Insect pest in rice field with legumes embankment applied by Beauveria bassiana vuill

Fitri¹, S N Aminah¹, T Abdullah¹, R Widarawati² and N W Annisa³

¹Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University, Makassar 90245, Indonesia
²Agrotechnology Program, Faculty of Agriculture, Universitas Jenderal Soedirman, Karangwangkal Purwokerto 53123, Central Java, Indonesia
³Magister Student of Phytopathology, Post Graduate Program Bogor Agricultural University, Bogor 16680, West Java, Indonesia

E-mail: srifirnas@gmail.com

Abstract. The objectives of research is to determine the diversity of insect pests in rice fields and the effect of B. bassiana spraying around the ecosystem. The collection and observation of pest populations in rice and legumes embankments was held in Mappadaelo village, Tanasitolo District, Wajo Regency, South Sulawesi. Experiments used Mekongga rice varieties in four different fields with a distance between rice fields of around 200 - 300 m. Legumes in the embankment was planted a week after planting rice, the types of legumes: green beans, long beans and cowpeas. The research used Randomized Block Design eight treatment and four replication. Observation of pest insect of rice started from 14 days after planting used ten sample of legume plant in embankment (five samples legumes without B. bassiana spraying and five samples of plants sprayed B. bassiana). The insects were collected on the embankment used D-Vac, then the sample put in a bottle contain alcohol 70%. The interval collected sample used D-Vac was seven days. The results was showed the diversity of insect pests in rice field without spraying B. bassiana was 2.48 with the highest diversity index in treatment P1 of 0.71. The lowest insect diversity index on plants in rice field without B. bassiana spray as P3 treatment of 0.65. The diversity of pest insect in rice fields sprayed with B. bassiana was 2.28. The highest diversity index was found in treatment P7 of 0.75. The lowest insect diversity index in rice fields sprayed with B. bassiana was treatment P6 of 0.45. The conclusion of the study spraying the entomopathogenic fungi B. bassiana affected the diversity index of pest insect attacked rice plant.

1. Introduction
Rice is the staple food ingredient of most Indonesian people. The high number of Indonesia's population which continues to grow is the important plant to cover food needs in Indonesia. In addition, the presence of pest attacks is very important because reduces agricultural production. The decline in agricultural yields caused by pest attacks occurs every planting season with damage reaching 15-20% each year. This encourages farmers to use pesticides in their crop cultivation. The lowland rice ecosystem is a dynamic habitat because changes often occur due to soil processing, harvesting and another agricultural activities [1, 2]. Planting times not only suppresses pest populations but also affects pest population density at the beginning of the next planting season. This
is impact to presence of insect natural enemies populations [3, 4]. The low population density of natural enemies during fallow areas has strong related low population of prey, especially insect pests. It necessary pests insect still available in population number that does not harm to the plant. This giving favorable effect on the development of natural enemies. Increasing the abundance of insect pests will increase natural control through increased activity in food web [5, 6, 7].

In general, few horticultural crops are chosen by farmers to be used as plants on the embankment of rice ecosystem. Embankment has function as shelter and a source of food predatory arthropods when the land is fallow. The presence valuable plant grow on the embankment in the rice ecosystem can increase the diversity of yields and farmers income [8, 9]. Arthropods playing an important role in structure and processes in maintaining biological diversity in an ecosystem [1]. The diversity of plant in ecosystem can increase the diversity of arthropods including insects pest and predator. Several studies have shown the diversity of arthropods in monoculture lower than polyculture system [10].

The one alternative controlling insect pests in an environmentally friendly manner is to use a control agent in the form of an entomopathogenic fungi that produces toxic endotoxins that kill insects. Entomopathogenic fungi is one of the biological control agents that potential control plant pests. The popular entomopathogenic fungi in nature and often used as biological agents is Beauveria bassiana Vuill [11]. The previous study conducted by [12] that entomopathogenic fungi B. bassiana was able to control 175 species insects from orders Coleoptera, Diptera, Hemiptera, Orthoptera and Hymenoptera.

B. bassiana is a fungi caused white muscardine disease in insect pests. Entomopathogenic fungi produce white mycelium and spores [11, 13]. The entomopathogenic fungi B. bassiana contain beauvericin compound [11], is very toxic to target insects with sufficient time ranging from 3-5 days after application. The advantages of fungi that able to infect various insect stages including larvae and adult [11, 14]. The objectives of research is: to determine the diversity of insect pests in rice fields and the effect of B. bassiana spraying around the ecosystem. The research results can reduce chemical control using synthetic pesticides.

2. Methodology

2.1. Research site
The collection and observation of arthropods population in rice and plant embankment was held in Mappadaelo village, Tanasitolo District, Wajo Regency, South Sulawesi. Pest insect determine and identification in Pest Laboratory, Department of Plant Pests and Disease, Faculty of Agriculture, Hasanuddin University from August to October 2019.

2.2. Planting rice and legumes embankment
Experiments used Mekongga rice varieties in four different rice fields with a distance between rice fields about 200 - 300 m. Planting in the embankment was held a week after planting rice. The plant on the embankment used in the study were legumes such as: green beans, long beans and cowpeas planted on different embankments. The study used Randomized Block Design in eight treatments and four replications. The treatments is: P1 = rice and green beans embankment; P2 = rice and cowpeas embankment; P3 = rice and long beans embankment; P4 = rice without plant embankment; P5 = rice and green bean embankment sprayed B. bassiana; P6 = rice and cowpea embankment sprayed B. bassiana; P7= rice and long bean embankment sprayed B. bassiana; P8 = rice without plant embankment sprayed with B. bassiana.

2.3. Application of the entomopathogenic fungi B. bassiana
Spraying of the entomopathogenic fungi B. bassiana was held twice a week on rice and legumes embankment. The source of the entomopathogenic fungi used from commercial product (dosage 32 g/l water).
2.4. Observation of pests insects in rice and legumes embankment

Observation of the insect pests of rice and legumes embankment started from 14 days after planting by determining ten sample plants from each of the legume planting at embankment. The insect was collected at legumes embankment used D-Vac. The sample put in bottle containing alcohol 70%. Interval collected insect used D-Vac in seven days. The identification of insects found in rice and legumes embankment was identified used literature [15, 16]. The data obtained were analyzed by calculating the Shannon-Wiener diversity index [1].

3. Results and discussion

3.1. Presence pests insects on legumes embankment

In general, the entomopathogenic fungi *B. bassiana* is widely used as a biological agent in controlling insect pest populations from orders Lepidoptera, Hemiptera, Homoptera and others. Biodiversity index of pest insects in legumes embankment without spraying of *B. bassiana* was presented in table 1.

| Treatment | Total (individual) | Shannon-Wiener Biodiversity Index (H') |
|-----------|--------------------|----------------------------------------|
| P1        | 311                | 0.71                                   |
| P2        | 286                | 0.69                                   |
| P3        | 282                | 0.65                                   |
| P4        | 168                | 0.43                                   |
| **Total** | **1,047**          | **2.48**                               |

P1 = rice and green beans embankment; P2 = rice and cowpea embankment; P3 = rice and long bean embankment; P4 = rice without legumes embankment.

The results of the observation in table 1 showed that the diversity index of pest insect in legumes embankment without spraying *B. bassiana* is 2.48 from 1,047 individual. The highest diversity index was found in the P1 (rice and green bean embankment) about 0.71. The lowest insect diversity index in plants in legumes embankment without spraying *B. bassiana* is P3 (rice and long bean embankment) of 0.65. The diversity index value of 2.48 is included in medium category with balancing ecosystem. It is meaning that fluctuation of pest insect as impact of intensive synthetic pesticide spraying in the previous planting season.

P1 treatment used rice and green bean embankment showed the largest insect population found was stink bug (*Leptocoryxa acuta*) at 58.19% and adult of *S. incertulas* at 29.58%. The high population of similar pest insect in P2, P3 and P4 treatments indicated that the population continued to grow because they are not sprayed by the biological control agent *B. bassiana*. According to [5, 6] argued the areas that sprayed intensively using insecticides has great potential to reduce number of predators and parasitoids as biological agents. Insects as natural enemies is organisms that susceptible to chemical sprays in their active movements. In general, the plants in the rice fields playing role as refugia for pests insects and natural enemies when the fields in fallow condition after harvest. This is in accordance with the findings of [8] stated flowering weeds play an important role as a source of additional feed for predators (providers of nectar and pollen) and best shelter for predatory insects that live in the karst mountains. The biodiversity index of pest insects in legumes embankment with spraying of *B. bassiana* was presented in table 2.

As a comparison in table 2, the results of observations showed the diversity of pest insect in rice fields ang legumes embankment sprayed used entomopathogenic fungi *B. bassiana* is 2.28 with total 830 individuals. The highest diversity index was found in P7 (rice and long bean embankment sprayed of *B. bassiana*) of 0.75. The lowest insect diversity index in cowpea embankment sprayed *B. bassiana* as P6 (rice and cowpea sprayed *B. bassiana*) of 0.45. The total value of the diversity index 2.28 is in medium category such as in the field without *B. bassiana*. The total number individual of pest insects
was lower than rice field and legumes embankment without spraying of *B. bassiana*. The entomopathogenic fungi killed pest insect through exposed spraying of the spores.

**Table 2.** The biodiversity index of pest insects in legumes embankment with spraying of *B. bassiana*.

| Treatment | Total (individual) | Shannon-Wiener Biodiversity Index (H’) |
|-----------|--------------------|---------------------------------------|
| P5        | 149                | 0.64                                  |
| P6        | 286                | 0.45                                  |
| P7        | 282                | 0.75                                  |
| P8        | 113                | 0.44                                  |
| **Total** | **830**            | **2.28**                              |

P5 = rice with green bean embankment sprayed *B. bassiana*; P6 = rice with cowpea embankment sprayed *B. bassiana*; P7 = rice with long bean embankment sprayed *B. bassiana*; P8 = rice without plant embankment sprayed *B. bassiana*.

According to [14] stated *B. bassiana* infected host through cuticles and stomach toxins when herbivorous insects eaten host plants. The spore particles in the leaves or another plant parts enter the digestive tract of insects. The spores sprouts in the digestive tract caused death. The percentage of pest insect in rice and legumes embankment was presented in figure 1.

**Figure 1.** Identification of pest insects on rice and legumes embankment (%).

Based the observations in Figure 1, the dominant pest insect found during research in rice were *S. incertulas* and stink bugs (*L. acuta*). The highest insect pest population in the treatment with spraying and without spraying of *B. bassiana* was *L. acuta* about 57.38% and 59.12%, respectively. The population of *S. incertulas* in the treatment with spraying and without spraying *B. bassiana* were 28.04% and 27.88%. The insects were found attacking legumes were *Epilachna* sp. in the low population (<10%) in the treatment spraying and without *B. bassiana* treatment 9.22% and 6.78%, respectively.

Research result [13] stated generally known that *B. bassiana* is a famous biological control agent for insect pests around the world. *B. bassiana* killing insects used beauvericin toxin destroyed insect cell walls. Biological control using entomopathogenic fungi *B. bassiana* is not harmful to human health and other organisms. *B. bassiana* specifically attack certain types order of pest insect. This is the suggestion biological control based environmental friendly technique by utilizing commercial natural enemies available in many places. The application of *B. bassiana* also brings the benefits reducing the intensity of pesticide use and producing agricultural products safety for consumers.
4. Conclusions
Spraying with the use of the entomopathogenic fungi B. bassiana affects the diversity index of pests attacked rice plants. The technique can be applied as an environmentally friendly to control pest insects.

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