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# Trapping Power of Incandescent Light Color Traps against Copra Pests in Minahasa Regency

**Dantje Tarore[1*], Jusuf Manueke[1], Vivi B. Montong [1], Frangky J. Paat [1]., Lucia Cecilia Mandey[2], Daisy S. Kandowangko[1]**

[1]*Department of Agriculture, Sam Ratulangi University, Manado, North Sulawesi 95115 Indonesia*
[2] *Postgraduate Program of Sam Ratulangi University, North Sulawesi 95115 Indonesia*
*Corresponding author:
dantjetarore61@gmail.com

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**Abstract**

This study aims to determine the trapping efficacy of white, red, blue, green, and yellow incandescent light color traps on copra pest populations. The study employed a completely randomized design (CRD) with five treatments and three replications. The treatments were as follows: A = white light trap, B = red light trap, C = blue light trap, D = yellow light trap, E = green light trap, and F = control (trap without light). This research uses a descriptive exploratory approach.
The results indicated that three types of copra pests were trapped across the five light color traps: Necrobia rufipes, Carpophilus dimidiatus, and Tribolium castaneum. N. rufipes had the highest number of trapped adults, averaging 194.32 individuals, followed by C. dimidiatus with 112.0 individuals, while T. castaneum had the lowest count with 99.66 individuals. The highest populations of trapped N. rufipes, C. dimidiatus, and T. castaneum were observed in the white (42.0 adults), red (26.33 adults), and yellow (21.33 adults) incandescent light traps, respectively.

**Keywords:** *Catching power test, light traps, copra insect pests, pests' control.*

## INTRODUCTION

Coconut (*Cocos nucifera*) is a plant of the *Arecaceae* family and the sole member of the genus *Cocos*. Almost every part of the coconut plant is utilized, making it a multipurpose crop, particularly valuable to coastal communities. Coconut fruit serves as a primary source of vegetable oil and can also provide protein, vitamins, minerals, and carbohydrates. Coconut meat is processed into a variety of useful products, one of which is copra (Mandey, et al., 2024).

Copra, a product derived from dried coconut meat, is widely produced due to its relatively simple processing methods, (Xiao et al., 2017). Production costs for copra are lower than those associated with processing coconut meat into products like dry coconut milk or cooking oil. However, copra production faces several challenges, notably losses due to pest infestations. Pests attack not only crops in the field but also stored agricultural products. Significant pests affecting copra include insects, fungi, and bacteria (Gabriel et al., 2020).

Several important insect pests have been identified in copra commodities. These pests typically target lower-quality copra with a high moisture content above 15%. Key insect pests affecting copra include *Necrobia rufipes* De Geer, *Carpophilus dimidiatus* F., *Tribolium castaneum* Herbst., *Ahasverus advena* Walt., and *Oryzaephilus surinamensis* L. (Tarore, et al., 2025 and Williams & Scharf, 2024., Hasan, et al., 2020a and Kumara, et al, 2015.

Efforts to control copra pests have largely been limited to physical or mechanical methods, which have proven only partially effective. Research on copra pest infestations in North Sulawesi indicated substantial economic losses and reduced defecation, with pest damage causing losses of 5-10% in copra yield over three months. The Center for Plantation Research and Development also reported severe damage from *N. rufipes* in improperly stored copra, leading to weight loss and compromised product quality due to pest activity.

The challenge in controlling stored-product pests lies in finding agents that are effective, simple, economical, hygienic, and safe (Khalil et al., 2021). Studies have shown promising results in using physical control agents, such as ultraviolet and microwave irradiation, thermal remediation, and silica nanoparticles, on coleopteran pests like *S. oryzae* and *T. castaneum* in stored wheat. Abd El-Aziz (2011) observed that physical treatments—such as mechanical processing, physical removal, barriers, inert dust, electric discharge, light, sound, and ionizing irradiation—can serve as hygienic control agents for stored-grain pests.

The objective of this research is to determine the trapping efficacy of white, red, blue, green, and yellow incandescent light traps in managing copra pest populations.

## MATERIALS AND METHODS

This research was conducted at the Laboratory of Plant Pests and Diseases, Department of Plant Pests and Diseases, Faculty of Agriculture, Sam Ratulangi University, Manado. Copra samples showing symptoms of pest infestation were collected from copra warehouses in Minahasa District. The study took place over six months, from February to September 2022.

Materials and tools used in this research included pest-affected rice, alcohol, ethyl acetate, aqua glass, transparent adhesive glue, treatment boxes, colored light bulbs (red, yellow, green, blue, and white), wire jars, collection bottles, label paper, black paper, loops, clamps, brackets, a camera, and stationery.

A completely randomized design (CRD) with five treatments and three replications was used to test the efficacy of the light traps. The research employed a descriptive exploratory method (Masaroh, 2016). The descriptive method involves examining insect morphology, while the exploratory method focuses on identifying insect species in an ecosystem or product where insect types or species may be unknown.

The treatments were as follows: A = white incandescent light trap, B = red incandescent light trap, C = blue incandescent light trap, D = green incandescent light trap, E = yellow incandescent light trap, and F = Control (trap without colored light).

The layout of the research using the color spreader type can be seen in **Fig 1**.

| | | | | | |
|---|---|---|---|---|---|
| C3 | E2 | D1 | F3 | A2 | B2 |
| E1 | B3 | A3 | D2 | E3 | F2 |
| C2 | F1 | B1 | C1 | A1 | D3 |

**Fig 1.** Research layout using colored light traps in controlling copra insect pests.

Description:
A = Traps light light incandescent color white
B = Trap light light incandescent color red
C = Trap light light incandescent color blue
D = Trap light light incandescent color green
E = Traps light light incandescent color yellow
F = Control ( trap without light lamp )
1-3 = Test

## RESEARCH PROCEDURE

### Preparation

**a. Maintenance of Test Insects**

- Test insects were obtained by collecting copra from warehouses showing signs of pest infestation and then bringing it to the Plant Pests and Diseases Laboratory for rearing.
- The infested copra was placed in jars (1 kg each) and covered with white azahi cloth.
- These jars were kept for 1.5 to 2 months to allow insect pests to multiply on the copra.
- The cultured test insects were then ready for use in the research.

**b. Construction of Treatment Boxes**

- **Treatment Box Dimensions:** 160 x 100 x 75 cm.
- The frame was made with wooden beams measuring 4 x 6 cm.
- The sides, back, bottom, and top of the treatment box were covered with white gauze.
- The front wall of the box was covered with transparent plastic, which could be opened and closed.
- Colored light bulbs were placed in aqua glasses, labeled according to color, and secured with transparent adhesive.
- Each light was hung on a designated hanger in the treatment box, with six hangers corresponding to the number of color treatments and repetitions.
- The distance between each trap light hanger was 20 cm, with the traps positioned 30 cm above the bottom of the box (as shown in Fig. 2).

**c. Implementation**

- Treatment boxes containing white, red, blue, yellow, and green light traps were prepared in advance.
- Jars containing reared copra insect cultures were placed in each treatment box.
- Light trap applications were conducted in the evening, starting at 17:00 WITA.

The incandescent light trap model setup is illustrated in Fig. 3.

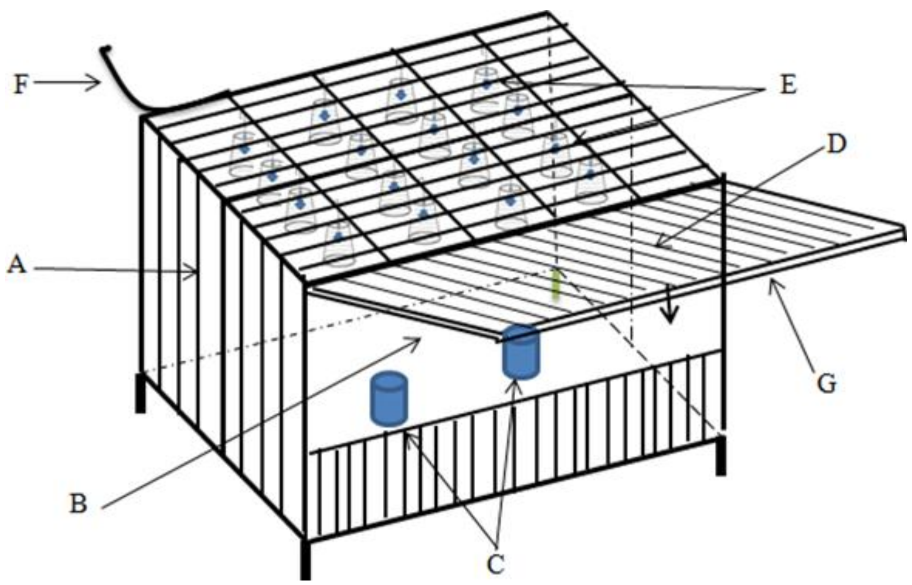


**Fig 2**. Treatment box: A = Wall of the box covered with white tiles; B = Window for observation; C = Insects tested in breeding jars; D = Window coverings for observation; E = incandescent lamp trap; F = Connecting cable to electric current; G = Tape on closing the viewing window.

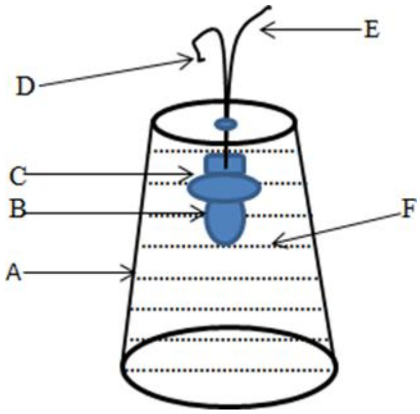


**Fig 3.** Fluorescent Color Traps: A = Used aqua glass; B = Light balloon; C = Vitting; D = Hangers; E = Connecting cable to electric current; F = transparent glue/adhesive.

***Observation***

Observations were made 3 times and the observation interval was 1 day. What will be observed is the population of copra pests trapped in each type of light color trap.

***Data analysis***

Calculation of the imago population trapped in each type of color trap uses a simple quantitative analysis with the following formula:

$$\mu = \frac{\sum xi}{n}$$

where:

μ: Average population of imago copra pests trapped in each type of light color trap

*xi*: Population of imago insect pests in each treatment.

*n*: the number of repetitions in each treatment

Data from the study of population averages between treatments were analyzed using the SPSS 21.0 program.

## RESULTS AND DISCUSSION

The results of the catching power test for each light color trap indicate that light color affects the attraction of copra pests. The populations of imago copra pests trapped in the white, red, blue, green, and yellow light traps are presented in Table 1.

Data in Table 1 shows that three types of copra pests—*Necrobia rufipes*, *Carpophilus dimidiatus*, and *Tribolium castaneum*—were trapped across all five light color traps. These pests are common on copra, with *N. rufipes* and *C. dimidiatus* identified as primary pests, while *T. castaneum* is a secondary pest.

Among these pests, *N. rufipes* consistently had the highest number of trapped imago across observations. In Observation I, *N. rufipes* accounted for 38.99 individuals, increasing to 110.66 in Observation II, and further to 194.32 in Observation III. *C. dimidiatus* had the second highest trapped population, with 14.67 individuals in Observation I, 53.34 in Observation II, and 112.0 in Observation III. *T. castaneum* had the lowest trapped population, with 11.66 individuals in Observation I, 24.67 in Observation II, and 99.66 in Observation III.

Hinton and Corbet (1975) and Kalshoven (1981) identified common insect pests, including *Sitophilus oryzae*, *S. zeamais*, *T. castaneum*, *T. confusum*, *C. dimidiatus*, *Rhyzopertha dominica*, *Callosobruchus maculatus*, *N. rufipes*, *Hypothenemus hampei*, and *Lasioderma serricorne*, among others. According to studies by CE Gabriel et al. (2020), *N. rufipes*, *C. dimidiatus*, and *T. castaneum* were found attacking copra in Manado City, Minahasa, and Tobelo District in North

Halmahera Regency. *N. rufipes* and *C. dimidiatus* are identified as primary pests of copra, while *T. castaneum* is considered a secondary pest.

Each type of copra insect pest shows a different attraction to light color, indicating that their responses vary by light color trap type. This is reflected in the variation in the number of trapped imago for each copra pest species across the different light color traps. Statistical analyses of the differences in imago populations for *N. rufipes*, *C. dimidiatus*, and *T. castaneum* can be seen in Tables 2, 3, and 4.

**Table 1.** The average number of copra imago trapped in white, red, blue, green, and yellow light traps

| No. | treatment | Type (Imago/ tail) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | | | II | | | III | | |
| | | Mr | CD | Tc | Mr | CD | Tc | Mr | CD | **Tc** |
| **1** | A | 11.33 | 4.0 | 2,33 | 26.0 | 11.33 | 6,67 | 42.0 | 23,33 | **18.33** |
| **2** | B | 7,33 | 2,33 | 3,33 | 21.67 | 8.67 | 4,33 | 40,33 | 26,33 | **20,67** |
| **3** | C | 6,33 | 2.0 | 1.67 | 20,33 | 10.33 | 2.67 | 37.0 | 25.0 | **20,33** |
| **4** | D | 5.0 | 3.67 | 2.0 | 17,33 | 10.67 | 5,33 | 33,33 | 22.0 | **19.0** |
| **5** | E | 8.67 | 2.67 | 2,33 | 23.0 | 11.67 | 5,67 | 41.33 | 24,67 | **21.33** |
| **Amount** | | **38.99** | **14.67** | **11.66** | **110.66** | **53,34** | **24,67** | **194.32** | **122.0** | **99.66** |

Description:
A = white incandescent lamp light trap; B = red incandescent light trap; C = Blue incandescent light trap; D = green incandescent light trap; E = yellow incandescent light trap; F = Control (Trap without light; Nr = Necrobia rufipes; Cd = Carpophilus dimidiatus; Tc = Tribolium castaneum.

**Table 2.** Average number of *N. rufipes imago* trapped in white, red, blue, green, and yellow light trap types

| Number | Treatment | Average Population *N. rufipes* ( Tail ) | Notation * |
|---|---|---|---|
| 1. | Control | 0.3333 | a |
| 2. | Trap Light Light Incandescent Green Color | 33.3333 | b |
| 3. | Trap Light Light Incandescent Color Blue | 37,0000 | c |
| 4. | Trap Light light Incandescent Red Color | 40.3333 | CD |
| 5. | Trap Light Light Incandescent Color Yellow | 41.3333 | d |
| 6. | Trap Light Light Incandescent Color White | 42,0000 | d |

Alpha = 0.05

Data in **Table 2** showed that *N. rufipes* had the highest population of trapped adults in white light traps, which was an average of 42.0 individuals, followed by yellow light traps with 41.33 individuals, red light traps with 40.33 individuals, and light trap types. green 37.0 individuals, and the lowest in green light traps is green, namely 33.33 individuals.

The data in Table 3 shows that C. dimidiatus has the highest population of trapped imago in the red light trap type, which is an average of 26.33 individuals, followed by blue light traps with 25.0 individuals, yellow light traps with 24.67 individuals, and types of white light traps are 23.33 individuals, and the lowest is green light traps, namely green, namely 22.0 individuals.

Table 4 shows that *Tribolium castaneum* had the highest average population of trapped adults in yellow light traps, with an average of 21.33 individuals. This was followed by blue light traps with 20.67 individuals, blue traps with 20.33 individuals, green light traps with 19.0 individuals, and the lowest in white light traps with 18.33 individuals.

**Table 3.** The average number of *C. dimidiatus imago* trapped in white, red, blue, green, and yellow light traps

| Num ber | Treatment | Average Population *N. rufipes* ( Tail ) | Notation* |
|---|---|---|---|
| **1.** | Control | 0. 0000 | **a** |
| **2.** | Trap Light Light Incandescent Green Color | 23.3333 | **b** |
| **3.** | Trap Light Light Incandescent Color Blue | 22,0000 | **b** |
| **4.** | Trap Light light Incandescent Red Color | 25.0000 | **C** |
| **5.** | Trap Light Light Incandescent Color Yellow | 24.6777 | **d** |
| **6.** | **Trap Light Light Incandescent Color White** | **26.3333** | **e** |

**Table 4.** Average number of adult *T. castaneum* trapped in white, red, blue, green, and yellow light traps from observations

| Number | Treatment | Average Population *T. castaneum* | Notation *) |
|---|---|---|---|
| 1. | Control | 0.0000 | a |
| 2. | Trap Light Light Incandescent Color White | 18.3333 | b |
| 3. | Trap Light Light Incandescent Green Color | 19,0000 | bc |
| 4. | Trap Light Light Incandescent Color Blue | 20.3333 | bc |
| 5. | Trap Light light Incandescent Red Color | 20.6667 | bc |
| 6. | Trap Light Light Incandescent Color Yellow | 21.3333 | c |

Alpha = 0.05

According to Budiamur (2014), insects can see wavelengths ranging from 300–400 nm (close to ultraviolet) up to 600–650 nm (orange). Lumoly (2019) found that black and white light traps were especially attractive to Sitophilus oryzae and Tribolium species. Fatmala et al. (2016) reported high insect diversity indexes for blue, white, and green light traps, with values of 3.070, 2.457, and 2.423, respectively.

Mohan et al. (2017) and Faradila et al. (2021) indicated that color traps are widely used for insect pest monitoring and control due to their practicality and low cost. Insects are attracted to contrasting colors, with green (a blend of blue and yellow) being particularly attractive, as well as yellow and blue separately.

Light color is determined by wavelength, with humans perceiving light within 380–780 nm. However, insects can see longer wavelengths than humans and are particularly drawn to ultraviolet light, which is naturally absorbed by leaves (Budiamur, 2014). Masaroh (2016) observed that nocturnal insects responded most strongly to yellow light in cocoa plantations in Malang, while Faradila (2020) found in Liwa Botanical Gardens that yellow light traps attracted the most nocturnal insects, with blue and green traps attracting the fewest.

In Budianur's (2014) comparative analysis of light colors on nocturnal insects in Nyaru Menteng Forest, yellow and white lights attracted the highest insect populations, while green, red, and blue attracted fewer. Manueke et al. (2015) found that Sitophilus oryzae populations were higher in black, blue, and red packaging, with lower populations in white and yellow packaging, suggesting that white and yellow could be effective colors for packaging aimed at pest control.

These findings support the idea that light traps with high insect attractiveness can be used for postharvest pest control, while certain colors disliked by pests can be applied in packaging to protect stored grains and reduce postharvest losses.

## CONCLUSION

Based on the research findings and discussions, the following conclusions can be drawn:

Light traps show potential as a control method for copra pests.

1. Different copra pests exhibit varied preferences for light colors.
2. Necrobia rufipes pests are more attracted to white, yellow, and red light traps.
3. Carpophilus dimidiatus shows a preference for yellow, red, and blue light traps.
4. Tribolium castaneum is attracted to red, blue, and yellow light traps.

These insights can be applied to optimize light trap strategies for effective copra pest management.

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