Development and Study of The Efficiency of Automatic Fruit Fly Trap

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Abstract

Fruit fly are major agricultural pests that cause serious damage to fruit crops, particularly thin-skinned fruits such as oranges. A survey conducted in a 30-rai Shogun orange orchard found annual losses of approximately 300,000 baht (4–5% of the cultivated area). Conventional traps using Methyl eugenol, Protein hydrolysate, and sticky glue but required frequent maintenance and showed limited efficiency. To overcome these limitations, an automatic fruit fly trap was developed using Methyl eugenol to attract males and Protein hydrolysate to attract females. The prototype was improved through three generations. Generation 1 combined a drip pump, fan, and Blacklight, capturing 3 times than the conventional trap Generation 2 introduced a redesigned structure, a Mist maker for improved Methyl eugenol dispersion, and yellow sticky boards, increasing captures , capturing 3.4 times than the conventional trap Generation 3 replaced the Blacklight with an automatic Protein hydrolysate refilling system, optimized the Mist maker position, and added internal and external glue insert channels, achieving captured insects 3.8 times than the conventional trap. These results demonstrate that continuous prototype improvement significantly enhanced trapping efficiency and highlights the potential of the automated trap to reduce crop losses, lower labor requirements, and support sustainable fruit production.

keywords : .Fruit fly , .Methyl eugenol , ..Protein Hydrolysate

Introduction

Fruit flies (*Bactrocera* spp.) are economically significant agricultural pests responsible for severe damage to fruit crops, particularly among thin-skinned varieties. A survey conducted in agricultural areas of Trang Province, southern Thailand, revealed that farmers sustained economic losses exceeding 300,000 baht from fruit fly infestations across a cultivated area of 30 rai, highlighting both the severity of the problem and the urgent need for more effective pest management strategies.

Currently, farmers in the affected area commonly employ plastic traps loaded with two types of attractants: Methyl eugenol to attract male fruit flies, and Protein hydrolysate to attract females. However, this approach requires a large number of traps to be installed and depends on regular labor-intensive maintenance, posing significant constraints on cost and workforce availability for smallholder farmers.

Since effective fruit fly population control requires reducing both male and female populations simultaneously in order to suppress reproduction, the research team designed and developed an automatic fruit fly trap capable of attracting both sexes concurrently. The system was developed with an emphasis on long-term continuous operation, minimal trap deployment, high trapping efficiency, and reduced labor demands. The trap underwent two rounds of iterative development and refinement to identify the most suitable components for maximizing attractant dispersal performance, utilizing both Methyl eugenol and Protein hydrolysate. Trapping efficiency was evaluated through a 30-day comparative trial against conventional trapping methods.

Methodology

1. Problem Study and Background Research

1.1 Study the problems and limitations of conventional fruit fly traps.

1.2 Investigate the behavior of male and female oriental fruit flies.

1.3 Study the characteristics of methyl eugenol and protein hydrolysate as attractants.

1.4 Study the application of solar energy and automatic control systems.

1.5 Collect background information for prototype development.

2. Prototype Design

2.1 Design the trap structure for outdoor use.

2.2 Design the internal system, including the Blacklight, mist maker, fan, timer, and solar power system.

2.3 Determine the optimal placement of the attractants and system components.

2.4 Design the electrical circuit and automatic control system.

2.5 Prepare all required materials and equipment.

3. Prototype Construction and Initial Testing

3.1 Assemble the prototype according to the design.

3.2 Install all system components, including the Blacklight, mist maker, fan, timer, and solar power system.

3.3 Fill the trap with methyl eugenol and protein hydrolysate.

3.4 Verify the operation of all systems before field deployment.

3.5 Conduct a 30-day field test in a fruit orchard.

3.6 Record the number of fruit flies captured each day.

3.7 Evaluate the performance of each component and identify operational limitations.

4. Prototype Improvement

4.1 Remove the Blacklight because the first field test showed that it was less effective in attracting oriental fruit flies.

4.2 Install an automatic protein hydrolysate refilling system to improve the continuous attraction of female fruit flies.

4.3 Optimize the mist maker to improve the dispersion of methyl eugenol.

4.4 Add yellow sticky traps to increase the overall trapping efficiency.

4.5 Reposition the mist maker and fan for more effective odor distribution.

4.6 Upgrade the electrical and solar power systems to support the improved prototype.

5. Performance Testing and Data Analysis

5.1 Conduct a second 30-day field test using the improved prototype.

5.2 Record the numbers of male and female oriental fruit flies captured each day.

5.3 Monitor the operation of the mist maker, automatic protein hydrolysate refilling system, fan, timer, and solar power system.

5.4 Compare the trapping efficiency before and after the prototype improvement.

5.5 Analyze the experimental data to evaluate the overall performance, operational reliability, advantages, and limitations of the automatic fruit fly trap.

6. Project Timeline The project was conducted over a period of 12 months, from June 2025 to May 2026

Result and Discussion

The performance of the three versions of the automatic trap was compared with that of the conventional traps used by farmers. However, each experiment was conducted during a different four-week period. Therefore, the total number of fruit flies captured cannot be directly compared among the three versions, as fruit fly populations vary with seasonal conditions and are generally higher during the fruit-ripening season. Consequently, the results should be interpreted by comparing each automatic trap with the conventional traps tested during the same experimental period.

Table 1 Comparison Table of the Number of Fruit Flies Captured by the Conventional Trap and the Automatic Trap Over a 4-Week Period (3 February 2025 – 1 March 2025)

Week	Methyl eugenol	Hydrolysate	Version 1
1	109	18	298
2	91	14	301
3	83	12	287
4	67	8	318
Total	350	52	1204

The automatic trap (Version 1) captured 1,204 fruit flies, which was approximately 3 times more than the conventional traps, which captured a total of 402 fruit flies over the four-week period

Table 2 Table 2. Comparison of the Number of Fruit Flies Captured by the Conventional Traps and the Automatic Trap (Version 2) Over a Four-Week Period (6 June 2025 – 5 July 2025)

Week	Methyl eugenol	Hydrolysade	Version 2
1	84	17	281
2	71	13	275
3	66	16	303
4	52	13	305
Total	273	59	1164

The automatic trap (Version 2) featured an improved structure, a misting system to prevent pump blockage caused by attractant solidification, additional adhesive traps around the device, and increased spacing between the attractant containers to improve trapping efficiency.

From the table, The automatic trap captured 1164 fruit flies, which was approximately 3.5 times more than the conventional traps (methyl eugenol and hydrolysate protein combined), which captured a total of 332 fruit flies over the four-week period.

Table 3 Comparison of the Number of Fruit Flies Captured by the Conventional Traps and the Automatic Trap (Version 3) Over a Four-Week Period (4 April 2026 – 3 May 2026)

Week	Methyl eugenol	Hydrolysade	Version 3
1	72	15	261
2	65	13	252
3	54	8	245
4	42	5	253
Total	233	41	1011

The automatic trap captured 1011 fruit flies, which was approximately 3.7 times more than the conventional traps (methyl eugenol and hydrolysed protein combined), which captured a total of 274 fruit flies over the four-week period.

The automatic trap (Version 3) was redesigned with a simpler and more user-friendly structure to improve ease of use while maintaining its trapping efficiency. The misting system was replaced with a floating attractant dispenser protected by a mesh cover to prevent clogging. In addition, the trap was equipped with an automatic hydrolysed protein dispensing system and adhesive trap holders on both the inside and outside of the trap to increase the capture area and further enhance trapping efficiency.

Conclusions

The development of an automatic fruit fly trap resulted in a substantial improvement in trapping efficiency compared with conventional fruit fly traps used by farmers. Three versions of the automatic trap were developed and evaluated against conventional traps using methyl eugenol and hydrolysed protein attractants. Because each experiment was conducted during a different four-week period, direct comparisons among the three automatic trap versions were not appropriate due to seasonal fluctuations in fruit fly populations. Therefore, each version was compared only with the conventional traps tested during the same experimental period.

The results demonstrated that all three versions consistently outperformed the conventional traps. Version 1 captured 1,204 fruit flies, approximately three times more than the conventional traps, which captured a total of 402 fruit flies. Version 2 captured 1,164 fruit flies, approximately 3.5 times more than the conventional traps, which captured 332 fruit flies. Version 3 captured 1,011 fruit flies, approximately 3.7 times more than the conventional traps, which captured 274 fruit flies. These findings indicate that the automatic trap maintained superior trapping performance throughout all field trials despite variations in fruit fly abundance between seasons.

The progressive design modifications also improved the practicality of the device. Version 2 incorporated a misting system to prevent pump blockage caused by attractant solidification, increased the spacing between attractant containers, and added adhesive traps around the device to improve trapping efficiency. In Version

3, the structure was simplified to enhance user convenience while maintaining high trapping performance. The misting system was replaced with a floating attractant dispenser protected by a mesh cover to eliminate clogging problems. Furthermore, an automatic hydrolysed protein dispensing system and additional adhesive trap holders were installed inside and outside the trap to increase the trapping area and improve operational efficiency.

Overall, the automatic fruit fly trap proved to be a more effective alternative to conventional fruit fly traps. The improved design not only increased the number of fruit flies captured but also enhanced ease of operation and reduced maintenance requirements. These results suggest that the developed automatic trap has strong potential for practical application in orchard pest management. Future studies should evaluate all trap versions simultaneously under identical environmental conditions and perform statistical analyses to further verify differences in trapping performance.

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