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The application local *Beauveria bassiana* Balls (Vuill.) flour formulation with bran flour carrier against *Spodoptera frugiperda* J.E Smith larvae in laboratory

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Abstract

Maize is a food crop that has high economic value in Indonesia. Pest attacks on maize are an obstacle in the cultivation of maize. *Spodoptera frugiperda* J.E Smith is a maize pest that can cause a 100% reduction in yield. Control using the local entomopathogenic fungi *Beauveria bassiana* is an effort to control *S. frugiperda* using environmentally friendly materials. Local *B. bassiana* can be made in the form of a flour formulation by adding a carrier material, namely bran flour. The purpose of this study was to obtain the best addition of bran flour to the local *B. bassiana* flour formulation on the mortality of corn plant pest *S. frugiperda* in the laboratory. The research was conducted using a completely randomized design consisting of five treatments and four replications. The treatment given was the addition of bran flour to 30 g of local *B. bassiana* flour formulation, namely 0 g, 0.45 g, 0.60 g, 0.75 g, 0.90 g. The results showed that the application of 30 g of local *B. bassiana* flour formulation with the addition of 0.90 g of bran flour was the best addition of bran flour to control *S. frugiperda* larvae by causing total mortality of 80%, early time or death of 42.25 hours after application, and Lethal Time 50 117 hours after application.

Keywords: Bran flour carrier; Flour Formulation; Local *Beauveria bassiana*; *Spodoptera frugiperda*

1. Introduction

Maize is a food crop that has a high carbohydrate and protein content which is widely used as food and a source of income for farmers. Maize production in Riau Province in 2019 reached 24,374 tons and increased in 2019 to 70,954 tons [1].

The fall armyworm *S. frugiperda* is an invasive insect that attacks maize plants in Indonesia. This pest originates from the tropics and subtropics of America and in 2019 was found in corn plants in the Sumatra region [2]. *S. frugiperda* attacks maize plants on young leaves that are still rolling and is characterized by bite holes and dirt. In addition to attacking young leaves, it also attacks corn cobs, so this pest attacks corn plants in the vegetative and generative phases.

Plant pest control that often uses chemical insecticides among farmers can have negative impacts such as the death of non-target organisms, pest resurgence, pest resistance, and leave residual effects on the agricultural environment. So that it requires another effective and relatively safe way of controlling plant pests, the solution that can be done is to use the biological agent local entomopathogenic fungi *Beauveria bassiana* .

The use of local *B. bassiana* isolates in plant pest control is effective because *B. bassiana* has a better ability to adapt to the local ecosystem and does not disturb the ecological balance. *B. bassiana* can be made in various formulations. Referring to Suwahyono [3] *B. bassiana* can be made in the form of flour formulations because it has advantages including being able to be stored for a long period of time, easy to apply, and practical. *B. bassiana* in the form of flour

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formulation can be made by adding a carrier material as energy and nutrients for the development of *B. bassiana*, the carrier material that can be used is bran flour [4]. Bran flour is a rice milling waste that is relatively cheap, easy to obtain and contains carbohydrates and proteins which are sources of nutrients and energy that are needed in the growth of the entomopathogenic fungi *B.bassiana*. The purpose of this study was to obtain the best addition of bran flour to the local *B. bassiana* flour formulation on the mortality of *S. frugiperda* in the laboratory.

2. Research Method

This research was conducted at the Laboratory of Plant Pest, Faculty of Agriculture, Riau University, Pekanbaru, with temperature of 24,8 ℃. The material used was a local *B. bassiana* isolate Desita Salbiah collection, *S. frugiperda* larvae third instar, rice, bran flour, aquades, potato dextrose agar (PDA), 70% alcohol, young corn. The tools used are haemocytometer, analytical scales, Laminar air flow cabinet, thermohygrometer, oven, autoclave, shaker, and other supporting tools.

The research was conducted experimentally using a completely randomized design (CRD) consisting of 5 treatments with 4 replicates obtained 20 experimental units each infested ten *S. frugiperda* larvae instar 3. The treatment given was the addition of bran flour to 30 g of local *B. bassiana* flour formulation, namely 0 g, 0.45 g, 0.60 g, 0.75 g, 0.90 g.

2.1. Research Implementation

Larvae were collected from sweet corn plantations and brought to the Plant Pest Laboratory. Larvae were reared individually and fed with young corn. Larvae were reared to pupate until they developed into imago and produced eggs. After the eggs hatch, the larvae are reared individually until they reach third instar and are ready to be used as test insects.

Reisolation of local *B. bassiana* on PDA media local *B. bassiana* entomopathogenic fungi isolates were isolated on PDA media in petri dishes aseptically in the LAFC. The preparation of flour formulations refers to [3]. The flour formulation of the local entomopathogenic fungi *B. bassiana* was weighed as much as 30g. The bran flour carrier material was sterilized using an oven for 2 hours at 80 ℃ and weighed according to the treatment 0.45 g, 0.6 g, 0.75 g, and 0.9 g. Furthermore, local *B. bassiana* flour formulation was mixed with bran flour in a container and added 1000 ml of distilled water and stirred until evenly distributed.

2.2. Observation

Consists of early time of death, lethal time 50, total mortality. Data on early time of death, total mortality, and lethal time 50 were statistically analyzed using variance honest real difference further test at the 5% level.

3. Results and Discussion

3.1. Early Time of Death

The results of variance analysis of the addition of bran flour to local *B. bassiana* flour formulation with the addition of bran flour significantly affected the early time of death of *S. frugiperda* larvae can be seen in Table 1.

Table 1 Average early time of death of *S. frugiperda* after application local *B. bassiana* flour formulation with the addition of bran flour

Addition of Bran Flour (g)	Early Time of Death (hours)
0.00	91.50 a
0.45	82.50 ab
0.60	72.50 bc
0.75	62.25 cd
0.90	42.25 d

The numbers in the column followed by small letters that are not the same are significantly different according to the honest real difference further test at the 5% level.

Table 1 shows that the application of no addition and the addition of bran flour to local *B. bassiana* flour formulation has a significant effect on the early time of death of *S. frugiperda* larvae, meaning that the addition of several levels of bran flour to the local *B. bassiana* flour formulation raffects the early time of larval death. The early time of larval death tends to be faster with the addition of 0.90 g of bran flour to the local entomopathogenic fungi *B. bassiana* flour formulation, which is 45.25 hours (1.88 days) after application. The results of Tobing[5] showed that the use of 30 $g.l^{-1}$ suspension of the local *B. bassiana* resulted in an early time of death of *S. litura* larvae for 53 hours (2.21 days) after application. This shows that changing from the starter form of the local *B. bassiana* to flour formulation can accelerate the early time of death of *S. frugiperda* larvae from 53 hours to 45.25 hours (1.88 days).

This is in accordance with opinion of Saleh [6] which stated that the initial symptoms of local entomophatogenic fungi *Beauveria bassiana* infection in insects are insects that do not want to eat, their movements slow down ,then they die.

The application of the flour formulation of *B. bassiana* to *S. frugiperda larvae* instar 3 causes changes in the morphology of the larvae which initially the larvae of instar 3 are reddish after the application of *B. bassiana* flour formulation. The color of larvae can blackish due to the melanization process due to *B. bassiana* producing beauvericin poison in the larval body which can cause the larvae to die after contact with the surface of the larval body.According to Soetopo [7]. stated that the local entomopathogenic fungi *Beauveria bassiana* produces beauvericin toxin which can cause tissue damages due to infection as awhole. Furthermore, the larvae undergo mummification characterized by a hardened larval body. Finally, the larval body is covered with white mycelium of the local entomopathogenic fungi *B. bassiana*. Morphological changes in *S. frugiperda* larvae can be seen in Figure 1.

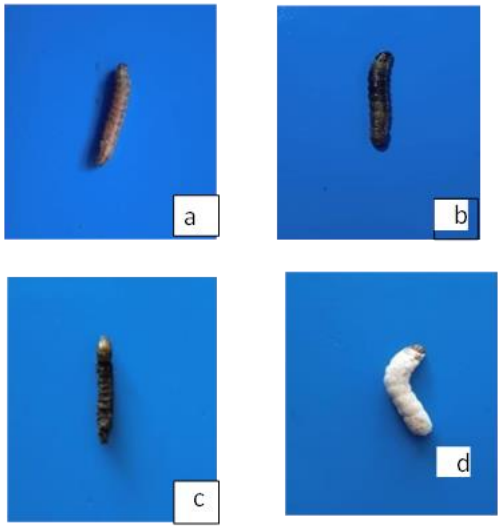

Figure 1 Morphological changes (a) Healthy larvae **(**b) die larvae at 2 days after application, (c) larvae turn black, (d) white mycelium of local entomophatogenic *Beauveria bassiana* grows all over the larvae body

3.2. Lethal Time 50 (LT 50)

Table 2 Average LT50 of *S. frugiperda* after application *B. bassiana* flour formulation with the addition of bran flour

Addition of Bran Flour (g)	Lethal Time 50 (LT50) (hours)
0.00	192.0a
0.45	141.5ab
0.60	123.0bc
0.75	119.0bc
0.90	117.0c

The numbers in the column followed by small letters that are not the same are significantly different according to the honest real difference further test at the 5% level.

The results of variance analysis of the addition of bran flour to local *B. bassiana* flour formulation with the addition of bran flour significantly affected the lethal time 50 of *S. frugiperda* larvae can be seen in Table 2.

Table 2 shows the application of several levels of bran flour to *B. bassiana* flour formulation affects the lethal time 50 (LT50) of *S. frugiperda* larvae. LT50 of *S. frugiperda* larvae tends to be faster with the addition of 0.90 g of bran flour to *B. bassiana* flour formulation, which is 117 hours (4.88 days) after application. The results of [5] showed that the use of 30 $g.l^{-1}$ *B. bassiana* suspension produced Lethal Time 50 *S. litura* for 94 hours (3.91 days) after application. This shows that the change from the form of local *B. bassiana* starter to a flour formulation can slow down the LT 50 death of *S. frugiperda* larvae from 94 hours to 117 hours (4.88 days).

3.3. Total Mortality of *S. frugiperda* Larvae

The results of variance analysis of the addition of bran flour to local *B. bassiana* flour formulation with the addition of bran flour significantly affected the total mortality of *S. frugiperda* larvae can be seen in Table 3.

Table 3 Average total mortality of *S. frugiperda* larvae after application local *B. bassiana* flour formulation with the addition of bran flour

Addition of Bran Flour (g)	Total Mortality (%)
0.00	192.0a
0.45	141.5ab
0.60	123.0bc
0.75	119.0bc
0.90	117c

The numbers in the column followed by small letters that are not the same are significantly different according to the honest real difference further test at the 5% level after being transformed by the formula arcsin $\sqrt{y}$.

Table 3 shows total mortality of *S. frugiperda* larvae tends to be higher with the addition of 0.90 g bran flour to local *B. bassiana* flour formulation, which is 80%. The results of [5] showed that the use of 30 $g.l^{-1}$ local *B. bassiana* suspension caused a total mortality of 77.5% of *S. litura* larvae. This shows that changing form of local *B. bassiana* starter to a flour formulation can increase the total mortality of *S. frugiperda* larvae from 77.5% to 80%.

4. Conclusion

The application of local entomophatogenic fungi *B. bassiana* flour formulation with the addition of 0.90 g of bran flour is the best addition of bran flour to control *S. frugiperda* larvae by causing total mortality of 80%, the early time of death of 42.25 hours after application, and Lethal Time 50 of 117 hours after application.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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