ISSN: 2249-7862 (Print) : 2455-877X (Online)
www.aureoleonline.in

Design and Development of an Eco-Friendly Flying Insect Trap Device

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Abstract

Insect pests represent a major ecological and economic challenge, particularly in agricultural and domestic environments where chemical pesticides remain the dominant control method. Mupli beetle is a litter dwelling detritivore pest that causes home invasions. Widely found in rubber plantation belts, they extend from tropical Africa, Asia to Papua New Guinea. The Flying Insect Trap Device (Patent Design No. 439133-001, dated 30 November 2024) is an economic innovation which is an eco-friendly alternative to commonly practised chemical-based control systems against Mupli beetles along with other flying insects. This device aims at sustainable pest management that traps flying insects without any use of toxic substances. The paper discusses the design process, novelty in form and structure, and its potential role in promoting sustainable ecological balance [1].

Keywords: insect trap, eco-design, pest management, sustainable technology, environmental innovation

Introduction

The majority of the flying insects show a positive response towards light, they are phototropic. Various conventional flying insect control strategies often rely on chemical pesticides that contribute to environmental degradation, pollinator decline, and public-health risks [2]. These issues can only be addressed using devices that are effective and ecologically sound. A Flying Insect Trap Device with this objective to deliver an efficient, chemical-free trapping mechanism was developed [3], [4], [10]. Utilization of hard paperbound cardboards makes this design a green initiative.

Design Methodology

The design utilized eco-design principles focusing on reusability, material efficiency, and insect-attraction and an economic design suitable for both indoor and outdoor [5]. The process of design development involved idea sketching, prototyping, and 3D modeling using CAD software [6]. This design helps to reduce the beetle infestation at residential buildings by passive light attraction.

The design consists of a light weight, portable upper body and a removable lower body. The upper body holds a light source (halogen bulb) that acts as an attractant. The

upper body has an entrance near the platform that guides flying insects attracted to light into the inner chamber. The insects that enter the device will not be able to escape as the negative pressure developed inside using a small fan will prevent the backflow, a form exhibited by natural trapping mechanisms such as pitcher plants. The lower chamber functions as a removable insect collection unit. A bucket filled with a mixture of water and oil, is placed in the lower chamber which will help to trap the insects and kill them. The device is lightweight, portable and easy to handle for both domestic and agricultural applications which makes it compact and ergonomic. Its simple yet user-friendly design ensures effective pest control while ensuring an environmentally conscious design [9].



Figure 1. 3D design model of the insect light trap device developed

Novelty and Functional Aspects

The flying insect trap device is novel in its unique shape and utility. It facilitates natural insect attraction and entrapment using non-toxic materials and light sources. This device employs a passive airflow mechanism that channels insects inward and prevents escape [10]. Unlike conventional traps that depend on chemicals or mechanical suction, this device helps to catch flying insects using their property of attraction towards light. The anterior inlet allows the light attracted insects to enter the box and get towards the water container. Insects that fall in the water will die eventually, which makes this device user friendly. A negative pressure generated through a small fan at the base of the device will help to suck the trapped insects into the container. Application of naphthalene powder can perform the function of the fan otherwise.

A major highlight of this innovation focuses on flexibility, that anyone can prototype this design based on the simplicity of construction, and use of biodegradable or recyclable materials [4]. Efficiency, durability, and aesthetic refinement of this design offers



Figure 2. A functional prototype developed using nature friendly materials

a practical, eco-friendly solution for everyday sustainable insect management practice[6].

Application and Sustainability Impact

The flying insect trap device can be applied in broad areas across domestic, agricultural, and educational settings. Mupli beetles are one of the major infestation pests affecting households that can be passively controlled using this device [9]. It can also be used as a sustainable pest-control tool, hence reducing harmful pesticide dependency [1]. Its lightweight, portable, and nature friendly design helps even a common man to develop a prototype using available materials at home. The device helps to improve sustainable living practices and biodiversity conservation by selectively targeting light attracted flying pest species while maintaining ecological harmony [5], [8].

Conclusion

This flying insect trap device can definitely contribute to the field of sustainable eco-friendly pest management innovations. It helps to adapt a low-cost, environmentally responsible alternative to chemical pest control of flying insects [7], [4]. In summary, this design shows how ecological balance and sustainable pest management can together deliver a product that is practical, eco-friendly and inclined with global sustainability goals [5].

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