

**COMPATIBILITY OF *Bacillus* sp. Bth-22 AND *Trichoderma* sp. FOR
CONTROLLING BACTERIAL LEAF BLIGHT DISEASE IN RICE
PLANTS**

UNDERGRADUATE THESIS



BY:

APRILLA HENDIANA DWIRIZKI PERMATA

NPM: 21025010031

**AGROTECHNOLOGY PROGRAM
FACULTY OF AGRICULTURE
UNIVERSITAS PEMBANGUNAN NASIONAL "VETERAN" JAWA TIMUR
SURABAYA
2025**

**COMPATIBILITY OF *Bacillus* sp. Bth-22 AND *Trichoderma* sp. FOR
CONTROLLING BACTERIAL LEAF BLIGHT DISEASE IN RICE
PLANTS**

UNDERGRADUATE THESIS

Submitted to fulfill the requirements for obtaining a Bachelor of Agriculture
degree in the Agrotechnology program



BY:

APRILLA HENDIANA DWIRIZKI PERMATA

NPM: 21025010031

**AGROTECHNOLOGY PROGRAM
FACULTY OF AGRICULTURE
UNIVERSITAS PEMBANGUNAN NASIONAL "VETERAN" JAWA TIMUR
SURABAYA
2025**

APPROVAL SHEET

COMPATIBILITY OF *Bacillus* sp. Bth-22 AND *Trichoderma* sp. FOR
CONTROLLING BACTERIAL LEAF BLIGHT DISEASE IN RICE
PLANTS

Written by:

APRILLA HENDIANA DWIRIZKI PERMATA

NPM: 21025010031

Submitted on:

17 October 2023

This thesis is accepted as one of the requirements for obtaining a Bachelor of
Agriculture degree

Universitas Pembangunan Nasional "Veteran" Jawa Timur

Approved by,

Main Supervisor

Co-Supervisor

Dr. Ir. Arika Purnawati, M.P.

NIP. 19650422 199003 2001

Dr. Dra. Endang Tri Wahyu P., M.Si.

NIP. 19641203 199103 2001

Known by,

Dean of the Faculty of Agriculture

Coordinator of the Agrotechnology
Undergraduate Program

Prof. Dr. Ir. Wanti Mindari, M.P.

NIP. 19631208 199003 2001

Dr. Ir. Tri Mujoko, M.P.

NIP. 19660509 199203 1001

APPROVAL SHEET

COMPATIBILITY OF *Bacillus* sp. Bth-22 AND *Trichoderma* sp. FOR
CONTROLLING BACTERIAL LEAF BLIGHT DISEASE IN RICE
PLANTS

Written by:

APRILLA HENDIANA DWIRIZKI PERMATA

NPM: 21025010031

Has been revised on:

17 October 2025

This thesis is accepted as one of the requirements for obtaining a Bachelor of
Agriculture degree

Universitas Pembangunan Nasional "Veteran" Jawa Timur

Approved by,

Main Supervisor

Co-Supervisor

Dr. Ir. Arika Purnawati, M.P.

Dr. Dra. Endang Tri Wahyu P., M.Si.

NIP. 19650422 199003 2001

NIP. 19641203 199103 2001

PLAGIARISM STATEMENT LETTER

Name : Aprilla Hendiana Dwirizki Permata
NPM : 21025010031
Program : Bachelor (S1)
Study Program : Agrotechnology
Faculty : Agriculture

I declare that in this scientific document of the final project or thesis, there are no part of others scientific works that have been submitted to obtain an academic degree at any higher education institution, and there are also no works or opinions that have been written or published by other individual or institution, except those that are cited in writing in this document and fully listed in the bibliography

I declare that this scientific document is free from elements of plagiarism. Any indication of plagiarism are found in this thesis in the future, I am willing to accept sanctions in accordance with the applicable laws and regulations.

I make this statement truthfully without any coercion from anyone and to be used as it should be.

Surabaya, 17 October 2025

Who made the statement,



SEPULUH RIBU RUPIAH
10000
METERAI
TEMPEL
00154ANX025937644

Aprilla Hendiana Dwirizki Permata

NPM. 21025010031

**COMPATIBILITY OF *Bacillus* sp. Bth-22 AND *Trichoderma* sp. FOR
CONTROLLING BACTERIAL LEAF BLIGHT DISEASE IN RICE
PLANTS**

**Aprilla Hendiana Dwirizki Permata¹, Arika Purnawati^{1*}, Endang Tri Wahyu
Prasetyawati¹**

¹Agrotechnology, Universitas Pembangunan Nasional “Veteran” Jawa Timur

*Corresponding Author: arika_p@upnjatim.ac.id

ABTRACT

Bacterial leaf blight (BLB), caused by *Xanthomonas* sp., is one of the most destructive diseases affecting rice plants in Indonesia. This study aimed to evaluate the compatibility and antagonistic effectiveness of *Bacillus* sp. Bth-22 and *Trichoderma* sp. applied both individually and in consortium against *Xanthomonas* sp. through in vitro and in vivo experiments. The research was conducted at the Plant Health Laboratory of the Faculty of Agriculture, UPN “Veteran” East Java and Kebun Bibit’s Greenhouse from February to July 2025. The in vitro test, using the dual culture method, revealed that *Bacillus* sp. Bth-22 and *Trichoderma* sp. were compatible, indicated by the absence of inhibition zones and a compatibility index below 1. Antagonism tests showed that the consortium treatment produced the highest inhibition zone (13 mm, strong category), significantly greater than single treatments of *Bacillus* sp. (1 mm) and *Trichoderma* sp. (8.3 mm). In vivo results demonstrated that the consortium effectively reduced disease intensity to the lowest level (30.02%) at 55 days after planting, compared to control treatments. Additionally, plants treated with antagonistic microbes exhibited increased height and leaf number, indicating improved growth. These findings confirm that the combination of *Bacillus* sp. Bth-22 and *Trichoderma* sp. works synergistically to suppress *Xanthomonas* sp. infection and enhance rice growth, suggesting its potential as a sustainable biocontrol strategy for managing bacterial leaf blight in rice.

Keywords: *Bacillus* sp., *Trichoderma* sp., *Xanthomonas* sp., bacterial leaf blight, antagonism, consortium, rice

ABSTRAK

Penyakit Hawar Daun Bakteri (BLB) yang disebabkan oleh *Xanthomonas* sp. merupakan salah satu penyakit paling merusak pada tanaman padi di Indonesia. Penelitian ini bertujuan untuk mengevaluasi kompatibilitas serta efektivitas antagonisme *Bacillus* sp. Bth-22 dan *Trichoderma* sp., baik secara tunggal maupun

dalam bentuk konsorsium, terhadap bakteri patogen *Xanthomonas sp.* melalui uji in vitro dan in vivo. Penelitian dilaksanakan di Laboratorium Kesehatan Tanaman dan Fakultas Pertanian UPN “Veteran” Jawa Timur dan *Greenhouse* Kebun Bibit Wonorejo pada bulan Februari hingga Juli 2025. Hasil uji in vitro menggunakan metode kultur ganda menunjukkan bahwa *Bacillus sp.* Bth-22 dan *Trichoderma sp.* bersifat kompatibel, ditandai dengan tidak terbentuknya zona hambat serta nilai indeks kompatibilitas kurang dari 1. Uji antagonisme menunjukkan bahwa perlakuan konsorsium menghasilkan daya hambat terbesar (13 mm, kategori kuat), lebih tinggi dibandingkan perlakuan tunggal *Bacillus sp.* (1 mm) dan *Trichoderma sp.* (8,3 mm). Hasil uji in vivo menunjukkan bahwa konsorsium mampu menekan intensitas serangan penyakit hingga 30,02% pada 55 hari setelah tanam, lebih rendah dibandingkan kontrol. Selain itu, tanaman padi yang diberi perlakuan mikroba antagonis menunjukkan pertumbuhan yang lebih baik dengan peningkatan tinggi dan jumlah daun. Hasil penelitian ini membuktikan bahwa kombinasi *Bacillus sp.* Bth-22 dan *Trichoderma sp.* bekerja secara sinergis dalam menekan infeksi *Xanthomonas sp.* sekaligus meningkatkan pertumbuhan tanaman padi, sehingga berpotensi digunakan sebagai strategi pengendalian hayati berkelanjutan terhadap penyakit hawar daun bakteri.

Kata kunci: *Bacillus sp.*, *Trichoderma sp.*, *Xanthomonas sp.*, hawar daun bakteri, antagonisme, konsorsium, padi

FOREWORD

The author would like to express his gratitude and thanks to Allah SWT, the One and Only, for all His blessings and guidance that have enabled the author to complete his thesis entitled "Compatibility of *Bacillus* sp. Bth-22 and *Trichoderma* sp. for Controlling Bacterial Leaf Blight Disease in Rice Plants" on time. This thesis was prepared to fulfill the requirements for a Bachelor of Agriculture degree in the Agrotechnology Study Program, Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Jawa Timur.

The author realizes that in the process of writing this thesis, many parties have provided support, guidance, and assistance, both directly and indirectly. Therefore, the author would like to express his deepest gratitude to:

1. Dr. Ir. Arika Purnawati, M.P., as the main supervisor who has provided guidance, direction, and support during the writing of this thesis.
2. Dr. Dra. Endang Tri Wahyu P., M.Si., as the co-supervisor who also helped provide valuable guidance and input.
3. Dr. Ir. Sri Wiyatiningsih, M.P., and Dr. Ir. Tri Mujoko, M.P., as examiners who provided constructive criticism and suggestions for the improvement of this thesis.
4. My beloved parents, who have always prayed for and provided moral support to help me complete this task successfully. Especially my lovely mother who have strived to be excellent single parent, able to guide their children to become valuable and successful individuals. Through her prayers and endless battles in life, they serve as a source of encouragement for the author. May they always be blessed with good health and abundant blessings from Allah SWT.
5. Dr. Ir. Tri Mujoko, M.P., as the Coordinator of the Agrotechnology Study Program, Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" East Java.
6. Prof. Dr. Ir. Wanti Mindari, M.P., as Dean of the Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" East Java.
7. All parties and friends who have contributed to the completion of this thesis. Especially Aisyah, Nirmala, and Andhika who have helped with their energy and

thoughts, both big and small, which have lightened the author's burden in the research process and also in compiling this paper.

May this thesis be of benefit to readers, especially those in need, and serve as additional knowledge and reference for further research development. The author also hopes that this modest work may contribute positively to the advancement of knowledge, particularly in the field related to this research.

Surabaya, August 2025

The Author

TABLE OF CONTENTS

	Page
FOREWORD	i
TABLE OF CONTENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	x
I. INTRODUCTION	1
1.1. Background	1
1.2. Problem Formulation	3
1.3. Research Objectives	3
1.4. Research Benefits	4
II. LITERATURE REVIEW	5
2.1. Rice Plants	5
2.2. Bacterial Leaf Blight	6
2.3. Antagonistic Bacteria <i>Bacillus</i> sp. Bth-22	7
2.4. Antagonistic Fungus <i>Trichoderma</i> sp.	8
2.5. Compatibility of <i>Bacillus</i> sp. Bacteria and <i>Trichoderma</i> sp. Fungi	10
2.6. Hypothesis	11
III. RESEARCH METHOD	12
3.1. Research Location and Time	12
3.2. Equipment and Materials	12
3.3. Research Design	12
3.3.1. <i>In vitro</i> Research Design	13
3.3.2. <i>In vivo</i> Research Design	13
3.4. Research Implementation	14
3.4.1. Sterilization of Equipment	14
3.4.2. Media Preparation	15
3.4.3. Sampling of <i>Xanthomonas</i> sp. Bacteria	16
3.4.4. Plant Tissue Isolation	16
3.4.5. Purification of Bacterial Isolates	16
3.4.6. Selective Media Test	16
3.4.7. Gram Stain Test	17

3.4.8. <i>Soft-Rot</i> Test	17
3.4.9. Pathogenicity Test	17
3.4.10. Isolate Rejuvenation	18
3.4.11. Compatibility Test	18
3.4.12. Antagonistic Test	18
3.4.13. Preparation of Planting Media.....	19
3.4.14. Provision of Rice Seeds.....	19
3.4.15. Pathogen Multiplication	19
3.4.16. Propagation of Antagonistic Microorganisms	19
3.4.17. Calculation of Bacterial and Fungal Colony Density.....	20
3.4.18. Pathogen Transmission.....	21
3.4.19. Application of Antagonistic Microbes.....	21
3.4.20. Rice Plant Maintenance.....	21
3.5. Observation Parameters	21
3.5.1. Compatibility Index.....	21
3.5.3. Incubation Period	22
3.5.4. Disease Intensity	23
3.6. Data Analysis	23
IV. RESULTS AND DISCUSSION	24
4.1. <i>Xanthomonas</i> sp. Bacteria.....	24
4.1.1. Bacterial Morphology and Gram Staining of Bacteria.....	24
4.1.2. Selective Medium Test	26
4.1.3. <i>Soft-Rot</i> Test	27
4.1.4. Pathogenicity test	27
4.2. <i>Bacillus</i> sp. Bth-22 bacteria	29
4.3. <i>Trichoderma</i> sp. Fungus.....	30
4.4. <i>In-vitro</i> Test Results	31
4.4.1. Compatibility of <i>Bacillus</i> sp. Bth-22 and <i>Trichoderma</i> sp.....	31
4.4.2. Antagonism test	33
4.5. <i>In-vivo</i> Test Results	36
4.5.1. Incubation Period	36
4.5.2. Disease Attack Intensity	36
4.5.3. Plant Growth	39
V. CONCLUSION	42

5.1. Conclusion	42
5.2. Recommendations	42
REFERENCES	43
ATTACHMENT	50

LIST OF TABLES

Number	<u>Text</u>	Page
3.1.	Scale of damage to rice crops	23
4.1.	Virulence level of <i>Xanthomonas</i> sp. bacteria	28
4.2.	Compatibility of antagonistic microbes	33
4.3.	Inhibitory activity of antagonistic microbes.....	35
4.4.	Intensity of bacterial leaf blight disease in rice plants	37
4.5.	Rice plant height each week	40
4.6.	Number of rice plant leaves per week	41
	<u>Attachment</u>	
1.	Description of the Ciherang rice variety	50
2.	ANOVA of the inhibitory power of antagonistic microbes.....	51
3.	Further testing of HSD antimicrobial activity of antagonistic microorganisms.....	51
4.	ANOVA of disease incubation period	51
5.	Further testing of HSD disease incubation period.....	52
6.	ANOVA of disease attack intensity at 14 DAP	52
7.	Further testing of HSD disease attack intensity at 14 DAP	52
8.	ANOVA of disease attack intensity at 21 DAP	53
9.	Follow-up test of HSD disease attack intensity at 21 DAP	53
10.	ANOVA of disease attack intensity at 28 DAP	53
11.	Follow-up test of HSD disease attack intensity at 28 DAP	54
12.	ANOVA of disease attack intensity at 35 DAP	54
13.	Follow-up test of HSD disease attack intensity at 35 DAP	54
14.	ANOVA of disease attack intensity at 42 DAP	55
15.	Follow-up test of HSD disease attack intensity at 42 DAP	55
16.	ANOVA of disease attack intensity at 49 DAP	55
17.	Follow-up test of HSD disease attack intensity at 49 DAP	56

18. ANOVA of disease attack intensity at 55 DAP	56
19. Follow-up test of HSD disease attack intensity at 55 DAP	56
20. ANOVA of plant height at 7 DAP	57
21. Further testing of high HSD in plants at 7 days after planting	57
22. ANOVA of plant height at 14 days after sowing	57
23. Follow-up test of HSD disease attack intensity at 14 DAP	58
24. ANOVA of plant height at 21 DAP	58
25. Follow-up test of HSD plant height at 21 DAP	58
26. ANOVA of plant height at 28 DAP	59
27. Further testing of plant height HSD at 28 DAP	59
28. ANOVA of plant height at 35 DAP	59
29. Further testing of plant height HSD at 35 DAP	60
30. ANOVA of plant height at 42 DAP	60
31. Further testing of plant height HSD at 42 DAP	60
32. ANOVA of plant height at 49 DAP	61
33. Further testing of plant height HSD at 49 DAP	61
34. ANOVA of plant height at 55 DAP	61
35. Further testing of plant height HSD at 55 DAP	62
36. ANOVA of leaf number at 21 DAP	62
37. Further test of HSD leaf number at 21 DAP	62
38. ANOVA of leaf number at 28 DAP	63
39. Follow-up test of HSD leaf count at 28 DAP	63
40. ANOVA of leaf number at 35 DAP	63
41. Follow-up test of HSD leaf count at 35 DAP	64
42. ANOVA of leaf number at 42 DAP	64
43. Follow-up test of HSD leaf count at 42 DAP	64
44. ANOVA of leaf number at 49 DAP	65
45. Follow-up test of HSD leaf count at 49 DAP	65
46. ANOVA of leaf number at 55 DAP	65

47. Follow-up test of HSD leaf count at 55 DAP	66
--	----

LIST OF FIGURES

Number	<u>Text</u>	Page
3.1.	<i>In vitro</i> experiment layout	13
3.2.	<i>In vivo</i> experiment layout	14
4.1.	Rice plants showing symptoms of BLB disease	24
4.2.	Morphology of <i>Xanthomonas</i> sp. bacteria	25
4.3.	Gram staining of <i>Xanthomonas</i> sp. at 1000x magnification	26
4.4.	Selective medium test for <i>Xanthomonas</i> sp. bacteria.....	26
4.5.	<i>Soft-rot</i> test for <i>Xanthomonas</i> sp. bacteria.	27
4.6.	Pathogenicity test of <i>Xanthomonas</i> sp. bacteria on rice plants	28
4.7.	Morphology of <i>Bacillus</i> sp. Bth-22 bacteria	29
4.8.	Gram staining of <i>Bacillus</i> sp. Bth-22 at 1000x magnification	30
4.9.	Colony morphology of <i>Trichoderma</i> sp. fungus	31
4.10.	Compatibility test of <i>Bacillus</i> sp. Bth-22 and <i>Trichoderma</i> sp.	32
4.11.	Antagonism test against <i>Xanthomonas</i> sp. bacteria.....	34
4.12.	Treatment on rice plants	38