

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

*by* Dyah Indriyanti

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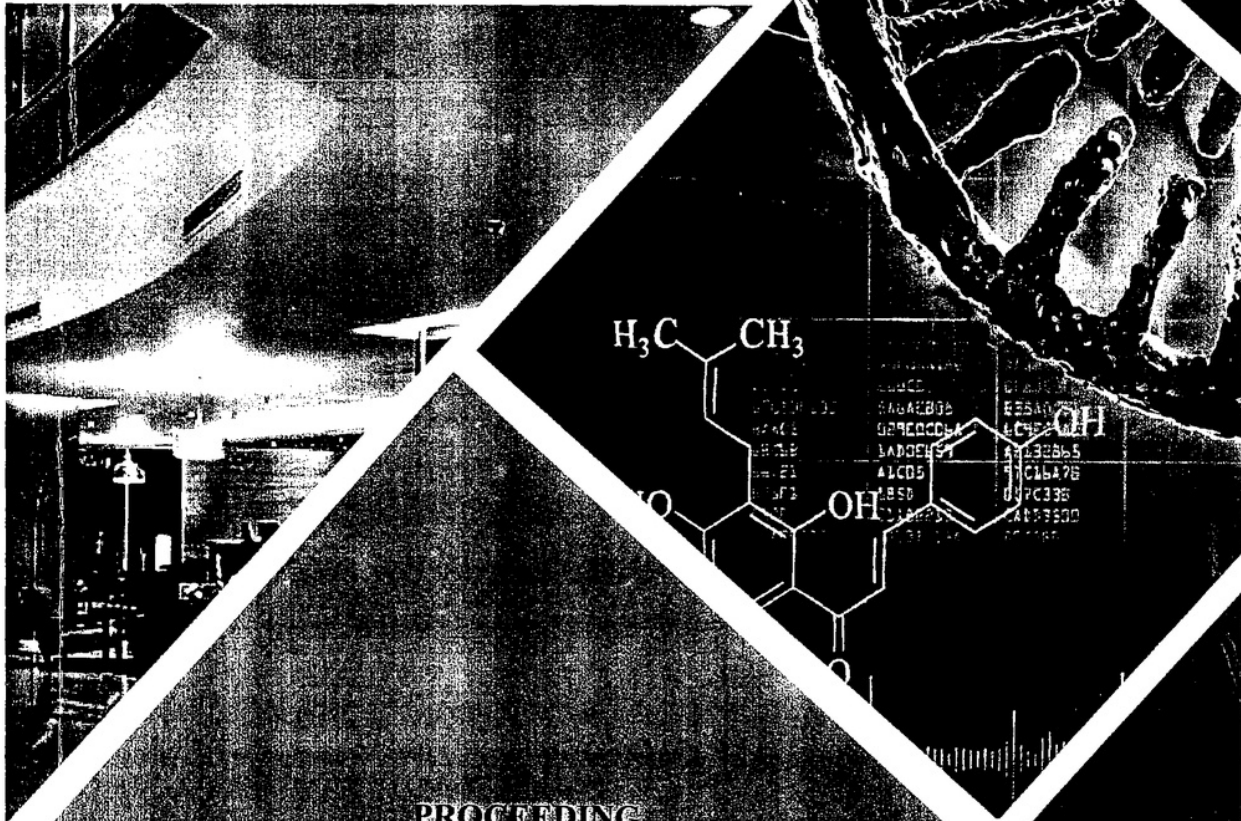
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# ICMSE 2015

INTERNATIONAL CONFERENCE ON MATHEMATICS,  
SCIENCE, AND EDUCATION



PROCEEDING

INTERNATIONAL CONFERENCE ON MATHEMATICS,  
SCIENCE, AND EDUCATION 2015

*Applied Research of Mathematics and Natural Sciences  
to Improve its Usefulness for Knowledge and Society*

Aston Hotel, Semarang  
5 – 6 September 2015

Organized by  
Faculty of Mathematics and Natural Sciences,  
Semarang State University - Indonesia



**PROCEEDING**

**INTERNATIONAL CONFERENCE ON MATHEMATICS,  
SCIENCE, AND EDUCATION**

**"Applied Research of Mathematics and Natural Sciences  
to Improve Its Usefulness for Knowledge and Society"**

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**FACULTY OF MATHEMATICS AND NATURAL SCIENCES  
SEMARANG STATE UNIVERSITY**

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## PREFACE

Thanks to God Almighty this International Conference Proceeding could be completed. All articles in this proceeding are presented in **International Conference On Mathematics, Science, and Education – Applied Research of Mathematics and Natural Sciences to Improve Its Usefulness for Knowledge and Society** on September 5-6, 2015 at Aston Hotel Semarang. This Conference is organized by Faculty of Mathematics and Natural Science. This proceeding has been reviewed of Mathematics and Science experts before it is published.

This conference is designed to improve the discussion and research scope in mathematics, science, and education area in the international level. Sub topics in this proceeding cover mathematics, applied mathematics, and mathematics education in accelerating character building. Enhancing biology and biology education research for a better life. Green chemistry in research and education. Physics and physics education for trending research.

Hopefully this publication of proceeding will be profitable for all of us.

Semarang, 3 December 2015

Regards  
Committee of ICMSE 2015

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## MESSAGE FROM THE DEAN OF FMIPA UNNES

Dear Participants of ICMSE 2015,

It is a pleasure to welcome all of you in the first International Conference on Mathematics and Science Educations (ICMSE 2015) held by Faculty of Mathematics and Natural Sciences, Semarang State University.

Faculty of Mathematics and Natural Science Semarang State University or more popularly known as FMIPA Unnes has 6 departments and 11 study programs of Mathematics and Natural Sciences education backgrounds and non education backgrounds. FMIPA Unnes has the mission of being an excellent and meaningful faculty by improving human resources through scientific activity.

One of efforts to result excellent and meaningful human resources through scientific activity is by performing discussion and knowledge sharing. To widen discussion of science and research development in mathematics and science educations scopes in national and international level, ICMSE 2015 was initiated as the medium of that discussion. I believe that ICMSE 2015 as the first international conference held by FMIPA Unnes can facilitate the knowledge sharing in mathematics and science educations area in order to establish a global cooperation among experts and researchers.

With the hope that this conference will be the medium to optimize the role of Mathematics, Science and Education in global cooperation, I am proud to welcome all of you and I wish you a pleasant sharing and discussion in this conference and enjoyable stay in Semarang, Indonesia.

**Prof. Dr. Wiyanto, M.Si.**

Dean of Faculty of Mathematics and Natural Sciences  
Semarang State University



## MESSAGE FROM CONFERENCE CHAIRMAN

My pleasure, welcome to you today on the occasion of this **International Conference on Mathematics, Science, and Education** (ICMSE 2015). I would like to extend my warmest welcome to all of the distinguished participants, especially those who have travelled long distances to be present here. This conference has already established itself as a key event to offer various thoughts and knowledge in enhancing our understanding in fundamental sciences and education.

This conference focus on "Applied Research of Mathematics and Natural Sciences to Improve Its Usefulness for Knowledge and Society", offers all of us the opportunity to explore exciting information. The aim of the conference is to provide an interdisciplinary forum for scientist engaged in the full spectrum of research and development activities. The meeting intends to bring together researchers, scientists, and scholars to exchange and share their experiences, new ideas, and research result in related fields and discuss the practical challenges encountered and the solutions adopted. I invite all of you to approach this year's events to take advantage of the many ways in which you too might explore the unfamiliar - and discover a great deal in the process.

First, the various sessions that have been organized for the next day promise exciting revelation for all who attend them. Each speakers who are experts in their respective fields, will address a major topic or issue related to Fundamental Sciences,. You might learn more about a topic with which you were already familiar; or you might also find yourself discovering a whole new world of ideas and information you didn't know existed. Either way, you'll have many opportunities to explore fascinating new terrain with these reputable speakers.

Second, the key note speakers will provide, for all of us, an important window into the world of the future. We are privileged to have them as our key note speakers Prof. Barke, Munster University Germany, Prof. Martin Stein, Munster University Germany, Prof. Simone Krees, Munster University Germany, Prof. Matthias Ludwig, University Frankfurt Germany, Prof. Van Horssen, Delf Univesity Netherland, Prof. Rahim Sahar, UTM Malaysia and Dr. Margareta Rahayuningsih, M.Si experience has taken them through the whole cycle of Life and General science.

Finally, as you attend these various events, keep in mind that other people can also serve as doorways to new worlds. Hearing of someone else's background and experiences can often make for fascinating discoveries that can educate and profoundly affect us. So take advantage of this rare gathering of hundreds of people working in various fields to meet one another, talk with one another, and learn from one another.

In conclusion, I hope that you will find your time with us exciting. We have a great agenda for you with esteemed speakers and presenters from our profession. I do hope you will enjoy the next couple of days. I would like to once again extend my gratitude to all the participants, generous sponsor and I look forward to a most successful and fruitful conference.

**Professor Dr. Supriyadi, M.Si**  
Chairman of ICMSE 2015

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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 larvae were put it into the plastic container for each treatment, six replications, total 240 larvae. The third instar larvae 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 (Widiyaningrum 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 seasons 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 Jepara.

**METHODS**

The study was conducted in coconut plantations along 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, 3<sup>rd</sup> instar (size 7-10 cm and weight 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.

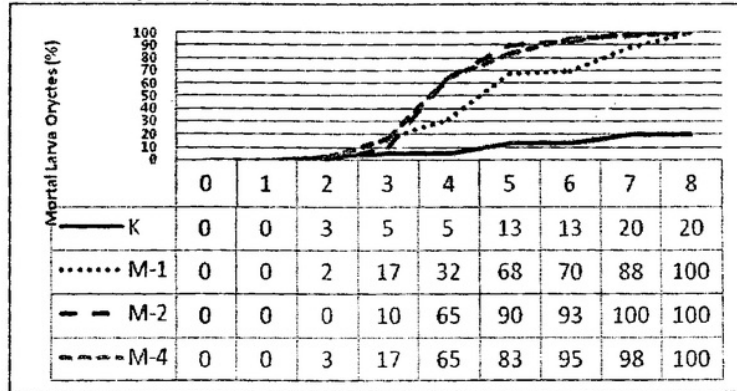


Figure 1. The percentage of *O. rhinoceros* larvae mortality as the result of *Metharizium anisopliae* application at doses of 0 gram (K), 1 gram (M-1), 2 gram (M-2) dan 4 gram (M-4) for 8 weeks

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 some 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 °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 °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  $0.5 \times 10^7$  gram/ml. According to Hosang et al (2004), conidia density of  $5 \times 10^5$  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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# LARVAE MORTALITY OF ORYCTES RHINOCEROS (COLEOPTERA: SCARABAEIDAE) CAUSED BY METARHIZIUM ANISOPLIAE ON THE RAINY SEASON

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