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LARVAE MORTALITY OF *ORYCTES RHINOCEROS* (COLEOPTERA: SCARABAEIDAE) CAUSED BY *METARHIZIUM ANISOPLIAE* ON THE RAINY SEASON

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ABSTRACT

Oryctes rhinoceros (Coleoptera: Scarabaeidae) is one of the major pests in several provinces of Indonesia. Biological control by using natural enemies such as entomopathogens *Metarhizium anisopliae* has been proved as a promising method to control plant pests. Pathogenicity of *M. anisopliae* were examined under rainy season in field conditions. The doses of Metarhizium respectively 0,1,2, and 4 grams for each 5 kilogram organik soil, put in a plastic container, diameter 34 cm and 22 cm height. Ten larvaes were put it into the plastic container for each treatment, six replications, total 240 larvaes. The third instar larvaes were obtained from Jeruk Wangi village, Jepara. Metarhizium formulation was flour kaolin media. Observations were carried out each week for eight weeks. The results showed that the fungi can infect larvae *O.rhinoceros*. Larvae mortality of *O.rhinoceros* caused by *M. anisopliae* began at second week (2-3% mortality) then increased up to seventh weeks (88-100%), whereas in the control treatment larvae were still alive until the end of research (80%). Data showed that application *M. anisopliae* in the field on the rainy season need a long time to kill the larvae *O.rhinoceros* (2-7 weeks)

Keyword : Biological control, *Oryctes rhinoceros*, *Metarhizium anisopliae*, the rainy season.

INTRODUCTION

Coconut trees are found to grow in many tropical countries like in Indonesia. There are a lot of benefits from parts of coconut trees such as from the roots, stems, fruits and leaves. They are also widely cultivated as raw material for oil palm. Some constraints to cultivate them are pests and plant diseases attack. One of potential pest causing stem damage and leaf is coconut rhinoceros beetle *(Oryctes rhinoceros)* or *kwangwung* in Javanese. *O. rhinoceros* attack inhibits the growth of trees and damage the growing point of plants (Widyaningrum 2014).

Based on interview with the staff of Department of Plantation District of Jepara, in Jeruk Wangi of Bangsri Jepara, there are many coconut trees that belong to people of that district (over 75%) were attacked by *O. rhinoceros*. Farmers could not control *O. rhinoceros* pest, so its population kept growing uncontrollably (personal communication, 2015).

The control of *O.rhinoceros* can be performed on the stage of imago and larva. Controlling *O.rhinoceros* imago with pesticides is less effective because the use of systemic pesticide is causing the pesticide contamination of coconut tree. Lately the control *O. rhinoceros* imago with pheromone attractant compound is performed because it is predicted to be more effective.

Controlling *O.rhinoceros* larvae stage is generally done by using parasitic fungi as biological control agents, such as *Metarhizium anisopliae*. It is done by sprinkling the fungi on larvae habitat. *O. rhinoceros* larvae can be found in the soil around the area of dead coconut trees, haystacks around the fields, heap husk of rice mills, animal waste and decaying rubbish bins that contain a lot of organic compound. Controlling *O. rhinoceros* larvae by using *M. anisopliae* can be done easily and cheaply. The fungi can easily be bred through corn or rice media. According to Prayogo (2004) and Trizelia et al (2011) one of the advantages of using Metarhizium is being able

to be used to control various stages of insect development from egg, larva, pupa and imago. Metarhizium fungi is found to be used to control locust population in Africa (Seyoum & Negash 2007).

Indonesia has two season of wet and dry. The peak of the rainy season is shown by intense high rainfall every day with low temperature and high humidity, while the dry season usually has high temperature, low humidity and no rain. Meanwhile metarhizium application can be done in the dry and rainy seasons. Preliminary test results in the laboratory showed that Metarhizium may infect and cause death *O. rhinoceros* larvae in one week (unpublished research report, 2015). The evaluation of *O.rhinoceros* control with Metarhizium in the peak of rainy season has not been studied. Therefore, this study aims to evaluate the mortality of *O. rhinoceros* larvae due to *M. anisopliae* at the peak of rainy season in Jeruk Wangi Bangsri District of Jepara.

METHODS

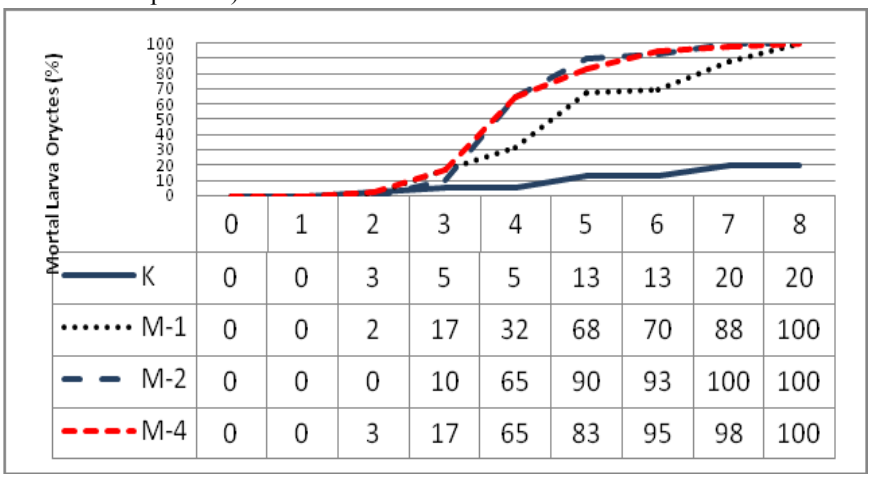
The study was conducted in coconut plantations belong to the people of Jeruk Wangi Bangsri District of Jepara, in February-March 2015. The *Metarhizium anisopliae* fungi were obtained from the Balai Proteksi Tanaman Perkebunan (BPT-BUN) Salatiga Central Jawa. The formulation of Metarhizium was powder (Conidia of Metarhizium mixed with kaolin powder). While *O.rhinoceros* larvae was obtained from around the coconut plantations.

Black plastic pot with diameter of 34 cm and height of 22 cm was used as test containers. It contained 5 Kg organic soil media and Metarhizium fungi. Organic soil media consisted of mixture of soil, manure and powdered coconut trunk. Metarhizium dose treatment consisted of: 1 gram, 2 grams, 4 grams and 0 grams (control) for each pot. In the bottom of container it needed a hole for discharge of water. The larvae put into the pot. Each treatment used 10 larvae, 3th instar (size 7-10 cm and weigt 9-11 grams). Each treatment was repeated six times, the total larvae were 240. The plastic pot container surface was covered with netting plastic to keep it safe from animals. Then it was placed around the coconut plantations for eight weeks. Observations were made every week to see *O.rhinoceros* larvae mortality.

RESULT AND DISCUSSION

The research location, Jeruk Wangi Bangsri District of Jepara, was located at the coast of Java sea. According to the data from the Central Bureau of Statistics of Jepara (2013), Jeruk Wangi Bangsri area has high rainfall rate of 3295 mm / year, with rainy days of 131 days / year.

O.rhinoceros larvae mortality as the result of *M. anisopliae* application for eight weeks is presented in Figure 1.



	0	1	2	3	4	5	6	7	8
K	0	0	3	5	5	13	13	20	20
M-1	0	0	2	17	32	68	70	88	100
M-2	0	0	0	10	65	90	93	100	100
M-4	0	0	3	17	65	83	95	98	100

Figure 1. The percentage of *O.rhinoceros* larvae mortality as the result of *Metharizium anisopliae* application at doses of 0 gram (K), 1 gram (M-1), 2 gram (M-2) dan 4 gram (M-4) for 8 weeks

In Figure 1 we can see the larval mortality of *O.rhinoceros* began to appear in second week in the control and treatment group. This shows that there were living microbes in the soil before it was added by Metarhizium. This was evident is showed in the control mortality of 3%.

Microbes were probably derived from mix of manure in soil media. The addition of *M. anisopliae*

fungi causes high the increasing of larval mortality, so that in the seventh week, larval mortality (88-100%) was higher than control group (20%). Therefore the addition of Metarhizium causes the increasing of microbial parasites on insect larvae that live in the soil and quicken the larval mortality (68-80%). The weather condition during the research was raining with high intensity every day, with temperature of 23-31 ^{o}C and humidity (RH) of 76-95%.

This result was in contrast to a similar study using larvae *O.rhinoceros* and *M. anisopliae*, conducted in early September 2014 in Telogoweru, District of Demak. Larval mortality, at a dose of 1 gram Metarhizium, started to appear in the first week (29%) control mortality of 0% and in the third week all of larval mortality were infected with the fungi. The weather condition during the research intensity was raining with low intensity, drizzle, with temperature of 34.5 - 39,5 ^{o}C and humidity of 57-75% (research report, 2014, unpublished). This shows that there was influence of temperature, humidity and humidity on the rate of mortality of *O.rhinoceros* larvae. This is in accordance with the opinion of Hussein et al (2010) that stated temperature and RH have very important role in the occurrence of Metarhizium infection to insects. Goettel et al., (2000) and McCoy et al., (2003) said that temperature and humidity are the main factors that affect the ability of the fungi to survive, spread, infect and kill the host.

Optimal low temperature and high humidity for the fungi with rain and low intensity gave the opportunity conidia of *M. anisopliae* in the soil to germinate. When conidia attached to the surface of the larvae integument it will grow and parasitize its host. As a result, the larvae was infected quickly, in one week there have been a lot of mortal larvae. However, when conidia germinated, then heavy rain was falling for long time, then a lot of hyphae of Metarhizium were damaged and die. Another possibility of conidia did not attach in insect cuticle surface because was because it was dissolved through water. Consequently *M. anisopliae* growth was slow and not as fast at the beginning of the rainy season, so the mortality of the larvae required a longer time. Therefore, controlling *O.rhinoceros* larvae with *M. anisopliae* at the peak of rainy season is not effective because it takes up to seven weeks.

It is suggested when applying *M. anisopliae* we need to consider the right season. When it is applied during the dry season, the soil media where the larvae lives need to be watered every day in a week. It is intended to *M. anisopliae* conidia can germinate, multiply well and infect the larvae.

In Figure 1 we can see the treatments dose of M-2 and M-4 causes the highest mortality compared to treatment of M-1. *O.rhinoceros* larval mortality charts of M-2 and M-4 treatments were not significantly different. Therefore it is recommended to use a dose of M-2 of 2 grams of Metarhizium in 5 Kg of organic soil media. Conidia density test showed that the amount of conidia of *M. anisopliae* that were stored on the kaolin media was 0.5x 10^{7} gram/ml. According to Hosang et al (2004), conidia density of 5 x 10^{5} conidia / ml was able to infect the larvae of *B. longissima*.

CONCLUSION

Larval mortality of *O.rhinoceros* as the result of M. anisopliae fungi application needs 2-7 weeks. Application of fungi at the peak of rainy season is less effective because it takes a long time to kill the host.

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