

***Beauveria bassiana* APPLICATION EFFECTS ANALYSIS ON
THE FEEDING ACTIVITY OF *Aphis gossypii* BY ELECTRICAL
PENETRATION GRAPH ON *Capsicum frutescens* L.**

RIZKIA FENANDRI



**DEPARTMENT OF PLANT PROTECTION
FACULTY OF AGRICULTURE
BOGOR AGRICULTURAL UNIVERSITY
BOGOR
2025**



@Hak cipta milik IPB University

IPB University



IPB University
— Bogor Indonesia —

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.

Perpustakaan IPB University

AUTHOR'S STATEMENT ON THESIS AND ITS SOURCE OF INFORMATION AND DELEGATION OF COPYRIGHT

I hereby declare that the thesis entitled "*Beauveria bassiana* Application Effects Analysis on the Feeding Activity of *Aphis gossypii* by Electrical Penetration Graph on *Capsicum frutescens* L." is my work under the direction of my supervisors and has not been submitted in any form to any university. Sources of information derived or cited from published or unpublished works of other authors have been mentioned in the text and listed in the Bibliography at the end of this thesis.

I hereby delegate the copyright of my undergraduate thesis to Bogor Agricultural University.

Bogor, August 2025

Rizkia Fenandri
A340121072



ABSTRAK

RIZKIA FENANDRI. Analisis Efek Aplikasi *Beauveria bassiana* terhadap Aktivitas Makan *Aphis gossypii* dengan Grafik Penetrasi Elektrik di *Capsicum frutescens* L. Dibimbing oleh PURNAMA HIDYAT dan RULY ANWAR.

Cabai rawit (*Capsicum frutescens* L.) merupakan salah satu komoditas hortikultura yang memiliki nilai ekonomi tinggi. Produksi cabai rawit sampai saat ini masih mengalami gangguan dari hama, terutama kutu daun (*Aphis gossypii*). Salah satu pengendalian ramah lingkungan yang dapat dilakukan adalah aplikasi *Beauveria bassiana*. Penelitian ini bertujuan mempelajari efek aplikasi *B. bassiana* terhadap tanaman cabai rawit dan aktivitas makan *A. gossypii* menggunakan *electrical penetration graph* (EPG). Percobaan dilakukan menggunakan rancangan acak lengkap (RAL) dengan target aplikasi (kutu daun dan tanaman) dan hari setelah aplikasi kutu daun (1 jam, 1, 2, 3, 4, dan 5 HSA) dan tanaman (1 jam, 1, 5, 10, 15, dan 20 HSA) sebagai perlakuan. Setiap perlakuan diulang sebanyak 2 kali dan terdiri atas 8 tanaman. Percobaan perlakuan makan kutu daun dengan EPG dilakukan di laboratorium dan pengamatan dilakukan selama 10 jam. Hasil pengamatan makan dengan EPG menunjukkan bahwa aplikasi pada kutu daun mulai memberikan perubahan makan pada 3 HSA dan menurun setelahnya, sedangkan perlakuan pada tanaman terjadi pada 5 dan 10 HSA. Perubahan pada perlakuan kutu daun dilihat dari meningkatnya durasi *non-probing* dan menurunnya durasi *probing* dan makan, sedangkan pada tanaman terjadi peningkatan durasi *probing* dan penurunan durasi makan.

Kata kunci: biopestisida, EPG, pengendalian hayati



ABSTRACT

RIZKIA FENANDRI. *Beauveria bassiana* Application Effects Analysis on the Feeding Activity of *Aphis gossypii* by Electrical Penetration Graph on *Capsicum frutescens* L. Supervised by PURNAMA HIDAYAT and RULY ANWAR.

Cayenne pepper (*Capsicum frutescens* L.) is a commodity with high economic value. Cayenne pepper production is still experiencing problems from pests, especially aphids (*Aphis gossypii*). One environmentally friendly control method that can be done is the application of *Beauveria bassiana*. This study aimed to study the effect of *B. bassiana* application on cayenne pepper plants and the feeding activity of *A. gossypii* using electrical penetration graph (EPG). The experiment was conducted using a completely randomized design (CRD) with application targets (aphids and plants) and days after aphid application (1 hour, 1, 2, 3, 4, and 5 DAA) and plants (1 hour, 1, 5, 10, 15, and 20 DAA) as treatments. Each treatment was replicated twice and consisted of 8 plants. The experiment on aphid feeding treatment with EPG was conducted in the laboratory and observations were made for 10 hours. Feeding observations using EPG showed that application to aphids began to produce changes in feeding at 3 days after planting and decreased thereafter, while treatment on plants occurred at 5 and 10 days after planting. Changes in the aphid treatment were seen in the increase in non-probing duration and decrease in probing and feeding duration, while in plants, there was an increase in probing duration and a decrease in feeding duration.

Keywords: biological control, biopesticide, EPG



Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.

© 2025, Bogor Agricultural University
All rights reserved

It is prohibited to make any quotations from the part or whole of this undergraduate thesis without citing the author or the copyright holder. Quotation is allowed as long as for education, research, scientific writing, scientific report, research proposal, or scientific review purposes only; those quotations should not produce any adverse effects to Bogor Agricultural University.

No part of this undergraduate thesis may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without express written permission from Bogor Agricultural University.



@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.

***Beauveria bassiana* APPLICATION EFFECTS ANALYSIS ON
THE FEEDING ACTIVITY OF *Aphis gossypii* BY ELECTRICAL
PENETRATION GRAPH ON *Capsicum frutescens* L.**

RIZKIA FENANDRI

Undergraduate Thesis
In partial fulfillment of the requirements for the degree of
Bachelor of Agriculture
In
Department of Plant Protection

**DEPARTMENT OF PLANT PROTECTION
FACULTY OF AGRICULTURE
BOGOR AGRICULTURAL UNIVERSITY
BOGOR
2025**



@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.



Thesis title : *Beauveria bassiana* Application Effects Analysis on the Feeding Activity of *Aphis gossypii* by Electrical Penetration Graph on *Capsicum frutescens* L.
Name : Rizkia Fenandri
Student ID : A3401211072

@Hak cipta milik IPB University

Approved by

Principal Supervisor:
Prof. Dr. Ir. Purnama Hidayat, M.Sc

Co-Supervisor:
Dr. Ir. Ruly Anwar, M.Si

Acknowledged by

Head of Plant Protection Department:
Dr. Ir. Ali Nurmansyah, M.Si
196302121990021001

Date of Examination: 14 AUG 2025
(tanggal pelaksanaan ujian)

Date of Graduation: 15 AUG 2025
(tanggal penandatanganan)



PREFACE

Praise and gratitude to Allah SWT for all the graces that have been given so that this undergraduate thesis entitled “*Beauveria bassiana* Application Effects Analysis on the Feeding Activity of *Aphis gossypii* by Electrical Penetration Graph on *Capsicum frutescens* L.” can be completed well. This undergraduate thesis is a part of the fulfillment of the requirements for the degree of Bachelor of Agriculture in the Department of Plant Protection, Bogor Agricultural University.

The author would like to give a big thank you to everyone who has given support in making this thesis. I’m so grateful to Allah SWT for all the blessings, mercy, and strength He has given me to complete this final project and navigate life. I would like to thank my thesis supervisors, Prof. Dr. Ir. Purnama Hidayat, M.Sc, and Dr. Ir. Ruly Anwar, M.Si, for their guidance, my external examiner Prof. Dr. Ir. Tri Asmira Damayanti, M.Agr for pointing my thesis mistakes, and my academic supervisor, Dr. Ir. Sugeng Santoso, M.Agr, for all the help in academic matters. The author is grateful to the parents, Mr. Dadang and Mrs. Sri Suwasti, and my siblings who’ve always had my back and kept me in their prayers, to Bu Dewi Ratna Wulan who helped and guided me in operating EPG tools, to all friends at Biosystematics and Taxonomy Laboratory, and the 58th batch of Plant Protection Euphorant friends. Also, a nod to the stack of light novels I read daily, which kept my imagination alive.

The author acknowledges that there are numerous aspects of improvement for this undergraduate thesis. Consequently, constructive feedback and suggestions are eagerly anticipated. The aspiration is that the outcomes of this research will prove beneficial and make a meaningful contribution to science and agriculture.

Bogor, August 2025

Rizkia Fenandri



TABLE OF CONTENTS

LIST OF FIGURES	xi
LIST OF CONTENTS	xii
INTRODUCTION	1
1.1 Background	1
1.2 Problem Statements	2
1.3 Objective	2
1.4 Outcomes	2
LITERATURE REVIEW	3
2.1 <i>Beauveria bassiana</i>	3
2.2 Chili Aphid	4
2.3 Cayenne Pepper	5
2.4 Electrical Penetration Graph	6
III MATERIALS AND METHODS	8
3.1 Place and Time	8
3.2 Equipment and Materials	8
3.3 Research Procedure	8
3.3.1 Collection, Identification, and Rearing of Aphids	8
3.3.2 Cayenne Pepper Preparation	8
3.3.3 <i>Beauveria bassiana</i> Application	8
3.3.4 Feeding Behavior Experiment	9
3.3.5 Data Analysis	10
IV RESULT AND DISCUSSION	11
4.1 Aphids Identification	11
4.2 Feeding Behavior of <i>Aphis gossypii</i> Based on the EPG Waveform	11
4.2.1 Waveform of Feeding Behavior Recording Using EPG	11
4.2.2 Non-probing Phase Waveform Activity	14
4.2.3 Probing Phase Waveform Activity	16
4.2.4 Xylem Phase Waveform Activity	20
4.2.5 Phloem Phase Waveform Activity	22
4.3 General Discussion	28
V CONCLUSION AND SUGGESTION	31
5.1 Conclusion	31
5.2 Suggestion	31
REFERENCES	32
ATTACHMENTS	37
BIOGRAPHY	44

LIST OF FIGURES

3.1 Schematic drawing of a direct-current electrical penetration graph (DC-EPG)-based behavioral analysis system (Liu <i>et al.</i> 2013)	9
3.2 Schematic mechanism of EPG recording in the laboratory	10
4.1 Ventral view of <i>Aphis gossypii</i> under microscope (Leica M 205 C), (A) full body, (B) caudal region	11
4.2 Non-probing (Np) waveform of aphid feeding activity using EPG	12
4.3 Pathways (C) and potential drop (Pd) waveform of aphid feeding activity using EPG	12
4.4 Xylem (G) waveform of aphid feeding activity using EPG	13
4.5 Phloem (E) waveform of aphid feeding activity using EPG. (A) E1 waveform, (B) E2 waveform	14
4.6 Non-probing frequency (times) of <i>Aphis gossypii</i>	15
4.7 Non-probing duration (600 minutes) of <i>Aphis gossypii</i>	16
4.8 Pathways (C) frequency (times) of <i>Aphis gossypii</i>	17
4.9 Pathways (C) duration (600 minutes) of <i>Aphis gossypii</i>	18
4.10 Potential drop (Pd) frequency (times) of <i>Aphis gossypii</i>	19
4.11 Potential drop (Pd) duration (600 minutes) of <i>Aphis gossypii</i>	20
4.12 Xylem (G) frequency (times) of <i>Aphis gossypii</i>	21
4.13 Xylem (G) duration (600 minutes) of <i>Aphis gossypii</i>	22
4.14 Phloem salivation (E1) frequency (times) of <i>Aphis gossypii</i>	23
4.15 Phloem salivation (E1) duration (600 minutes) of <i>Aphis gossypii</i>	24
4.16 Phloem sucking (E2) frequency (times) of <i>Aphis gossypii</i>	25
4.17 Phloem sucking (E2) duration (600 minutes) of <i>Aphis gossypii</i>	26
4.18 <i>Aphis gossypii</i> feeding activity frequency (times) at various timepoints	27
4.19 <i>Aphis gossypii</i> feeding activity duration (600 minutes) at various timepoints	28



LIST OF CONTENTS

1. Feeding behavior of <i>Aphis gossypii</i> on non-probing (Np) activity	38
2. Feeding behavior of treated <i>Aphis gossypii</i> on pathways (C) activity	39
3. Feeding behavior of treated <i>Aphis gossypii</i> on potential drop activity	40
4. Feeding behavior of treated <i>Aphis gossypii</i> on xylem (G) activity	41
5. Feeding behavior of treated <i>Aphis gossypii</i> on phloem salivation (E1) activity	42
6. Feeding behavior of treated <i>Aphis gossypii</i> on phloem ingestion (E2) activity	43