

*This work is Dedicated to  
my beloved Father and Mother*

# Declaration

I declare that the thesis entitled “Studies on the selected tea garden weeds for the promotion of Tea plant health” has been prepared by me under the supervision of Prof. Arnab Sen, Department of Botany, University of North Bengal, and co-supervision of Dr. Chandra Ghosh, Associate Professor of the Department of Tea Science, University of North Bengal. No part of the thesis has formed the basis for the award of any degree or fellowship previously.

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### CERTIFICATE OF SUPERVISOR

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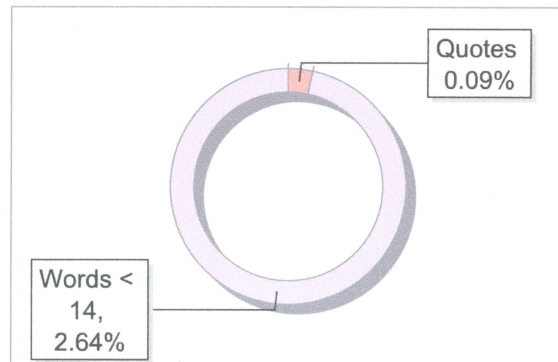
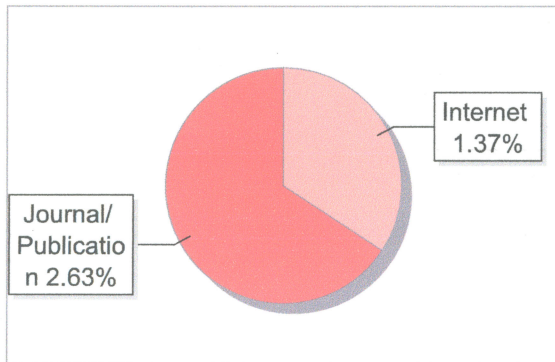
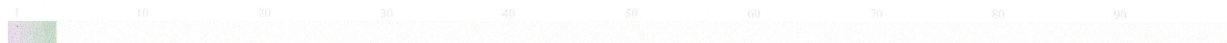
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Author Name	Sandipan Ghosh
Title	Studies on the selected tea garden weeds for the promotion of Tea plant health
Paper/Submission ID	1379535
Submitted by	nbuplg@nbu.ac.in
Submission Date	2024-01-30 15:01:31
Total Pages	176
Document type	Thesis

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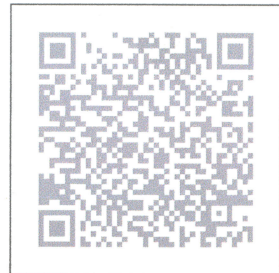
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Journals & publishers	Yes
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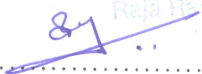
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# Acknowledgement

*When you have a dream, you have to grab it and never let it go.*

**-Carol Burnett**

This Ph.D. thesis is the culmination of my work over nearly four years (2020–2024) in the Molecular Cytogenetics Laboratory, Department of Botany, University of North Bengal. Without the great help and support of people around me, completing my thesis would not have been possible during this difficult trip that was filled with highs and lows. I would like to express my appreciation to many colleagues locally as well as globally, whose efforts have significantly impacted the creation of this thesis.

I am incredibly fortunate to have had the guidance and support of my Supervisor, Professor Arnab Sen, from

the Department of Botany, and my Co-supervisor, Dr. Chandra Ghosh. When I felt devoid of contributions to offer to the research endeavor, Professor Arnab Sen graciously welcomed me, extending a guiding hand and illuminating the path ahead. Additionally, Dr. Chandra Ghosh provided invaluable assistance in crafting the work plan for my thesis, offering support in every conceivable manner.

I extend my heartfelt gratitude to the esteemed members of the academic faculty who played pivotal roles in facilitating my doctoral research endeavours. Specifically, I would like

to express my sincere appreciation to Professor Aniruddha Saha Head of the Department, who served as the Coordinator overseeing the SAP, and Professor Monoranjon Choudhury, the esteemed faculty in charge of the DST-funded central facility. Their unwavering commitment and instrumental support have been indispensable, contributing significantly to the successful completion of my doctoral research. I am also indebted Prof. S.C. Roy, Dean faculty of Science, University of North Bengal. I extend my deep sense of gratitude to other faculty members Dr.Swarnendu Roy sir and Dr. Piyush Mathur sir. . I extend my gratitude to all the non-teaching staff of the Department of Botany.

I am deeply grateful to Dr. Gargi Sen for her unwavering support in all my endeavors and her exceptional ability to assist in solving research-related

challenges. Whenever I encountered a problem, a simple call to her resulted in quick resolutions. Her words of wisdom felt like a divine power capable of addressing any issue. Words alone cannot express the extent of my gratitude, Mam.

I also owe my gratitude to my big brother Dr. Priyanku Sharma, who has continuously supported me mentally and when I ran into any research-related problems. Certain well-trodden pathways on the left significantly facilitated my journey. I express my sincere appreciation to my senior research colleagues, namely Dr. Reha Labar, Dr. Indrani Sarkar, Dr. Pallab Kar, and Mr. Arnab Kumar Chakraborty, for their invaluable contributions and guidance. I am incredibly fortunate to be surrounded by an exceptional group of labmates, including Soumita Bhattacharjee, Swarnendra Banerjee, Moushikha Lala,



Saroja Chettri, Sutapa Datta, and Sagarika Roy, each of whom contributes to creating a truly enriching and supportive research environment.

I would like to acknowledge the invaluable assistance rendered by my fellow laboratory colleagues in Tea Science Department, Priyanka Das and Arindam Poddar, who have consistently provided unwavering support in every conceivable manner.

I am also deeply grateful to Dr. Sukumar Debnath sir for his unwavering guidance and support throughout every step of my Ph.D. journey. His mentorship has been instrumental in shaping my research direction and navigating the challenges encountered along the way. His insightful advice and encouragement have been invaluable assets, contributing significantly to the success of my doctoral pursuits.

I extend my acknowledgment to my

younger brother, Mr. Abisekh Karki, whose assistance has been instrumental in every conceivable way. Furthermore, I express heartfelt gratitude to my elder sister, Mrs. Deewa Basnett, for her continuous support and guidance, particularly during times of challenge. I express my deep appreciation to the Head of the Department of Tea Science for their unwavering support and invaluable guidance at every stage of my research journey an assistance for which I am genuinely grateful.

I would like to acknowledge the assistance provided by the manager of Merry View and Ellanbari Tea Gardens, who generously granted us access to their tea estates for conducting trials on our samples. Additionally, I extend my appreciation to the tea garden managers and staff who facilitated our field survey by providing essential data and support.

The mission wouldn't have been possible without the blessings and endless prayers of my parents, sisters, and dear and near ones whose names are not mentioned separately. Above all, I give thanks to Almighty God for bestowing upon me the wisdom, health, and strength to embark on and complete this research task.

[SANDIPAN GHOSH]

*Sandipan Ghosh*

*04/04/2024*

# Preface

*In the quest for understanding, we stand on the shoulders of giants, reaching ever higher towards the truth*

-Isaac Newton

Tea (*Camellia sinensis*) is one of the world's most widely consumed beverages, making tea cultivation a vital aspect of global agriculture. However, the tea industry faces significant challenges from various pests that can adversely affect yield, quality, and overall sustainability. This thesis aims to explore and propose an integrated pest management (IPM) approach to mitigate the impact of pests on tea cultivation, promoting environmental sustainability and economic viability.

The global tea industry is a significant sector with cultural, economic, and

social importance worldwide. Tea stands as one of the world's most popularly consumed beverages, second only to water in global consumption.

The industry encompasses the cultivation, processing, packaging, distribution, and consumption of tea products. China and India are the largest producers of tea globally, accounting for a substantial portion of the world's total tea output. The global tea industry holds significant economic importance, providing livelihoods for millions of people, contributing to international trade, and serving as a cultural staple with diverse varieties

enjoyed by consumers worldwide. The industry continues to adapt to changing consumer preferences and global challenges while striving for sustainability and quality.

One of the important problems in the tea industry is the pest problem, that causes severe crop loss in every year.

The major tea pests are tea red spider mites, tea mosquito bugs, Tea Green Leafhoppers, Tea Stem Borer, etc.

Sustainable and environmentally friendly pest management practices are crucial for maintaining the delicate balance of ecosystems and safeguarding the health of our planet.

Emphasizing the importance of these practices is paramount in the face of growing environmental challenges.

Tea plantations currently rely on synthetic pesticides for pest management, yet there is a growing interest among researchers to investigate the biopesticidal properties

inherent in plants as a more environmentally friendly alternative.

Utilizing native plant materials such as oils, extracts, and secondary metabolites has proven effective in safeguarding against pests and diseases. Various plant-based preparations, including powders, solvent extracts, essential oils, and insecticidal properties, are increasingly being explored and employed as biopesticides.

The objective of our study is to conduct a survey, document, and characterize plants utilized in formulating biopesticides for pest management. In various tea estates in the Tarai and Dooars regions, as well as at tea research institutes, cultural practices incorporating locally available weed plants are being introduced to combat tea pests. To gather relevant knowledge, we conducted a survey and selected ten

weed plants based on our findings. Subsequently, we collected these plants and formulated a biopesticide.

In our research, we conducted experiments using individual plant aqueous extracts to determine their effectiveness compared to formulated blends. Our findings revealed that *Clerodendron viscosum* L., *Artemisia vulgaris* L., and *Justicia adhatoda* L. demonstrated superior efficacy when applied to control red spider mites under laboratory conditions. We conducted a series of experiments to assess the effectiveness of a bioformulation by applying it in varying doses within a greenhouse using infected samples. Upon obtaining positive results, we proceeded to conduct field trials in two tea estates one in the Tarai region and another in the Dooars region. Subsequently, we aimed to identify the compounds

present in the bioformulation through GC-MS analysis. Analyzing some red spider mite proteins of *Tetranychus uttrae* from the PDB database, we employed molecular docking studies to demonstrate that the identified compounds could potentially lead to the mortality of the insect pest. Our findings align with existing literature, supporting the pesticidal activity of these compounds based on previous studies. The thesis starts with an introduction where the objectives are given. A review of the present tea pest and its management. The materials and methods, results, and discussion regarding the present finding are given. The bibliography and supplementary details are given as an appendix at the end of the thesis.

[SANDIPAN GHOSH]

Sandipan Ghosh

04/04/2024

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