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The Effectiveness of Attractants for Fruit Fly in Orange Garden

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Abstract

Fruit flies are plant-disturbing insects that harm farmers both qualitatively and quantitatively. Initial symptoms of damage to host plants are marked by the appearance of black spots until the plant parts rot and fall. Fruit flies will inject their eggs until they hatch and become larvae, then the larvae will gnaw the fruit flesh from the inside. Control of fruit flies so far still uses factory chemical insecticides that are not environmentally friendly and leave residues that threaten health. Controlling fruit flies that are environmentally friendly and not at risk of leaving residue can use attractants made from natural ingredients. This study was aimed to determine the effectiveness of the use of natural-based attractants that utilize local raw materials on the allure of fruit fly insects. The materials used in this study were clove leaves, lemongrass leaves, guava leaves, pandan leaves, lime leaves, pineapple and star fruit. The tools used to trap insects use two tools, namely trap bottles and glue. The results showed that the use of lemongrass leaves, clove leaves, guava leaves and pineapple fruit was quite effective in trapping fruit fly pests. Lemongrass leaves more effective than others (27 results in a week). A more effective tool to use is fly glue. The most effective combination is glue with clove leaves, guava leaves, and pineapple (number of results is >100 in a week).

Keywords: Attractant; Fruit fly; Guava; Lemongrass

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INTRODUCTION

Orange is a fruit commodity that has high economic value and is widely developed there. One farmer can have several orange orchards with an area of 1,200 hectares of land planted only with oranges. Orange is a fruit category that does not know the season, it will continue to bear fruit at any time. The main harvest generally starts from July to August. One garden will produce tons of fresh oranges ready to eat. According to BPS (2021), orange production in Malang from 2018 – 2020 continues to increase significantly by 1.07% per year. However, despite this the production capability has not been able to meet market demands (Sastono & Adnyana, 2017). This can be caused by several things, one of which is caused by pests and diseases (Wirawan et al., 2014). Pests and diseases that commonly attack citrus plantations come from fruit flies.

Fruit flies are the most common pests found attacking horticultural crops such as oranges. Fruit flies are a group of insects or Plant Disturbing Organisms (PDO) causing qualitative/quantitative and qualitative losses due to decreased yields to

overall crop failure (Sahetapy et al., 2019). PDO insects will utilize plant parts to protect from sunlight and predators, reproduce and as a source of food (Budiyanto et al., 2021). Symptoms of damage that appear begins with the appearance of black spots that cause the fruit to fall before harvest. Generally fruit flies will attack fruits that are starting to enter the ripe phase.

Fruit flies will pierce the outer surface of the fruit to inject eggs through the ovipository, deposited until they hatch and turn into larvae (Vallabhbhai et al., 2018). It is these larvae that will later eat away at the fruit flesh from the inside causing decay and decreased production in terms of quality and quantity. Fruit flies often attack plantations during the rainy season (Sahetapy et al., 2019). Most farmers control pests using synthetic chemical insecticides (Sunaryo & Widiastuti, 2018; Nisa, 2020; Budiyanto et al., 2021; Andika et al., 2023). So far, fruit fly pest control still uses artificial chemical pesticide spraying, installing mothballs, making smoke by burning straw, and wrapping fruit with plastic which is less effective and leaves residues that are harmful to consumers. Effective, efficient and environmentally friendly pest control is needed by farmers in field operations (Firmanto et al., 2021).

A safe treatment that can be used to overcome this problem of fruit flies can be using attractants. Effective and environmentally friendly controls to suppress fruit fly populations can use methyl eugenol as an attractant (Firmanto et al., 2021; Mino, 2022; Susanto et al., 2018). Methyl eugenol is able to attract male insects because its aroma is similar to the sex pheromones of female fruit flies for copulation (Septariani et al., 2019; Mino, 2022). Male fruit flies will be attracted to methyl eugenol because of its ability to attract insects to come or "lure" so that the use of methyl eugenol is widely used by researchers to conduct surveys as well as monitor populations and control certain insects (Shelly, 2010; Tan & Nishida, 2012 ; Kardinan et al., 2020). The bodies of male fruit flies will convert methyl eugenol compounds into coniferyl alcohol and pheylpropanoid compounds, which function as sex pheromones to attract female insects (Vargas et al., 2000; Pujiastuti et al., 2020). Fruit flies need methyl eugenol to produce sexual pheromones to attract female fruit flies and carry out sexual reproduction.

The use of natural pheromones for the treatment of fruit flies has been studied by Andika et al. (2023) who used fermented star fruit, manganese, chili and pineapple using yeast to produce attractants. The results obtained show that all ingredients are effective for catching fruit flies. From this research, the current study intend to develop the manufacture of attractants with local raw materials around partner locations to control fruit fly pest populations. The population of fruit flies in Wonorejo Village is currently large, causing fruits and vegetables to spoil and rot before harvest.

Handling fruit flies using attractants has actually been practiced by farmer groups, but they are starting to be abandoned because the supply of attractants is not smooth and the prices are relatively expensive. In fact, when seen there are many local raw materials around that can potentially be used to make attractants. These ingredients include lemongrass, cloves (Firmanto et al., 2021), star fruit, pineapple (Andika et al., 2023), basil and basil (Rachmawati et al., 2022). Departing from the problems experienced by the farmers of this one urip source, an idea was sparked to deal with the problem of the fruit fly population using attractants with local raw materials.

This study aims to analyze the most effective attractant ingredients in attracting fruit fly pests. This research has theoretical and practical contributions. Theoretically,

this research provides reinforcement for the study of ecology and insect behavior. Practically, this research can provide alternative solutions to farmers in handling fruit fly pests.

METHOD

Place and Time

This research was conducted in a citrus plantation belonging to one of the Pertanian Sumber Urip in Wonorejo Village, Poncokusumo District, Malang Regency. This research lasted for two months from January to February 2023 covering site surveys, discussing problems with partners and the process of making attractants to installation.

Tools and Materials

The materials used are attractants with several local raw materials such as lemongrass leaves, clove leaves, guava leaves, lime leaves, pineapple and EM4 to help the fermentation process run. The equipment used is equipment used to make attractants such as smoothing (blender or pounder), ripening bottles, knives, filter paper, clean containers and traps or fruit fly traps.

Research Design

The attractant that has been made will be tested on citrus plantations for one week. Observation of fruit flies was carried out using an experimental method to test the effectiveness of using local raw materials for fruit fly attractants. The fly trap or trap that we use is a trap using a bottle and fly glue. The fruit flies caught were counted every day for a week. Compare the results of each trap by counting the total number of catches to determine the effectiveness of each ingredient used and determine the best concentration.

Data Analysis

The data obtained were tabulated and analyzed in a quantitative descriptive manner. Researchers recorded results in the form of fly pests that were entangled every day and accumulated for one week. The results of the analysis will provide an overview of the effectiveness of the attractant and provide an overview of the handling of fruit fly pests.

RESULTS AND DISCUSSION

Observations on the results of the installation of attractants were carried out every day for one week to determine the effectiveness of the use of attractants for each material. In addition, monitoring is also carried out to check whether the attractants in the traps are still there or have run out. This is because when doing research the conditions are in the rainy season. Install the attractant as shown in Figure 1.

Figure 1. Installation of attractants using bottle traps

After installing fruit fly attractants on citrus plantations, observations were made. Table 1 below shows the data on the results of the attractants for each material using bottle traps.

Table 1. Trap results using a trap for 1 week

Material	Monitoring Day To…							∑
	1	2	3	4	5	6	7	
Clove leaves	1	1	-	-	-	-	-	2
Pandan leaves	-	1	2	-	-	-	-	3
Guava leaves	-	2	-	-	-	-	-	2
Lime leaves	-	-	1	-	-	-	-	1
Lemongrass leaves	4	10	6	3	2	1	1	27
Pineapple	1	2	1	-	-	-	-	4
Star fruit	-	1	3	-	-	-	-	4

After looking at the observed data, it can be concluded that the use of attractants made from lemongrass leaves is the most optimal for trapping fruit flies, then pineapples, and pandan leaves. The data also shows that the ingredients for lime leaves and star fruit are not optimal.

Apart from using traps, the researchers also tried to trap fruit flies using fly glue with an attractant in the middle. The results are as presented in Table 2.

Table 2. The results of traps using glue added with an attractant for 1 week

Material	Monitoring Day To…							∑
	1	2	3	4	5	6	7	
Clove Leaves	10	17	>20	>20	>20	>20	>20	> 100
Pandan leaves	1	2	1	-	-	-	-	4
Guava Leaves	2	>20	>20	>20	>20	>20	>20	> 100
Lime leaves	2	1	-	-	-	-	-	3
Lemongrass Leaves	7	11	8	3	-	-	-	29
Pineapple	4	19	>20	>20	>20	>20	>20	> 100
Star fruit	-	2	2	-	-	-	-	4

Table 2 shows that the results of installing the attractant using fly glue turned out to have different results from the results of using a bottle trap. The use of fly glue was found to be more effective in trapping flies. On the first day, only a few flies can be trapped. But on the second to the last day some materials were able to trap many flies. The most optimal ingredients used clove leaves, pineapple fruit, and citronella leaves, while those that were less optimal used pandan leaves and star fruit (Figure 2).

Figure 2. Attractants using cloves (top) and pineapple (bottom) using glue

Clove leaves (Syzygium aromaticum) have an effective ingredient in repelling insects. One of the main ingredients in clove leaves is eugenol, which has insect repellent properties. Eugenol has antimicrobial, antifungal and antiparasitic properties, which make it effective in repelling various insects, especially mosquitoes and other plant-damaging insects (Silva et al., 2015). Apart from eugenol, clove leaves also contain β-cariophyllene, which is a sesquiterpene that has repellent properties against insects such as mosquitoes, flies and cockroaches. Other ingredients such as acetyleugenol and α-humulen can also provide insect repellent properties (Kumar et al., 2020). The use of clove leaves as an insect repellent can be done in various ways. For example, clove leaves can be used in the form of essential oils or extracts that are applied to the body or areas that want to be protected from insects. Clove leaves can also be used dry or fresh and placed around the house or plants to repel insects. Clove leaves contain essential oils which are rich in active compounds. The main component of clove essential oil is eugenol, which gives clove its distinctive aroma and has antimicrobial, antifungal and anti-inflammatory properties. In addition, clove essential oil also contains compounds such as acetyleugenol, β-karyophyllene, and α-humulen, which have various pharmacological and insect repellent properties (Singh et al., 2007).

Lemon grass (Cymbopogon nardus L.) is a plant that is rich in important chemical compounds. Citronella plants are growing very rapidly in various industries, pharmaceuticals, cosmetics and even pesticides. Alkaloid and flavonoid components are present in almost every plant, for example, seria which contains secondary metabolites. The content of secondary metabolites can suppress the development of pest insect populations such as fruit flies. The essential oil of the citronella plant has important chemical compounds including citronella, geraniol,

citronellol, geranyl acetate and citronella acetate. Lemongrass plants can overcome pests that often attack agricultural products. The content of citronella and geraniol in lemongrass plants functions as an insect repellent (Shah et al., 2011).

The attraction of insects such as flies to perch is due to sensory nerves so that farmers feel disadvantaged due to the presence of flies. Therefore, an effective way to prevent flies from perching on plants is to damage the sensory nerves. The scent of the lemongrass plant is highly disliked by flies and the lemongrass plant can eliminate the sensory nerves of flies (Sari et al., 2022). Making attractants with lemon grass can attract insects to come closer. To control fruit fly pests, it can be overcome by using lemongrass essential oil attractants which contain methyl eugenol, which is a pheromone attractant produced by insects (Lestari et al., 2020).

Pineapple fruit (Ananas comosus) has a natural ingredient that can function as an insect repellent. The main ingredient in pineapple that is known to have an insect repellent effect is the bromelain enzyme. Although bromelain is better known for its enzymatic properties, several studies have shown that this enzyme also has insect repellent effects (Loon et al., 2018). Some insects, such as mosquitoes and several other types of nuisance insects, do not like the aroma and compounds contained in pineapple. This can help keep the insects away from the area around the pineapple or prevent them from approaching it (Hikal et al. 2021).

Guava (Psidium guajava L.) is a plant that often grows in tropical or subtropical climates. Indonesian people are already familiar with the guava plant. The guava plant is often used for its leaves because it has a million benefits in human life. Guava also has benefits as a plant pest control. All of these bioactivities are contributed by the content of secondary metabolites (Kumar et al., 2021; Musyarofah et al., 2020).

Saponin compounds can dissolve in water which are anti-bacterial and antiviral, usually referred to as natural detergents. If the saponin compound is stirred in water, it will easily form a long-lasting foam. Flavonoid compounds, saponins, tannins, essential oils (eugenol), fatty oils, contained in guava are useful as natural attractants (Atolani et al., 2016; DeFilipps, & Krupnick, 2018). This is also because the content of essential oils can produce fragrances that can attract insects such as fruit flies. Natural attractants from guava leaves are usually applied to chili, citrus, mango plants to prevent or reduce the intensity of fruit fly pest attacks. The use of natural pesticides is certainly an effective step to replace the use of chemical-based attractants which can leave residues on plants and adverse effects.

CONCLUSION

Based on the results of the study, it can be concluded that giving attractants using natural ingredients (leaves) including cloves, lemongrass, pineapple and guava gives different results. The use of attractant traps made of lemongrass leaves is the most optimal for trapping fruit flies, while pineapple, pandan leaves, lime leaves and star fruit are less optimal for trapping flies. In the installation of fly glue attractants, the most optimal ingredients were using clove leaves, pineapple fruit and lemongrass leaves while the less optimal results were using pandan leaves and star fruit.

RECOMMENDATION

Broader research in agricultural areas by paying attention to the patterns of day and night insects (nocturnal and diurnal) needs to be carried out. It is also possible to

combine attractants so that the effect of attracting or trapping flies and other insects is more effective.

Author Contributions

Methodology, writing—original draft preparation, writing—review, editing, and revision, HH; writing—original draft preparation, data curation, MAF; data curation, data analisis, AMA; data curation, data analisis, PAA and ARS. All authors have read and agreed to the published version of the manuscript.

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Conflict of interests

The authors declare no conflict of interest.

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