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THE RELATIONSHIP BETWEEN LIGHTING AND INSECT FLIGHT

Abstract: In this paper, the issues of insect protection were considered. The paper presents methods of protection against insects. Spectral analysis of the effect on insect behavior was also considered. The condition and actions of insects depend on lighting. The paper proposed the choice of light illumination to improve the indicator of the light trap and the analysis of the luminous flux.
Keywords: luminous flux, analysis, illumination, insects, waves, frequency, voltage, food product, dependence, microorganisms.

Introduction. Starting in early spring and ending in late autumn, people are constantly fighting annoying flies. Throughout the entire period, parasites annoy with buzzing, crawl on human skin and food products [1].

Sanitary requirements for the human environment exclude the presence of any insects. If the fight against flies in a private apartment or house is a personal matter of the owners, then catering places and medical institutions are of particular importance.

Flies feed on decomposing organic waste, carrying pathogenic microorganisms. Flying from waste to food, flies mechanically carry pathogens of infectious human diseases, primarily intestinal infections, protozoan cysts, helminth eggs, which can persist for several days on the surface of the body and in the intestines of flies. The possibility of transmission by flies of the causative agent of food toxicoinfections and polio virus has been established. Some species of flies are bloodsuckers (for example, the stable fly) and transmit an infection (tularemia, anthrax) during blood sucking [2].

The presence of a large number of flies in a populated area is a consequence of a violation of sanitary order. They find their food in human habitats - housing, catering enterprises, public utilities, consumer services, and others. In rotting garbage, sewage, garbage collectors, cesspools of toilets, flies lay eggs, from which larvae appear, and they, in turn, turn into pupae after 2-3 days. Flies are born from the pupae. Within 2 hours, young flies are still unable to fly and are on the surface of sewage, where billions of pathogenic organisms are intensively multiplying [3]. The body of a fly contains from 6 to 8 million bacteria, and there are already 25-30 million microbes in the intestine. More than 60 types of microorganisms capable of causing dangerous diseases are found in this insect. Flies can swallow helminth eggs or protozoan cysts. Larvae and pupae of flies can, under favorable conditions, overwinter in the soil, under garbage collectors, around latrines and turn into flies with the onset of spring.

In search of food, flies fly into rooms, land on food and transfer pathogens to them, which, multiplying, are capable of causing acute intestinal disease when they enter the human body.

Setting tasks. There are such main categories of traps depending on the factor of attraction and destruction:

A UV lamp and a fan that sucks mosquitoes inside. Ultraviolet light of a spectrum safe for humans is used to attract people again. Flying insects see this spectrum differently — it is very noticeable to them and is like fire. The lamp is placed near a special tank. An air flow is created there, against which mosquitoes, flies, wasps, horseflies and similar pests cannot fly. They find themselves trapped, where they die due to lack of water. The area of operation of such devices depends entirely on the

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power of the UV lamps used and also reaches 400-500 m^2. In comparison with the models of the previous type, these destroyers are safer with respect to electricity, since there are no exposed live elements inside the case.

UV lamp and adhesive plate. The alluring effect of UV light leads pests to a sticky surface, where they get stuck forever. The adhesive plate needs to be replaced, which increases the overall cost of avoiding mosquitoes and flies. However, this approach is very hygienic, as there are no insect residues left inside the device. All vulnerable surfaces are periodically changed. Also, the advantages of these traps include a good variability of the possible form factor. For example, the shredder may take the form of a compact office lamp mounted in the ceiling. Mosquitoes and flies will still remain on the adhesive surface; they will not fall down. There are also options for devices in the form of a floor lamp.

Carbon dioxide, odor, ultraviolet light, heat and a fan that sucks mosquitoes inside. The most advanced category of devices. They use everything that can attract flying insects into an air trap. Due to this, they have a maximum area of action — up to 6,000 m^2. However, you have to pay a lot for this. The device itself can cost several tens of thousands of rubles, it also needs to constantly buy carbon dioxide, cartridges with attractants and pay the cost of electricity consumed. But the user completely gets rid of flying insects over a large area without using insecticides (Fig.1).

Fig.1. An air trap for flying insects.

The intrusion of bugs into the area near the light source causes, to put it mildly, discomfort. The fixtures should create a comfortable environment, not worsen it. This makes you think not only about the beams of light, but also about the shape, kelvins and size of the bulb. Most insects are attracted to the three main colors in the light spectrum: green, blue and ultraviolet. They lie in the wavelength range of 300-650 nm. Beetles prefer a wavelength of 300-420 nm, despite the fact that in the light spectrum visible light is in the range of 400-800 nm.

Problem solving. The color rendering index is embedded in various lamps during their production. The range of the color rendering index is in the range of 0-100. The higher the color rendering index of light, the greater the ability to produce visible color [4]. It is believed that it is the visible color that has a high attractive ability for insects. Therefore, LED lamps manufactured with a higher color rendering index have an increased ability to attract beetles [5]. LED lamps, which cover the ultraviolet part of the spectrum in the process of light production, have a significant attraction for beetles. The di- and trichromatic vision of most beetles tends to respond to the wavelength of ultraviolet light, which is less than 380 nm. LEDs are mainly produced to obtain high lumens, rather

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than to prevent the appearance of bugs [6]. One of the important factors in the production of LEDs is the color temperature. The color temperature is also responsible for obtaining the color of the light from the lamps using the color rendering index [7]. For example, a color temperature in the range of 2,700-3,000 K allows for soft white light, while at a value of 5,000-6,500 K, light similar to sunlight is obtained [8]. LED lamps with a color temperature above 5,000 K will emit light similar to daylight, with a large amount of blue in the range of 400-500 nm. Therefore, beetles will naturally be attracted to such lamps [9]. To reduce the total (but not complete) number of insects, use LED lamps with warm shades of light or purchase amber-colored lamps, which mainly emit in the range of 600-720 nm.

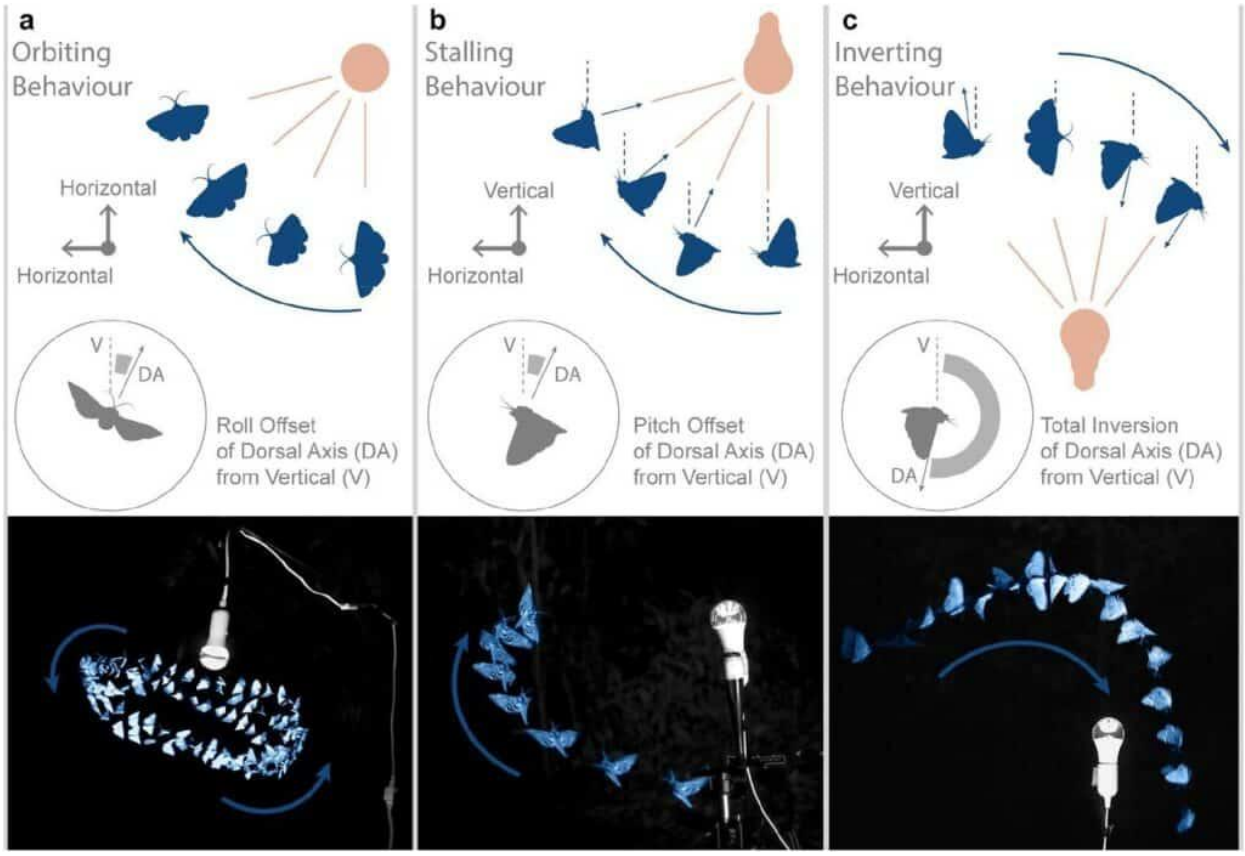

Fig. 2. Analysis of insect flight near a bright artificial light source.

Biologists have discovered strange details of insect flight near a bright artificial source. If they were above him, they turned upside down and fell into the light. Flying under the source, the insects began to describe loops in the air, and at awkward angles they also fell. And moving from the side, they began to describe circles around the light source (Fig.2) [10]. Scientists noticed that in most cases the insects flew in such a way as to hold the source from the back. Therefore, they associated this behavior with the "dorsal response to light" — one of the basic and conservative reactions that allow determining the directions up and down [11]. In natural conditions, both day and night, the upper part of the visual field almost always glows brighter than the lower one. To keep the body in the right position in flight, it is enough to keep the light closer to the back of the body. This is what insects do

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in the presence of an artificial source: it does not attract them by itself, but violates the orientation mechanisms (Fig.3).

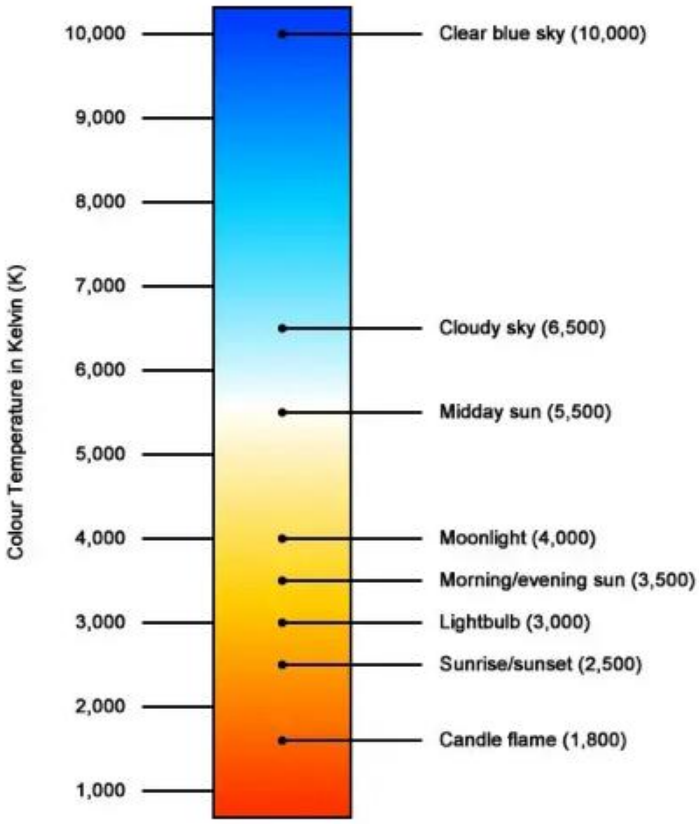

Fig. 3. Wavelengths, color temperature and heat.

Light attracts beetles and insects through a behavior known as phototaxis. It's intriguing and complicated. Phototaxis is a biological reaction in which organisms move towards or away from light. Insects such as spiders, flies, bees, wasps and moths are usually attracted by light sources. Many insects use the light of the moon and stars for night navigation. Under artificial lighting, insects get confused and fly in circles, rather than following the usual route. Some insects are attracted to ultraviolet light because they believe it is associated with flowers and food. Insect behavior affects home and business owners who want to control pests.

Conclusion. For insect protection, choose warm white LED lamps with a temperature of about 2700K. To avoid the appearance of insects and create comfortable indoor conditions, follow advanced pest protection methods.

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