ELECTROSTATIC POLLEN COLLECTOR FOR COCONUT PALM

By

ATHIRA P.

(2022-28-002)

DEPARTMENT OF FARM MACHINERY AND POWER ENGINEERING
KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING AND FOOD TECHNOLOGY, TAVANUR – 679573
KERALA, INDIA

2026

ELECTROSTATIC POLLEN COLLECTOR FOR COCONUT PALM

By

ATHIRA, P.

(2022-28-002)

THESIS

Submitted in partial fulfillment of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

in

AGRICULTURAL ENGINEERING

(Farm Machinery and Power Engineering)

Faculty of Agricultural Engineering and Technology
Kerala Agricultural University

DEPARTMENT OF FARM MACHINERY AND POWER ENGINEERING
KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING AND FOOD TECHNOLOGY, TAVANUR – 679573
KERALA, INDIA

2026

DECLARATION

I, hereby declare that this thesis entitled "ELECTROSTATIC POLLEN COLLECTOR FOR COCONUT PALM" is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Athira P.
2022-28-002

Tavanur
Date: 14.08.2026

CERTIFICATE

Certified that this thesis entitled "ELECTROSTATIC POLLEN COLLECTOR FOR COCONUT PALM" is a record of research work done independently by Athira P. (2022-28-002) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Tavanur
Date: 10.08.2026

Dr. Dhalin D.
(Major Advisor, Advisory Committee)
Professor
Department of FMPE
KCAEFT, Tavanur

CERTIFICATE

We, the undersigned members of the advisory committee of Athira P. (2022-28-002), a candidate for the degree of **Doctor of Philosophy in Agricultural Engineering** with major in Farm Machinery and Power Engineering, agree that the thesis entitled "ELECTROSTATIC POLLEN COLLECTOR FOR COCONUT PALM" may be submitted by Athira P. (2022-28-002) in partial fulfillment of the requirement for the degree.

Dr. Dhalin D.
(Major Advisor, Advisory Committee)
Professor
Department of FMPE
KCAEFT, Tavanur

Dr. Jayan P. R.
(Member, Advisory Committee)
Dean (Faculty of Agrl. Engg.)
Professor & Head (FMPE)
KCAEFT, Tavanur

Dr. Suma Nair
(Member, Advisory Committee)
Assistant Professor (FPM)
Agricultural Research Station
Mannuthy, Thrissur

Mr. Vaisakh Venu
(Member, Advisory Committee)
Assistant Professor
Department of BEAS
KCAEFT, Tavanur

Dr. Gayatri G.
(Member, Advisory Committee)
Assistant Professor
Plant Breeding and Genetics
College of Agriculture, Vellayani

External Examiner
Dr. T. Senthilkumar
Principal Scientist
ICAR-Central Institute of Agricultural Engineering, Regional Station
Coimbatore, Tamil Nadu

Acknowledgement

ACKNOWLEDGEMENT

With extreme pleasure, I express my deep sense of gratitude and heartfelt indebtedness to my major advisor ***Dr. Dhalin D.****, Professor, Department of Farm Machinery and Power Engineering (FMPE), KCAEFT, Tavanur, for his invaluable guidance, constructive criticism and constant encouragement throughout the course of research work.*

I express my whole hearted gratitude to ***Dr. Jayan P.R.,*** *Dean (Faculty of Agrl. Engg.)****,*** *Professor and Head, Dept. of FMPE, KCAEFT, Tavanur, for the proper counsel, support and for providing the necessary infrastructure and facilities for carrying out my research work.*

I extend my sincere thanks to my advisory committee members, ***Mr. Vaisakh Venu,*** *Assistant Professor, Department of BEAS, KCAEFT, Tavanur,* ***Dr. Suma Nair****, Assistant Professor (FPM), Agricultural Research Station, Mannuthy, Thrissur,* ***Dr. Gayatri G.****, Assistant Professor, Plant Breeding and Genetics, College of Agriculture, Vellayani, for their inevitable suggestions and guidance during the research work.*

I express my profound gratitude to ***Dr. Dipak S. Khatawkar,*** *Assistant Professor, Department of FMPE, KCAEFT, Tavanur for his continuous guidance and support from the beginning till the end of this research work.*

I remain thankful to all the faculty members in the Department of FMPE, KCAEFT, Tavanur, ***Er. Sindhu Bhaskar, Er. Sanchu Sukumaran, Dr. Edwin Benjamin, Dr. Rajesh G. N.,*** *for their kind co-operation and scholarly advice. I also extend my gratitude to* ***all faculty members*** *of KCAEFT, Tavanur, for their support and the facilities provided during the course of time.*

I offer special thanks to, ***Dr. Shaji James P.,*** *Retired Professor, Kerala Agricultural University, for his mentorship, constant support and guidance throughout my academic journey. I also extend my sincere thanks to* ***Dr. Anu Varughese****, Associate Professor, Department of IDE, KCAEFT, for all her support and encouragement.*

I am grateful to ***Kerala Agricultural University*** *for providing the fellowship and research grant during the doctoral programme. Also, I express my thanks to all*

*the **members of KCAEFT Library** for their help and co-operation.*

*I am extremely to my dear junior, a brother, **Er. Mohanaselvan T.**, for the boundless support and assistance provided. I express my profound gratitude to technical staffs, **Prasoon, Vimal, Shobith and Farm labour Unnikrishnan** for their whole hearted co-operation and assistance during the course of project work.*

*This accomplishment would not have been possible without the support of my friends, seniors, and juniors, especially **Er. Humbare Mrunalini Dinkar, Dr. Athira Prasad, Mr. Kiran, Dr. Arya K. T., Er. Ann Annie Shaju, Er. Yadhukrishnan, Er. Namitha M. R., Er. Amrutha Ajayan, Er. Devika Gugloth, Er. Arsha sugathan, Er. Amrutha, Er. Rachana, Er. Midhula B. N., Mr. Jayaprakash, Ms. Athira Vimal, Ms. Chithralekha (matron)** for their invaluable help during my study.*

*No words can truly express my deepest love and gratitude to the most important person in my life, my husband, **Deepak P. R.**, who has been and will always be a constant pillar of strength. His unwavering support through both my successes and failures, along with his steadfast belief in my dream of becoming a doctoral graduate, has been the foundation of this achievement. This accomplishment was his dream even more than my own.*

*I express my deepest gratitude and love to my parents **Ramakrishnan** and **Umadevi,** and my in-laws **Rajendran** and **Anitha,** for their unconditional love, support and encouragement that carried me through every challenge of this journey. I am also grateful to my brother, sisters and all family members for their constant support and belief in me. I extend special thanks to my dear friend **Suresh** for his unwavering support throughout my life. I am grateful to each and every individual who has directly or indirectly contributed to the successful completion of this research.*

*Finally, with heartfelt reverence, I offer my deepest gratitude to the **Almighty** and the quiet strength of nature, whose gentle guidance and boundless grace have uplifted my spirit and nurtured my path.*

Athira P.

Dedicated to my family

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF SYMBOLS AND ABBREVIATIONS

±	:	Plus or minus
×	:	Multiplication
º	:	Degree
ºC	:	Degree centigrade
AC	:	Alternate Current
DC	:	Direct Current
C	:	Coulomb
pC	:	Pico Coulomb
fC	:	Femto Coulomb
et al.	:	and others
FMPE	:	Farm Machinery and Power Engineering
mm	:	Millimeter
cm	:	Centimeter
m	:	Meter
µm	:	Micrometer
AM	:	Ante Meridiem
kg	:	Kilogram
$kg \cdot m^{-3}$	:	Kilogram per meter cube
mg	:	Milligram
g	:	Gram
h	:	Hour
$mC \cdot kg^{-1}$	:	Milli Coulomb per kilogram
Pa	:	Pascal
kPa	:	Kilo Pascal
ha	:	Hectare
$m \cdot s^{-1}$	:	Meter per second
s	:	Second
%	:	Per cent
$g \cdot L^{-1}$	:	Gram per liter
F	:	Farad

nF	:	Nano Farad
μF	:	Micro Farad
$F \cdot m^{-1}$	:	Farad per meter
h	:	Hour
N	:	Newton
V	:	Volt
A	:	Ampere
mA	:	Milli ampere
μA	:	Micro ampere
W	:	Watts
kWh	:	Kilo watt hour
mAh	:	Milli ampere hour
kV	:	Kilo volt
$kV \cdot m^{-1}$	:	Kilo volt per meter
$V \cdot m^{-1}$	:	Volt per meter
Hz	:	Hertz
kHz	:	Kilo hertz
Pa	:	Pascal
HV	:	High Voltage
FEA	:	Finite Element Analysis
Ω	:	Ohm
MΩ	:	Mega ohm
μ	:	Micro
σ	:	Greek small letter sigma
ε	:	Greek small letter epsilon
Ø	:	Greek small letter phi
Rs.	:	Rupees