

**DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF AN AIR-
ASSISTED MANGO (*Mangifera indica*) ORCHARD SPRAYER**

**DE VERA, RON JAY G.
TAN, EDUARDO II P.**


An Undergraduate Thesis Submitted to the Faculty of the Department of Agricultural and
Biosystems Engineering, College of Engineering, Central Luzon State University,
Science City of Muñoz, Nueva Ecija, Philippines
in Partial Fulfillment of the Requirements
for the Degree of

**BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS
ENGINEERING
(AB Machinery and Power Engineering)**

JULY 2024

ACCEPTANCE SHEET

This undergraduate thesis entitled “**DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF AIR-ASSISTED MANGO (*Mangifera indica*) ORCHARD SPRAYER**”, prepared and submitted by **RON JAY G. DE VERA** and **EDUARDO P. TAN II** in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING (AB MACHINERY AND POWER ENGINEERING)**, is hereby accepted:


Engr. **ELIZA E. CAMASO, MSc**
Member, Advisory Committee


JUNE 7, 2024

Date Signed


JEANNIE-ROSE G. FABULA, Ph. D.
Member, Advisory Committee

JUNE 7, 2024

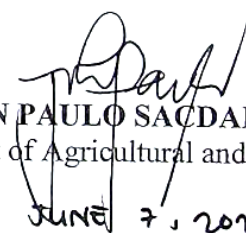
Date Signed


JONATHAN V. FABULA, Ph. D.
Chair, Advisory Committee

JUNE 7, 2024

Date Signed

Accepted as a partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING**:


JOHN PAULO SACDALAN, Ph. D.
Chair, Department of Agricultural and Biosystems Engineering

JUNE 7, 2024

Date Signed


ROY SEARCA JOSE P. DELA CRUZ Ph. D.
Dean, College of Engineering

JUNE 11, 2024

Date Signed

BIOGRAPHICAL SKETCH

Ron Jay G. De Vera, a 21-year-old individual, was born on August 27, 2001, in Cabanatuan City, Nueva Ecija. He is the son of Charito De Vera and Telesporo De Vera. Ron Jay hails from Brgy. Caalibangbangan, a close-knit community where he has spent much of his life.

His educational journey began at Caalibangbangan Elementary School, where he laid the foundation for his academic pursuits. He then continued his studies at Marciano del Rosario Memorial National High School for both his junior and senior high school education as a Science, Technology, Engineering, and Mathematics (STEM) student, demonstrating his commitment to learning. During his high school years, Mr. De Vera actively participated in press conferences as a sportswriter and photojournalist. Outside academics, he is one of the youth leaders in their church at Victory Church, actively involved in youth ministries that encourage students to always seek God.

Ron Jay's journey into agriculture began during his elementary to high school days, when his father would occasionally bring him to their duck poultry in Bulacan, owned by his aunt and father. Fascinated by the role of agriculture in their lives, he decided to pursue a degree in Agricultural and Biosystems Engineering at Central Luzon State University.

During his college years, he obtained a certificate as he accomplished his On-the-Job Training at the Agricultural Machinery Testing and Evaluation Center (AMTEC), where he experienced hands-on testing and evaluation of different agricultural machinery. His OJT helped him expand his knowledge and horizons in machine testing and apply it to his study.

With a strong foundation in his education and a promising path ahead, Ron Jay De Vera exemplifies determination and a drive for personal and academic growth.

Eduardo P. Tan II, a determined 21-year-old individual, was born on October 7, 2002, in Tarlac City, Tarlac. He is the son of Cristopher Ryan S. Tan and Regin P. Tan. He is the eldest of the three children in the family. He resides at Purok 4, Brgy. San Joaquin, Maria Aurora, Aurora.

In 2014, he completed his elementary education with honors at Maria Aurora Central School. Four years later, he attained high honors upon graduating from Mount Carmel School of Maria Aurora for his junior high school education. Subsequently, after two years, he concluded his senior high school education as a Science, Technology, Engineering, and Mathematics (STEM) student at Aurora National Science High School, earning honors upon graduation.

He pursued his bachelor's degree at Central Luzon State University, studying Bachelor of Science in Agricultural and Biosystems Engineering, majoring in AB Machinery and Power Engineering. He was a scholar of the Department of Science and Technology and the Philippine Development Foundation, which assists him with his financial needs as a student and supports his professional growth.

Eduardo's journey towards becoming an ABE student started with his father, an electrical engineering graduate. Initially, Eduardo aspired to follow in his father's footsteps and continue his legacy by becoming a licensed engineer. However, observing the agricultural situation in the country, he recognized an opportunity to contribute as an engineer while aiding the sector's advancement.

During his college years, he underwent his On-the-Job Training (OJT) at the Agricultural Machinery Testing and Evaluation Center (AMTEC), immersing himself in

an environment focused on agricultural machinery. His OJT experience enabled him to establish professional connections and develop in a conducive work environment, broadening his understanding of machine testing and applying his knowledge to his studies.

Upon graduation, Eduardo aims to pass the board exam and intends to dedicate two years of service as a teacher at the Department of Education. Subsequently, he plans to practice his profession in the country, contributing to the development of sustainable agriculture applications and technologies for society. He aspires to facilitate the integration of machinery into the practices of small-scale local farmers.

ACKNOWLEDGEMENT

In their research endeavors, the researchers eagerly look forward to those breakthrough moments when all their hard work finally pays off and their studies are complete. However, it's often true that the process feels like an endless waiting game. Doubts inevitably arise, making them question whether their efforts will ever be rewarded. Yet, it is important to remember that God's timing is perfect. As He promises in Isaiah 60:22, "When the time is right, I, the Lord, will make it happen." Therefore, when God plants a dream in their hearts, He already knows the ideal time for it to come to fruition. Every step they take in their research and every challenge they face is part of God's plan. He has already set the right moment for their success, just as He has planned the right time for this study to succeed.

Mr. Ron Jay G. De Vera extends his sincere appreciation and gratitude to the individuals who contributed to the successful completion of their academic endeavor:

Firstly, heartfelt thanks to Dr. Jonathan V. Fabula, their Research Adviser, whose invaluable insights, encouragement, and willingness to challenge their ideas propelled them to exceed their limits. Mr. De Vera considers himself fortunate to have received Dr. Fabula's guidance and steadfast support throughout the process;

To Dr. Jeannie-Rose G. Fabula, a committee member, for her patient oversight, guidance, and profound understanding. Furthermore, special thanks are extended to Ma'am Eliza E. Camaso, another committee member, for her valuable suggestions that aided in the development of the research;

To Kuya Daniel for his assistance in fabricating the machine. His invaluable expertise and support significantly contributed to the completion of the fabrication process;

To the farm staff and laborers in PreDiCt, especially Kuya Jojo for always making time to help and assist the researchers during the evaluation phase of the machine.

To his thesis partner, Eduardo Tan II, for his cooperation, support and effort in ensuring the success of this academic accomplishment and for being positive at most times;

To his college friends, Althea Dacayo and Eduardo Bagaporo Jr. for their assistance during the testing phase and their unwavering support throughout the challenges they encountered, their presence made it bearable;

To his parents, Mr. Telesporo De Vera and Mrs. Charito De Vera for unconditional love, understanding, sacrifices, patience and mental and financial support. Their encouragement has fueled his determination to pursue excellence;

To his Daddy Willy, Ninang Imelda, and Mama Gina for their emotional, mental and financial support;

To his Coach Aaron and Coach Jessa for their prayers and support. Their prayer makes challenges more meaningful and manageable.

To Real Life Foundation for their generous financial support. Their assistance made it possible to conduct their research and acquire the necessary machine components and also encouraged him to pursue excellence in his academic endeavors.

And ultimately, to the Almighty God, for blessings, protection, and guidance throughout the journey.

The quote from his beloved series resonates deeply: “It is okay to be scared; you just have to do it anyway.” This mantra has been his guiding light throughout the journey of this study. Embracing tasks outside his comfort zone became a daily routine as they stated on this research endeavor.

With that being said, Mr. Eduardo P. Tan II, wishes to convey his deepest gratitude and appreciation to the following individuals who offered invaluable aid and support in achieving this academic milestone:

To Dr. Jonathan V. Fabula, their esteemed research adviser, profound gratitude is extended for generously sharing his insights, ideas, and invaluable guidance, all of which were instrumental in realizing this study. His depth of knowledge served as a beacon, illuminating their paths throughout the research process.

To their research committee, Dr. Jeannie-Rose G. Fabula, for dedicating her time and patience to reviewing our paper and providing constructive feedback, which greatly enhanced the quality of our research. And Engr. Eliza E. Camaso, for her encouragement, profound knowledge, constructive comments, and patience in accommodating schedule adjustments to facilitate our thesis presentations.

To his partner, Ron Jay, whose patience, support, and belief in our project greatly contributed to its success. His presence made the thesis journey less challenging, both emotionally and financially.

Kuya Jojo, despite his busy schedule, provided invaluable assistance by driving the tractor during the testing phase of the machine. His support was instrumental in conducting the testing successfully.

Kuya Daniel's assistance in constructing the machine was invaluable. His expertise and support significantly contributed to the completion of the fabrication process.

Special thanks to their friends, Althea and Jr, for their assistance during the testing phase and their unwavering support, making the entire process more bearable.

He is deeply grateful to his parents, Mrs. Regin P. Tan, and Mr. Cristopher Ryan S. Tan, for their unwavering emotional and financial support throughout this research endeavor. Their encouragement fueled his determination to complete this study.

To Department of Science and Technology – Science and Education Institute (DOST-SEI) for their generous financial support, which facilitated the research and acquisition of necessary machine components. Their assistance not only provided essential resources but also served as a motivating force, inspiring him to pursue excellence in his academic pursuits.

Also, to Philippine Development (PhilDev) Foundation for their financial support, which played a vital role in the research process. Their contribution not only facilitated the completion of their thesis but also contributed to the advancement of knowledge and innovation. He is truly honored to have benefited from their vision and generosity.

Heartfelt appreciation is extended to all individuals who contributed in any capacity to the completion of this study, whether through consultations, feedback, or simply lending an ear. Your support was invaluable and deeply cherished.

Above all, recognition is given to Jehovah God for His abundant blessings, wisdom, protection, and unwavering guidance. Without His divine providence, this achievement would not have been possible.

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ABSTRACT

DE VERA, RON JAY G. & TAN EDUARDO II P., Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Muñoz, Philippines, July 2024, **DESIGN, FABRICATION, AND PERFORMANCE EVALUATION OF AIR-ASSISTED MANGO (*Mangifera indica*) ORCHARD SPRAYER**

Adviser: JONATHAN V. FABULA, Ph., D.

Conventional spraying methods in the Philippines are inefficient, time-consuming, and labor-intensive, leading to increased costs and pesticide use. This has prompted the adaptation of new technologies, such as air-assisted sprayers. The utilization of an air-assisted sprayer minimizes manual labor and time spent in spraying, making the process more efficient, faster, and easier. This study aimed to design, fabricate, and evaluate an air-assisted sprayer for mango orchards in the Philippines. The fabricated sprayer consisted of eight major components: the main frame, prime mover, pump, pipes, nozzles, tank, hose, and fan. The machine's performance was assessed based on its spray characteristics, including droplet size, density, effective field capacity, and field efficiency. The droplet size and density were collected using Kromekote cards. On the other hand, the effective field capacity and field efficiency were tested in an area spanning 1000 m². The embedded fan of the sprayer produces an air speed of about 10.53 m/s, which helps deposit the droplets over a longer distance, making the spray reach higher tree heights. The results showed better performance at an operating pressure of 60 psi, achieving a spray height of 5.6 meters, a swath width per row of 9.2 meters, and a discharge rate of 7.03 liters per minute. Also, with the same operating pressure, it produced the finest droplets of 81 µm and the highest density of 197.33 deposits/cm², ensuring excellent leaf retention across the

tree's canopy. The sprayer's actual field capacity was 1.16 hectares per hour, with a field efficiency of 92.7%. The cost of manufacturing the machine is approximately ₱28,703 per unit, with an estimated payback period of 2.33 years, a benefit-to-cost ratio of 2.68, and a net present value of PHP 77,026.57, demonstrating the economic viability of the sprayer. Hence, the developed air-assisted sprayer demonstrated its potential to significantly improve the efficiency of chemical application in mango orchard production.

Keywords: sprayer, air-assisted sprayer, sprayer evaluation, sprayer efficiency, mango sprayer

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