



Original article

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Application of Several Types of Rhizome Powder in Controlling *Sitophilus Oryzae* L. Pests in Local Siam Mutiara Rice

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ABSTRACT

Rice is the staple food of the Indonesian population. Siam Mutiara is the preferred local variety of rice in South Kalimantan. Sufficient rice availability must be supported by a rice surplus as food reserves. The main problem with rice storage is the emergence of *Sitophilus oryzae* L. Therefore it is necessary to control the pest. Non-toxic botanical pesticides can be applied to control *S. oryzae*. This study aimed to determine the effect of the application of several types of rhizome flour on the mortality rate of *S. oryzae*, population development of *S. oryzae*, and weight of Siam Mutiara rice to obtain the most effective rhizome flour. The one-factor Completely Randomized Design method (CRD) was used by treating z_0 (control/without rhizome powder), z_1 (red galangal rhizome powder), z_2 (kencur rhizome powder), z_3 (red ginger rhizome powder), and z_4 (rhizome powder combination). The results showed that the application of red galangal rhizome powder, kencur rhizome powder, red ginger rhizome powder, and rhizome powder combination was able to control the population development of *S. oryzae* and weight damage of Siam Mutiara rice due to *S. oryzae* pests. The rhizome powder that was most effective in controlling z_2 (kencur rhizome powder) with a mortality percentage of 65%, population of 3 individuals, and rice weight of 99.97%.

Keywords: *Sitophilus oryzae*, *zingiberaceae*, essential oils, vegetable pesticides

1. Introduction

Rice is the main food of Indonesian. The high demand for rice is caused by its function as a source of carbohydrates. According to data from the Food and Horticulture Department (2019), there is an increase in rice surpluses in South Kalimantan every year. Rice production in South Kalimantan experienced an increase in the surplus from 2017 to 2018. In 2017, rice production was 1,493,286 t with rice consumption of 613,437 t so that there was a surplus of 879,831 t. In 2018, rice production was 1,485,982 t with a consumption level of 510,583 t so that there was a 975,399 t surplus. Hence, it can be concluded that the rice production surplus continues to increase every year. It allows South Kalimantan to be self-sufficient in food. Siam Mutiara is a local superior rice variety in South Kalimantan.

The problem with the provision of rice stocks is in the warehouse. Damage during the storage period is generally caused by warehouse pests, namely rice weevil (*Sitophilus oryzae* L.). According to Sarastika et al. (2019), *S. oryzae* makes holes in the rice, starting from the end of the grain and extending to the entire grain. The center of the grains resembles a white line and causes the grains to

become brittle, crumble, and become flour. Therefore it is necessary to control *S. oryzae* in a way that is not toxic to humans, such as using vegetable pesticides. Using some type of orange powder pointed out the real difference in a 20-40 day storage. The percentage of rice damage does not fall apart from *S. oryzae* population. *S. oryzae* population is leading to more damage. Damage from rice can cause flour or powder to smell musty.

According to Parinduri (2010), *S. oryzae* is one of the most important pests in the barn. During the development of the eggs for imago these pests can reduce production to 20% in 5 weeks. Medicinal plants from the *Zingiberaceae* group, such as ginger, braid, and galanthas, contain essential oils that have the potential to be utilized. According to Rusli (2010), biologically, essential oil is a secondary metabolite used as a means of self-defense from predators and pest attacks. Insects and pests dislike some of the essential oils odors. Rhizomes are widely available in South Kalimantan. Therefore, research on the application of several types of rhizome flour in controlling pests (*S. oryzae*) in local Siam Mutiara rice needs to be conducted.

2. Materials and Methods

Materials

This research was conducted at the Agroecotechnology Production Laboratory, Faculty of Agriculture, Lambung Mangkurat University, Banjarbaru. The materials used in this study were Siam Mutiara Rice, red galangal rhizome, kencur rhizome, and red ginger rhizome. The tools used in this study were tea bags, rice sacks, plastic jars, binocular microscopes, analytical scales, scissors, knives, magnifying glasses, blenders, spoons, small plates, hygrothermographs, cameras, basins, filters, brushes, and stationery.

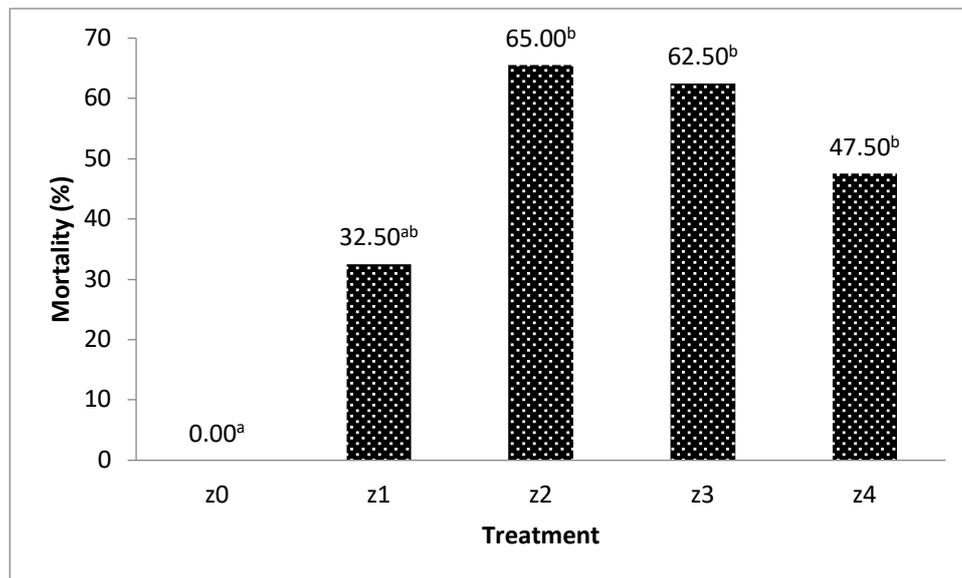
Methods

The propagation (rearing) of *S. oryzae* was carried out by inserting 50 pairs of male and female imago obtained from the storage of Siam Mutiara varieties. After ± 15 days, it was estimated that female *S. oryzae* imago has laid eggs and made holes in the rice seeds. *S. oryzae* was discarded, then the rice was left for ± 4 weeks or until the first mature *S. oryzae* derivatives appeared and could be used as the research material. Two kg of rhizome was cleaned with running water until clean, then dried for four days, and mashed in a dry blender until it became a fine powder. Then it weighed 10 g and wrapped in a teabag. A total of 100 g of rice was weighed and inserted in a jar. Ten *S. oryzae*, consisting of 5 males and 5 females, were put into a jar. The rhizome powder that has been wrapped using a teabag was inserted into the jar then closed. Observations were conducted on the percentage of *S. oryzae* mortality, population development, and percentage of rice weight (Sarastika et al. 2019). Statistical analysis was performed using IBM SPSS Statistic 21.

3. Results and Discussion

Mortality Percentage

The analysis showed that the treatment of several types of rhizome flour had a significant effect on the mortality of *S. oryzae*. The average mortality percentage is presented in Figure 1.



Description : z₀ (control/no rhizome powder); z₁ = red galanus rhizome powder; z₂ = kencur rhizome powder; z₃ = red ginger rhizome powder; z₄ = rhizome powder combination. The same letter above the line indicates that the treatment did not have a different effect based on the BNJ test at the 5% real level.

Figure 1. Graph of the percentage of mortality

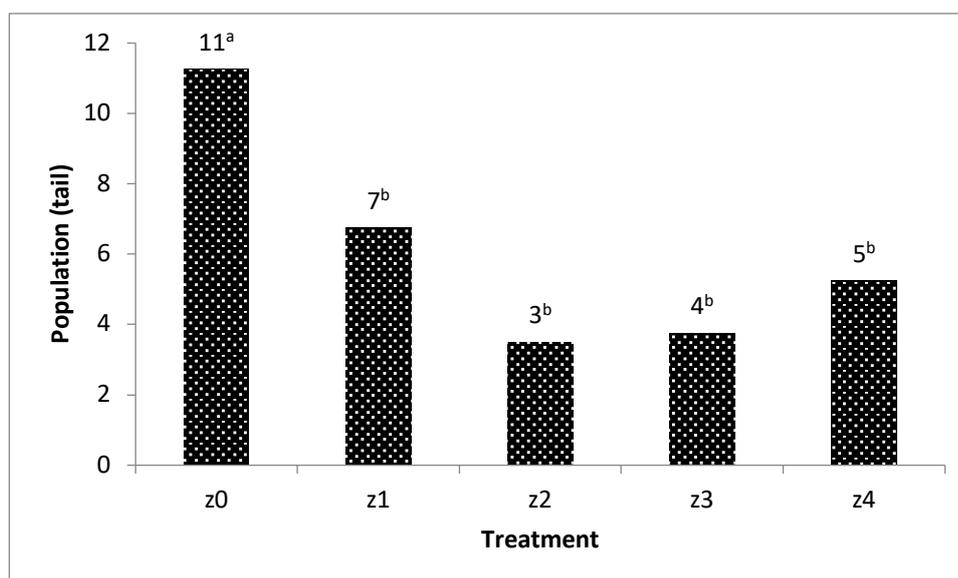
Based on the analysis of variance, rhizome flour had a significant effect on the mortality of *S. oryzae*. The treatment of z₁ (red galanus rhizome powder) was not different from the z₀ treatment (control/no rhizome powder). The control treatment (without rhizome powder) was significantly different from the treatment of rhizome powder, red ginger powder, and a combination of rhizome powder. The highest mortality was found in z₂ treatment (kencur rhizome powder) at 65.00%, and the lowest was in z₀ treatment (control/without rhizome powder) at 0%. The mortality percentage in z₁ (red ginger powder), z₃ (red ginger powder), and z₄ (combination of rhizome powder) treatment were 32.50%, 62.50%, and 47.50%, respectively.

The death of *S. oryzae* was caused by the active ingredients of the plant, so it has the potential as a vegetable pesticide. The activity of vegetable pesticides may occur due to the presence of various bioactive chemicals with different activities. According to Franz et al. (2011), the toxic effect of insecticides depends on the entry point of the toxin and the pungent aroma of the bioactive compound.

Zingiberaceae plants are toxic and can kill insects with their active ingredients. According to Rusli (2010), the compounds contained in rhizomes have the potential to affect the mortality of *S. oryzae*. The essential oil in the rhizome works like a poison in respiration. Red galangal rhizome, sash rhizome, and red ginger contain kaempferol compounds which act as effective respiratory inhibitors in insects. These compounds can block the insect olfactory organs, causing disturbances in the respiratory system. According to Asfi et al. (2015), *Zingiberaceae* plants also contain zingiberene compounds, which can reduce insect feeding activity.

Population Development

The analysis showed that the treatment of several types of rhizome flour had a very significant effect on the population development of *S. oryzae*. The average population growth is presented in Figure 2.



Description : z0 = control / without rhizome powder; z1 = red galanus rhizome powder; z2 = kencur rhizome powder; z3 = red ginger rhizome powder; z4 = rhizome powder combination. The same letter above the line indicates that the treatment did not have a different effect based on the BNJ test at the 5% real level.

Figure 2. Graph of population development

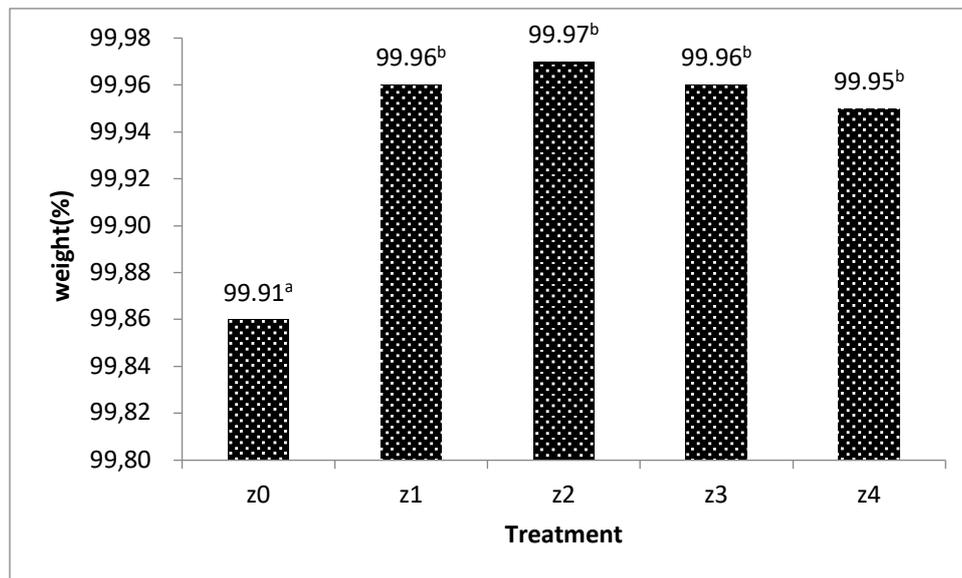
The highest *S. oryzae* population was found in treatment z₀ (control/without rhizome powder) of 11, and the lowest was in treatment z₂ (kencur rhizome powder) of 3. There were 7 in treatment z₁ (red galanus rhizome powder), 4 in treatment z₃ (red ginger rhizome powder), and 5 in treatment z₄ (ginger rhizome powder). The smaller the survival rate of *S. oryzae*, the more effective the rhizome powder is in controlling *S. oryzae* pests.

The administration of rhizome flour is very influential in suppressing the imago population. It can be seen from the absence of new imago in all rhizome powder treatments. Rhizome powder has active ingredients that can control *S. oryzae* pests. Kencur plant has a contact poison effect for insects because it contains alkaloids, saponins, flavonoids, essential oils, steroids, tannins, and polyphenols (Hasanah, 2011). Kencur on z₂ treatment (kencur rhizome powder) had the highest value in suppressing *S. oryzae* populations because it contained sesquiterpenoid compounds. The active ingredients work by blocking the sensory nerves. Red galancas have a significant effect in suppressing the *S. oryzae* population. Red galangal contains essential alkaloid oils, flavonoids, saponins, and steroids (Untoro *et al.*, 2016). Red ginger contains active ingredients of alkaloids, tannins, saponins, flavonoids, triterpenoids, and phenolics (Febriani *et al.*, 2018).

Alkaloids cause chaos in the impulse delivery system to muscle cells causing larvae to develop continuous infection and eventually paralysis until death. Flavonoid compounds function as strong inhalation inhibitors or as respiratory toxins, resulting in insects being unable to breathe and die (Miranti & Awalul, 2018). Saponins work as systemic gastric poisons that cause death in insects (Rahmat, 2017).

Weight Percentage

Analysis of variance showed that the treatment of several types of rhizome flour had a very significant effect on the weight percentage. The weight average is presented in Figure 3.



Description : z0 = control / without rhizome powder; z1 = red galangal rhizome powder; z2 = kencur rhizome powder; z3 = red ginger rhizome powder; z4 = rhizome powder combination. The same letter above the line indicates that the treatment did not have a different effect based on the BNJ test at the 5% real level.

Figure 3. Graph of weight percentage

The highest rice weight was found in z₂ treatment (kencur rhizome powder) of 99.97% and the lowest at z₀ (control/without rhizome powder) of 99.86%. Whereas, in the treatment z₁ (red galanus rhizome powder), z₃ (red ginger rhizome powder), and z₄ (the combination of rhizome powder) were 99.96%, 99.96%, and 99.95%, respectively.

The decrease in rice weight was influenced by the *S. oryzae* population and storage time. Rice containing *S. oryzae* in a low population and stored for a long time will cause high rice damage. According to Alonso *et al.* (2011), the percentage of weight loss and perforated rice increased sharply during the rice storage process. *S. oryzae* is an important warehouse pest insect. It causes significant damage to grain foods stored in the tropics.

In the 21-day observation, there were samples with whole rice that were still experiencing larval and cocoon stages. The weight of rice can be seen from the amount of rice that has become powdered. There was rice that had been damaged by the impact like a white line. According to Sarastika *et al.* (2019), *S. oryzae* makes rice with holes starting from the end of the grain and extending to the entire grain of rice. The center of the grains resembles a white line and causes the grains to become brittle, crumble, and become flour.

The administration of rhizome flour to rice for 21 days gave a strong aroma that can control *S. oryzae* pests. There was no change in the color of the rice due to rhizome powder administration. Environmental factors that affect the life of *S. oryzae* are temperature and humidity. The temperature during the 21 days of the study ranged from 29-32.6°C, and humidity ranged from 59-79%. According to Wagiman (2014), the external factors affecting the *S. oryzae* population are temperature and humidity. Optimum temperatures range from 17-34°C, and relative humidity ranges from 42-100%.

4. Conclusions

Application of several types of rhizome powder affected *S. oryzae* mortality, *S. oryzae* population development, and local rice weight of Siam Mutiara. Rhizome powder which is effective in controlling *S. oryzae* pests in Siam Mutiara local rice is z₁ (red galangal rhizome powder) with a mortality percentage of 32.50%, population of 7 individuals, and rice weight of 99.96%; z₂ (kencur rhizome powder) with a mortality percentage of 65%, population of 3 individuals, and rice weight of 99.97%;

z₃ (red ginger rhizome powder) with a mortality percentage of 62.50, population of 4 individuals, and rice weight of 99.96%; and z₄ (rhizome powder combination) with a mortality percentage of 47.50%, population of 5 individuals, and rice weight of 99.95%.

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