV (in the UVA spectrum) and green receptors in the eye of the cockroach, Periplaneta americana. McCann and Arnett (1972) and more recently Bellingham and Anderson (1993) studied Dipteran species and found spectral sensitivity peaks in the UVA, the green and another peak in the red region at 630nm. They also discovered a difference in light sensitivity between the sexes and in different regions of the eye.

Markze et.al.(1973) showed that the electrical response of the eye of a variety of stored product insects was particularly sensitive to light between 520nm and 560nm. This was backed up in behavioural experiments from Kirkpatrick et.al (1970) (1972) who found in general that stored product moths were more attracted to green light and stored product beetles to UVA light. However, the picture is not as clear cut as that. Roppel and Butler (1970) and Stermer (1958,1959,1966) tested a number of stored product beetles; Attagenus megatoma, Rhyzopertha dominica and Tribolium castaneum and found them to be more attracted to green light with Plodia interpunctella (a stored product moth) more attracted to UVA light.

COMMISSIONED STUDIES

The literature clearly demonstrates that insects are attracted to both UVA and green spectral peaks. Insect-O-Cutor then decided to test what would happen if both peaks were emitted from the same light source. A lamp was created by Sylvania (the Synergetic lamp, patented by Insect-O-Cutor) that contains both UVA and green phosphors and was tested in-house in 1993 by Insect-O-Cutor scientists. The results showed that the Synergetic lamps were significantly more attractive to house flies than the UVA lamps.

However, in order to prove the validity of this research it was decided to commission independent testing of the hypothesis. The work was carried out in 1995 by the Medical Entomology Centre at Cambridge. Veal et.al. showed that lamps containing UVA + green phosphors (the Synergetic lamp) caught on average 30% more houseflies in a 2 hour period than lamps containing UVA phosphors only.

Given the previously referred to research on light sensitivities in Dipteran eyes that showed spectral peaks in both UVA and green wavelengths, this result is perhaps not surprising.

In 1994, Insect-O-Cutor commissioned further studies on the effects of Synergetic lamps on mosquitoes. The work was carried out by Hill (1994) at the London School of Hygiene and Tropical Medicine. Whilst it is well documented that mosquitoes are attracted to a range of stimuli of which light in just one, Synergetic lamps were more effective in attracting mosquitoes than other lamps.

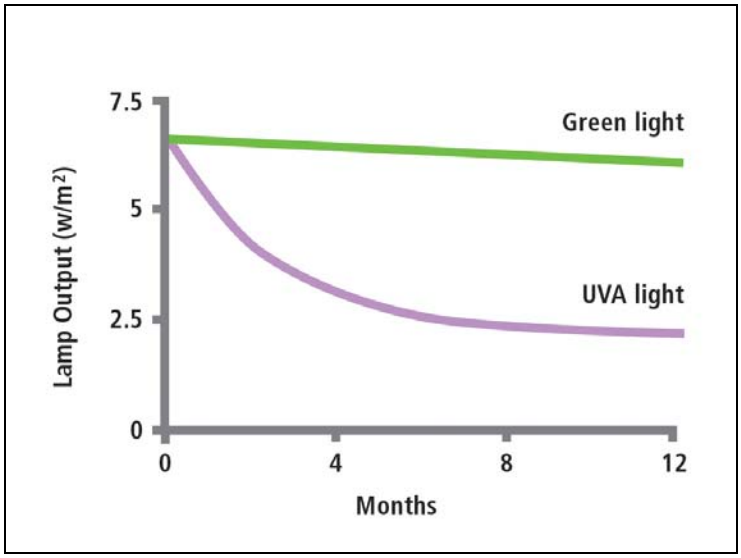
FLY KILLER LAMPS

Traditionally lamps used in fly killers appear blue and emit light only in the UVA spectrum. The intensity of the light, the UVA output and the exact spectral peak varies between different lamp manufacturers. UVA output can vary significantly with a good quality lamp emitting around 10% UVA (measured as a percentage of total lamp output) down to half that for a poor quality low cost lamp. There are heated debates between the manufacturers as to the effective merits of their lamps but what is not in question is the degradation of the UVA phosphor in all lamps.

Even a good quality lamp will lose 15% of its UVA initial output in the first 100 hours of use and a further 20% in the next 900 hours i.e. after 6 weeks the lamp is 65% effective. After 30 weeks the UVA output is down to 50% and declines steadily thereafter.

Green light output, or any other light in the visible spectrum, is virtually unaffected with time. Degradation of the phosphors that make up the green spectral peak is under 2% in the course of the year (Figure 1).

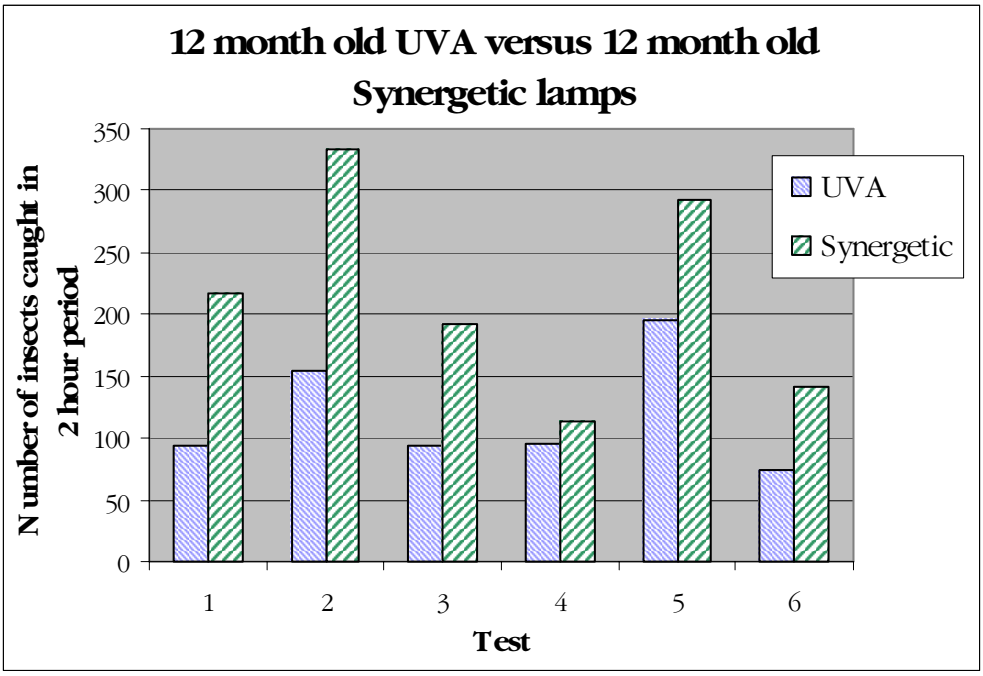
Figure 1



These facts about phosphor degradation might suggest that the effectiveness of Synergetic lamps in attracting insects should increase in time relative to UVA lamps. This is because whilst the UVA output in both the Synergetic and UVA lamps decreases by 60% over the course of a year, the Synergetic lamps maintain over 98% of the output of the green attractant phosphors and it is known that many insects have an attractant peak in the green spectrum.

To test this Insect-O-Cutor scientists looked at catch ratios with 12 month old UVA versus Synergetic lamps against houseflies. Insect-O-Cutor units fitted with the Synergetic lamps caught on average 82% more flies than those with the UVA lamps (Figure 2).

Figure 2



This result confirms the hypothesis that Synergetic lamps become more attractive to house flies over time relative to UVA lamps.

Some major lamp manufacturers try to promote their version of green light to the industry. These lamps emit highly intense green light with no UVA and are more commonly used in discos and chicken rearing pens. In-house tests found these lamps to be no more effective than common white fluorescent lamps in attracting flies.

Figure 3

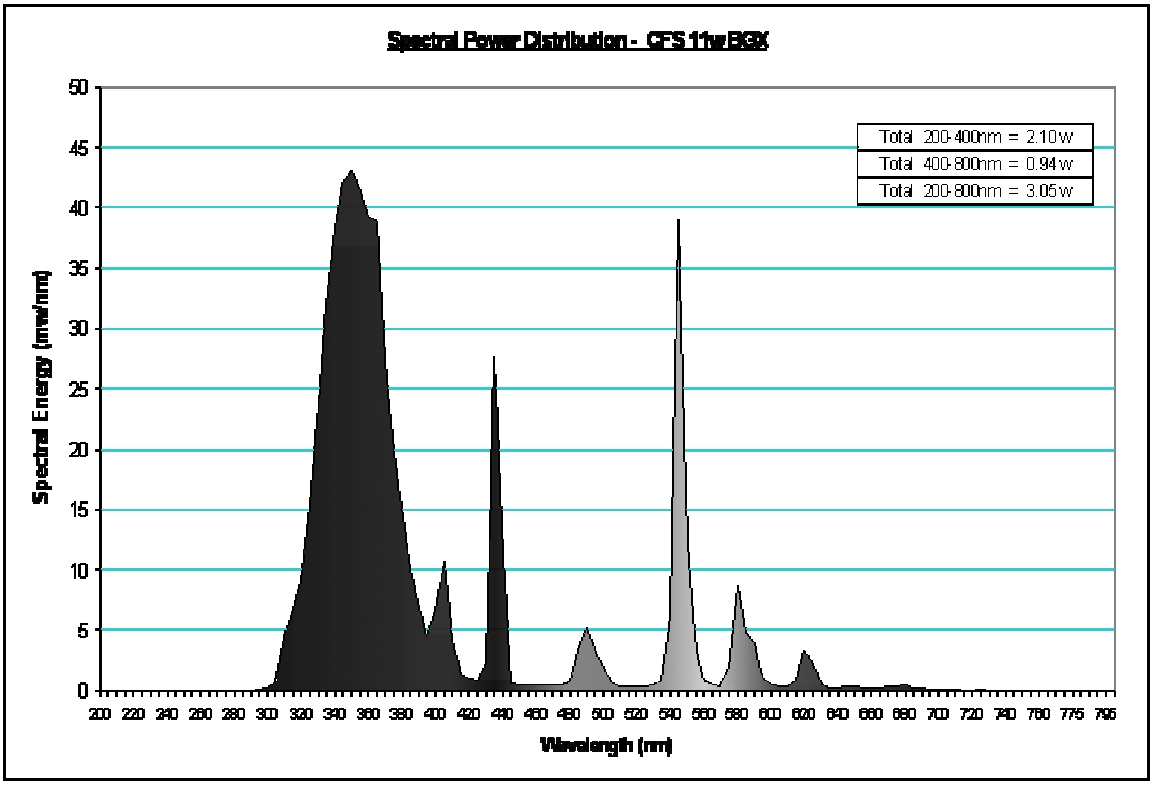


Figure 3 shows the spectral output from a Synergetic lamp.

OTHER FACTORS AFFECTING EFFICACY

All the references to date in this report are independent and in-house scientific studies on light. However, over the years Insect-O-Cutor has tested many other criteria that impact on the effectiveness of a fly killer covering:

- Colour of the unit.
- Size and shape of the killing grid.
- Size and shape of the exterior guard.
- Incorporating pheromones (heated and non-heated) with the fly killer.
- Colour and patterns of glueboards.
- Size of the glueboard.
- Effect of different types of glue.
- Impact of crawl out lips.
- Size and design of the catch tray.

All these factors impact on the efficacy of a fly killer, however efficacy is only one criterion in the design of an Insect-O-Cutor: – aesthetics and production are also very important factors. Market research was carried out in a number of different market sectors to establish the relative importance of these three criteria when designing the latest range of Insect-O-Cutor units. Ease of servicing is a very important factor for the pest control industry.

The factors listed above, the siting of the unit and the suitability of the model for the location all impact on the catching of flying insects. The Insect-O-Cutor Synergetic lamp is simply another factor in the most efficient trapping of insects.

SCIENTIFIC BENEFITS OF GREEN LIGHT - CONCLUSION

It is apparent from both historical scientific evidence and in-house experimentation that the incorporation of green light into attractant lamps has a number of benefits:

1) Many insects have eyes with 2 spectral peak sensitivities, UVA and green and show behavioural attraction towards them. Different insect species show different preferences to either UVA and/or green depending upon a number of physiological and environmental factors. Synergetic lamps emit both attractant peaks and are therefore more attractive to a broader range of insect species than a UVA lamp. This is important in a very practical sense. House flies, which are the test species for many fly killer tests do not represent the majority of flying insects caught in traps. In a food industry environment many species of stored product insects as well as non-stored product insects will be present so it is important to have the greatest

range of attractant spectral peaks as possible.

2) Insect-O-Cutor units fitted with Synergetic lamps catch on average 30% more house flies in a given period than units fitted with UVA lamps. In a food environment, the faster flying insects are trapped the less likelihood there is for contamination and subsequent health risks.

3) The fall in UVA lamp output during the course of a year means that the effectiveness of UVA lamps in catching flying insects diminishes rapidly. However, the fact that the green phosphors do not degrade to any significant degree at all means that there is year round protection from this attractant spectral peak to which many insects have specific receptors. The effect of this is that Insect-O-Cutor units fitted with 12 month old Synergetic lamps caught 82% more house flies than units fitted with UVA lamps.

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