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Article

UVA-UV Light Reflective Anti-Fly Tablecloth

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Abstract: The ultraviolet A (UVA) reflective anti-fly tablecloth was designed to solve the problem of fruit flies. This tablecloth was coated to reflect ultraviolet rays, effectively prevent fruit flies, and provide a clean and comfortable learning environment. Fruit residues attract fruit flies to breed, causing trouble for students' health and learning. To solve this problem, considering the traditional fly control methods, we proposed a long-acting, low-cost, and harmless solution for humans. We used paint made of enamel and a polymer dispersant, which was mixed and applied to the tablecloth, and treated the tablecloth with waterproofing to make it reflect ultraviolet light. The tablecloth showed fly-proof and long-lasting effects at a low cost and can be used for various furniture and materials. The tablecloth can be used for an environmentally friendly, comfortable, and clean learning environment, repelling the fruit fly.

Keywords: Anti-UV, Compound eye, Titanium dioxide, Zinc oxide

1. Introduction

Using a special coating that reflects ultraviolet rays, fruit flies can be repelled for a more hygienic and comfortable environment. We developed a tablecloth that prevents fruit flies from food residues on tables. We referred to traditional fly control methods to propose an innovative and long-lasting solution. By applying special paint, the tablecloth reflected ultraviolet (UV) light and became waterproof. The advantages of this design were fly-proof effects that were long-lasting, low-cost, and harmless to the human body [1]. The tablecloth was environmentally friendly and comfortable to use in the learning environment. In this study, we referred to the agricultural anti-insect mechanism to find out the scientific principles that were applied to anti-fly tablecloths not affecting the health of the user and avoiding discomfort. The physical structure was designed and produced, and the anti-fly effect was tested in this study to prevent flies and other insects from staying in areas covered with paint such as tabletops. The tablecloth had a long-term, effective, and low-cost invention with widespread benefits.

2. Materials and Methods

UV has varying degrees of significance on the behavior of insects [2]. UV is classified as UVA, UVB, and UVC. The latter two are almost absorbed by the atmosphere before entering the troposphere, and the remaining UVA is the electromagnetic wave that usually causes sunburn. In this study, we observed the characteristics of the fruit fly that is sensitive to UVA. There was diluted into tablecloths and then baked. The main materials that we used were ZnO and TiO_2. Both of them have a high degree of reflection effect on ultraviolet light and are harmless to the natural environment of the ocean [3]. These two materials were mixed with a polymer dispersant to make a coating with a resin in the form of a sol and then strengthened with a waterproof spray coating so that the tablecloth became waterproof and reflected ultraviolet light. The nano-sized ZnO dispersion with nano PU has an antibacterial effect [4]. The developed tablecloth had the effect of preventing flies from staying. Using the physical properties of materials, and the raw materials, the tablecloth was invented for long-term use at a low cost. The experimental process of this work is shown in Fig. 1.

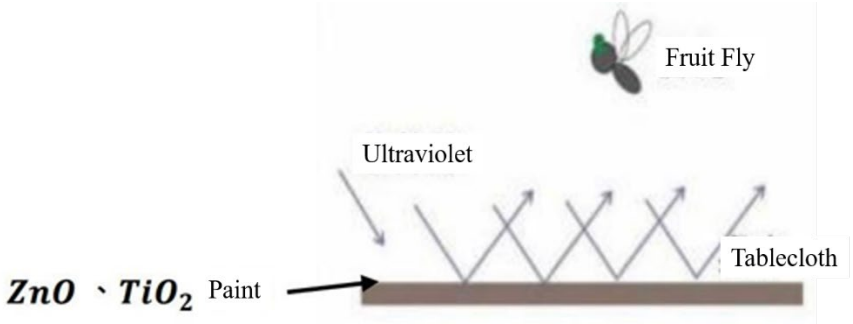

Fig. 1. Schematic diagram of experimental principle [5].

First, we took 0.5 g of polymer dispersant, dissolved it in 300 mL pure water, stirred quickly for about 15 minutes, and mixed it evenly with pure water (see Fig. 2).

Fig. 2. Polymer dispersant mixing process diagram.

We added 30 g of ZnO and 30 g of TiO_2 into the polymer dispersant solution at the same time, then stirred for about 15 minutes, and continued to observe to ensure uniform mixing (see Figs. 3 and 4).

Fig. 3. Operation diagram of adding ultraviolet reflective material.

Fig. 4. Mixing operation diagram of adding resin in a gradual pouring manner.

We added the resin slowly until the above substances were evenly mixed to form a suitable paint texture. The tablecloth was rotated to form a film in the area of 15 cm × 15 cm (see Fig. 5).

Fig. 5. Photos of tablecloths after spin cloth coating.

We baked the tablecloth at a low temperature of 70 ℃ until it was dried and set (see Fig. 6).

Fig. 6. Photo of the process of baking the tablecloth to final shape.

Then, waterproof paint was sprayed to strengthen the waterproofness, and the tablecloth was dried (see Fig. 7).

Fig. 7. Evenly sprayed waterproof coating and photos of the finished product.

3. Results

The irradiation experiment was carried out for one month. We prepared a few flies and put them in the jar, sprayed the scent on the bottle cap to attract flies, and put a tablecloth on it to test it. The tablecloth of this study reflected UV effectively, thereby repelling flies (Fig. 8 and Tables 1–5).

Fig. 8. Actual photos of the experimental group (left) and the control group (right).

Table 1. Control group test results.

Total number of jar flies	1	2	3	4	5
Number of flies staying	1	1	2	4	4

Table 2. Test results of the first week of the experimental group.

Total number of jar flies	1	2	3	4	5
Number of flies staying on tablecloth	0	0	1	1	0

Table 3. Test results of the second week of the experimental group.

Total number of jar flies	1	2	3	4	5
Number of flies staying on tablecloth	0	0	0	2	1

Table 4. Test results of the experimental group in the third week.

Total number of jar flies	1	2	3	4	5
Number of flies staying on tablecloth	0	0	1	0	2

Table 5. Test results of the fourth week of the experimental group.

Total number of jar flies	1	2	3	4	5
Number of flies staying on tablecloth	0	1	1	1	0

4. Conclusion

The developed tablecloth reflected UV rays and repelled fruit flies when exposed to UV light. This result suggested that UV has an effect in repelling flies. We will conduct more in-depth research for further development and improvement of the tablecloth. The effect of the developed paint was proven to reflect UV light under different environmental conditions. For example, multiple repeated experiments are required to verify the stability and consistency of the results. The developed tablecloth also can be used in kitchens and other outdoor activities to prevent insect breeding. The safety of this coating needs to be further studied in the future to ensure that it is harmless to the human body and the environment. Other paints can be considered for potential effectiveness against other pests or bacteria. If the developed paint is validated in a wider range of experiments, further development of related products can be considered through practical application tests in real environments. Factors such as the manufacturing, durability, and practicality of the product need to be considered in further development.

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Conflicts of Interest: The authors declare no conflict of interest.

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