Increasing the weight of onion bulbs due to the reduction of *Spodoptera exigua* using a portable light trap

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**Abstract.** Red onion is one of the strategic horticultural commodities whose distribution is almost in all regions of Indonesia. The problem of this commodity is the low productivity resulting from the *Spodoptera exigua* pest attack. Based on the problem above, the purpose of this research is to design a portable pest control lamp. This lamp will be measured its effectiveness in trapping pests. This study also aims to determine the effect of trap effectiveness on increasing the weight of onion bulbs. This study used a randomized block design with 3 treatments. The observed variables were the number of pest catches in each treatment as well as the weight of onion bulbs produced by the land that was placed in each treatment. The results showed that T3, a trap with a constant light, was the best treatment with an average yield of *S. exigua* catch reaching 126.75 *S. exigua*. The second best results were given by T2 and T1 with an average catch reaching 74.75 and 46.75. The best weight is also given by T3 with an average weight reaching 116 g. The second best results were given by T2 and T1 with an average weight of 96 g and 85 g.

1. **Introduction**

Red onion is one of the strategic horticultural commodities whose distribution is almost in all regions of Indonesia. The majority problem to develope this commodity is the low productivity as a result of *Spodoptera exigua* [1] and [2]. This happens because the onion plant is the main host of *S. exigua*. [3] and [4] state that the *S. exigua* pest attacks onion cultivation from the vegetative phase to the time of harvest and during severe attacks can cause losses of up to 100%.

Facing this problem, what is done by farmers is conventional control using the yellow trap. However, the application of this control is less optimal because at night it is not visible to pests, considering that *S. exigua* pests start to attack at night [5]. In addition, the *S. exigua* is also not too fond of the color yellow. This is in line with the results of research [6] and [7] which state that white lights are more attractive to *S. exigua* than yellow lights.

Knowing such conditions, farmers add another conventional control device in the form of lights [8]. However, its application is also not optimal because there is still a distance between the water tank and the lamp that can cause pest to escape even though it has been trapped before. The relatively short age of the lamp construction and electrical circuit also results in the application of this model to be less economical. The last drawback is that the energy source that uses alternating current often causes electrical short circuit.
Based on the problem above, the purpose of this research is to design a portable pest control lamp. This lamp will be measured its effectiveness in trapping pests. This study also aims to determine the effect of trap effectiveness on increasing the weight of onion bulbs.

2. Methodology

2.1. Preparation of Portable Light Trap
Traps can be made using used bottles, inside the used bottles are mounted with spiral led ribbon lights as in figures 2 and 3. The electrical circuits are installed in a box under the bottles. The outer layer of the bottle is coated with plastic, then coat the outer plastic with glue to trap pests. The traps that have been made are then installed at a flight height of $S. exigua$, 60 cm. The lights are turned on just before dusk, which is around 5.30 p.m until 20.00 p.m. The light energy source uses batteries.

![Figure 1](image1.png)

**Figure 1.** (1) hanger, (2) top side, (3) tube, (4) lamp, (5) bottom side, (6) electronic components, (7) timer, (8) battery, (9) box

![Figure 2](image2.png)

**Figure 2.** The trap looks sideways

![Figure 3](image3.png)

**Figure 3.** Traps look ahead

2.2. Experimental Design
This study used a randomized block design with 3 treatments. The observed variables were the number of pest catches in each treatment as well as the weight of onion bulbs produced by the land that was placed in each treatment.

| Treatments | Description                                      |
|------------|--------------------------------------------------|
| T1         | Control tools used by farmers everyday           |
| T2         | Treatment of tools based on blinking lights      |
| T3         | Treatment of tools based on not blinking lights  |
2.3. Treatment Application and Data Collection
The light trap was applied to 3 red onion fields measuring 180 m² located in Gending District, Probolinggo Regency. The three fields are separated from one another by 100 meters. The three fields were also given the same fertilization, which used liquid organic fertilizer. The third application is done when the age of onion enters the second month. Repetition is done 3 times a week, this repetition is carried out for 4 weeks until the age of the onion reaches the age of harvest (2 months).

The captured pests will be observed by adjusting to the \textit{S. exigua} morphology, this is done to ensure that the pests that are caught are actually \textit{S. exigua}. While the weight of onion bulbs will be measured using a digital scale. The catch of pests and onion bulbs weight in the field will be written on research instruments such as table 2.

3. Results and Discussion

3.1. Effect of Light Trap on \textit{S. exigua} Population
Based on observations made, it was found that the best catch was given by T3 with an average number of catches reaching 126.75 \textit{S. exigua}. The second best results were given by T2 and T1 with an average catch reaching 74.75 and 46.75. From this table it is also found that the effectiveness of T3 is almost 3 times compared to the effectiveness of T1 which is a conventional lamp used by farmers. This effectiveness is obtained from the results of the application of the glue-tube-light collaboration system applied to T3. The effectiveness of T3 is also far from leaving T2 with the same lamp but the blazing pattern of the lamp is used blinking.

| Treatments | The average number of \textit{S. exigua} caught per week | Mean |
|------------|--------------------------------------------------------|------|
|            | Week 1          | Week 2 | Week 3 | Week 4 |      |
| T1         | 52              | 46     | 48     | 41     | 46.75|
| T2         | 69              | 77     | 74     | 79     | 74.75|
| T3         | 125             | 129    | 122    | 131    | 126.75|

The above results reinforce research [5] that \textit{S. exigua} uses its vision in adapting to the environment. \textit{S. exigua} is also able to use the moonlight to see and choose which locations they will use to breed [9]. The results of this study also found a finding that the lights were quite effective in suppressing the population of \textit{S. exigua} broodstock. This author found when observing the application of T2, \textit{S. exigua} failed to approach T2 because of the concept of the blinking lights, where at one time the lights were dim and one time bright. This condition actually makes \textit{S. exigua} confused and never approaches the trap.

This finding is in line with the results of the study [10] which states that the strength of the light lamp affects the coming \textit{S. exigua}, a lamp with greater strength will attract the arrival of \textit{S. exigua} more. The results showed that lamp traps with a constant flame were most preferred by \textit{S. exigua} compared to other treatments. This is presumably because the light on the T3 is brighter compared to other treatments.

According to [6], white lights will be more attractive to \textit{S. exigua} moths than yellow lights. The range of wavelengths produced by a 10 watt lamp is around 379.2-640.9 nm [11]. Therefore, \textit{S. exigua} will be more interested in the color spectrum which has a wavelength of 400-600 nm where this range is the wavelength range of its host [12]. Different light colors will emit different wavelengths [13]. Meanwhile the farther or dimmer the light, the less likely the insects to approach [14].

3.2. Effect of The \textit{S. exigua} Reduction on Increasing the weight of onion bulbs
Based on the weighing that had been done, it was found that the best onion bulbs weight was given by T3 with an average weight reaching 116 g. The second best results were given by T2 and T1 with an
average weight of 96 g and 85 g. From this table it was also found that the weight of onion bulbs from land given T3 produced the highest weight compared to land given T2 and T1. Increasing the weight of onion bulbs produced will be directly proportional to the high rate of onion production in a field.

| Treatments | Rata-rata berat umbi basah bawang merah (g) |
|------------|---------------------------------------------|
| T1         | 85                                          |
| T2         | 96                                          |
| T3         | 116                                         |

One of the main factors influencing the yield of onion bulbs weight is the successful control of *S. exigua*. It can be seen in tables 2 and 3 that T3 gives the highest *S. exigua* catch, where these results are directly proportional to the weight of onion bulbs produced by land given T3. In this case, it can be seen that the more insects caught in the light trap, the chance of the insects in breeding will be interrupted. The capture of *S. exigua* will affect the activity of males and females to meet so that the level of attack by *S. exigua* on shallots will also be affected. At the same time, liquid fertilizer given early in the planting period can work optimally to supply nutrient requirements on the leaves where the condition of the leaves of the onion plant is in good condition because the *S. exigua* attack has been reduced.

The high onion bulbs weight produced is thought to be due to the role of the elements Mg, Potassium and Nitrogen contained in the fertilizer used. This is consistent with the results of research [15] which states that Magnesium (Mg) can increase the length and diameter of the tuber better, because magnesium has a role in activating enzymes related to carbohydrate metabolism, respiratory enzymes, and also works as a catalyst. In addition, magnesium also functions as a cofactor in enzymes, especially those that activate the phosphorylase process.

Element potassium is importance because it is able to synthesize proteins to stimulate the formation of tubers more perfect. This is according to the opinion [15], potassium has an important role in the process of photosynthesis directly, able to increase growth and leaf area index in addition to having a function to increase CO₂ assimilation, can also increase the translocation of photosynthetic results out of leaves (to other tissues that need).

The role of Nitrogen is a building material for proteins, nucleic acids, enzymes, and alkaloids in each plant growth, especially plant vegetative growth. This is consistent with studies [16] which reported an increase in nitrogen levels that could significantly increase plant height. Plants that get a lot of nitrogen are thicker green leaves and wider leaves so that the process of photosynthesis has increased. This is consistent with the opinion [16] that the role of nitrogen is very important for vegetative growth, especially the leaves are more green colored, can increase the root shoot ratio, and affect the formation of fruit in seeds.

4. Conclusion
The results showed that T3, a trap with a constant light, was the best treatment with an average yield of *S. exigua* catch reaching 126.75. The second best results were given by T2 and T1 with an average catch reaching 74.75 and 46.75. The best onion bulbs weight is also given by T3 with an average weight reaching 116 g. The second best results were given by T2 and T1 with an average weight of 96 g and 85 g. From this study, a major finding was found that there was a relationship that was directly proportional between the high number of catches of pests and the high weight of onion bulbs. The main factor of this finding is the ability of plants to process nutrient supply from organic liquid fertilizers. Plants can make the maximum process to improve the quality of life if the condition of the leaves and other parts are healthy due to the successful control of *S. exigua*.
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