CARBONIZED RICE HULL AS SOIL CONDITIONER FOR BELL PEPPER (*Capsicum annuum L.*) PRODUCTION UNDER GREENHOUSE CONDITION

CHRISTIAN CLARK P. RIMOCAL

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 Requirement for the Degree of

BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING
(Land and Water Resources Engineering)

JUNE 2019

ACCEPTANCE SHEET

This undergraduate thesis title entitled, "**CARBONIZED RICE HULL AS SOIL CONDITIONER FOR BELL PEPPER (*Capsicum annuum L.*) PRODUCTION UNDER GREENHOUSE CONDITION**", prepared and submitted by **CHRISTIAN CLARK P. RIMOCAL** in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING (LAND AND WATER RESOURCES ENGINEERING)** is hereby accepted:

CLAIRE MARIE M. CASTILLO, M.Sc.
Member, Advisory Committee

6 / 10 / 19
Date Signed

ARMANDO N. ESPINO, JR, Ph.D.
Member, Advisory Committee

6 / 19 / 19
Date Signed

CAROLYN GRACE G. SOMERA, M.Sc.
Chairperson, Advisory Committee

6/13/19
Date Signed

Accepted as partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING (LAND AND WATER RESOURCES ENGINEERING)**

MARVIN M. CINENSE, Ph.D.
Chairperson, Department of Agricultural and Biosystems Engineering

6/14/19
Date Signed

VICTORINO T. TAYLAN, Ph.D.
Dean, College of Engineering

6 / 14 / 19
Date Signed

BIOGRAPHICAL SKETCH

Christian Clark Pamandanan Rimocal is the second child of Mr. Reynaldo R. Rimocal and Mrs. Catalina P. Rimocal. He was born on September 07, 1997 at Baliuag, Bulacan.

He finished his primary education at Guimba East Central School, Guimba, Nueva Ecija on March 2010 and his secondary education at Bartolome Sangalang National High School at Guimba, Nueva Ecija on March 2014. He enrolled at the Central Luzon State University for the Agricultural and Biosystems Engineering curriculum.

He attended various seminars and activities as a student such as Amazing Race and Technopreneurship Forum held at Central Luzon State University.

ACKNOWLEDGEMENT

The author wishes to express his sincere thanks to the people who helped through their humble contributions in the success of this study:

Engr. Carolyn Grace G. Somera, Chairperson of the advisory committee, his kind and generous adviser, for her excellent suggestions, knowledge, guidance, criticisms and supervision in the conduct of the study;

Dr. Armando N. Espino Jr. and Engr. Claire Marie M. Castillo, members of the advisory committee, for their guidance, immense support, comments and suggestion for the improvement of the study;

Dr. Marvin M. Cinense, Department Chairman, and to all the members of the faculty and staff of the Department of Agricultural and Biosystems Engineering for the knowledge they shared;

Dr. Victorino T. Taylan, Dean of College of Engineering, and to all the members of the faculty and staff of the college of engineering for their exceptional service and dependability;

Dr. Purisima Quico, for her guidance and support for the conduct of soil analysis and to the study;

His family, especially to his parents, Mr. Reynaldo Rimocal and Catalina Rimocal, for their sacrifices that enabled the author to reach this stage of his life;

His classmates, who became her good friends, John Karlo Domingo, Bravely Jehu Fernandez, Jhovirey Victoria, Alvin Laplano, Johnny Reyes, Menard Soni and Raymart Mc Carkle for sharing stress-relieving moments after a long day at school;

His travel buddy, Mark Anthony Rimocal, for their unforgettable travels that became good memories to cherish and for giving him so much strength and inspiration;

Above all, the author wants to praise, honor and thank God for all the blessings, guidance, courage, knowledge, life, strength, love, hope and faith He has given the author.

To God be all the glory.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURES

ABSTRACT

RIMOCAL, CHRISTIAN CLARK P., Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Munoz, Nueva Ecija, **June 2019, CARBONIZED RICE HULL AS SOIL CONDITIONER FOR BELL PEPPER (*Capsicum annuum L.*) PRODUCTION UNDER GREENHOUSE CONDITION**

Adviser: CAROLYN GRACE G. SOMERA, M.Sc.

Bell peppers (*Capsicum annuum L.*), also called sweet peppers are grown for its fruit. It is one of the crops that can be planted inside a greenhouse because of its high market value. Rice hull can be used as fuel, as fertilizer and as soil conditioner. Rice hull needs to undergo the carbonization process to become more effective as fertilizer and as soil conditioner. Most of the farmers use inorganic fertilizer that in the long run, arises some issues like decrease in macro aggregate resulting to soil acidification that can lead to damage of top soil. Using a carbonized rice hull, it can improve the soil properties like the downward movement of the water that can help roots to easily access the water. The study aimed to evaluate the carbonized rice hull as soil conditioner for bell pepper production under greenhouse condition.

The design of drip irrigation system for bell pepper production was made by considering some parameters. The different components of drip irrigation system are water tank, lateral, mainline, emitters and water filter. The experiment was laid out in a Completely Randomized Design (CRD). The data on plant height, fruit weight, root length and crop yield were recorded and analyzed using Analysis of variance (ANOVA). Comparison among means was done using Least Significant Difference (LSD). All the expenses throughout the study were recorded and some assumptions were made.

A design of drip irrigation system was made and installed inside the greenhouse for the irrigation of bell pepper plants. Results revealed that treatment 4 (65% garden soil + 30% Vermicompost + 5% carbonized rice hull) was the best mixture of growing media in terms of increasing the growth and yield of the bell pepper under greenhouse condition. In terms of plant height, treatment 4 has the highest height with a mean of 79.44 cm followed by treatments 2, 3 and 1 with means of 67.78 cm, 61.33 cm and 58.22 cm. In terms of yield, treatment 4 has also the highest yield with a mean of 73.30 g followed by treatment 2 with a mean of 34.00 g. The estimated cost of production per kilogram is Php 384.88.

Keywords: carbonized rice hull, soil conditioner, drip irrigation

LITERATURE CITED

AKAND, M. H., ISLAM, M., RAHIM, M. A., and SAHA, S. 2011. Effect of Spacing on the Growth and Yield of Sweet Pepper. Retrieved on December 1, 2018 from https://www.researchgate.net/publication/263859107_Effect_of_Spacing_on_the_Growth_and_Yield_of_Sweet_Pepper.

AMEND, I.G. 2005. Irrigation Water Management. Irrigation Guide, 210-vi NEH 652. New York, US. Retrieved on October 8, 2018 from http://www.nces.usda.gov/Internet/FSE_DOCUMENT/nrcs141p2_017781.pdf.

AYRES, S.A. 2014. Sweet and Hot Pepper Production Guideline.pdf. Retrieved on November 11, 2018 from http://www.starkeayres.co.za/com_variety_docs/Sweet-%26-Hot-Pepper-Production-Guideline-2014.pdf

BONNIE. 2011. Should You Stake Pepper Plants?. Retrieved on October 27, 2018 from https://bonnieplants.com/library/peppers-to-stake-or-not-to-stake/.

BRENNAN, E. 2018. Growing Plants and Harvesting Seed. Retrieved on October 26, 2018 from https://dengarden.com/gardening/How-to-Sow-Seeds.

CASTILLO, J.P. 2005. Determination of the Management Allowed Deficit of Eggplant. CentralLuzon State University. Nueva Ecija, Philippines.

DALPE, 2001. Guide to Commercial Greenhouse Sweet Bell Pepper Production in Alberta. Retrieved on October 2, 2018 from https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/opp2873.

DALUSONG, T.C. 2016. Effect of Agriculture Substrate in Hydroponics System under High Tunnel Structure for Lettuce (*Lactuca sativa*) Production. Central Luzon State University. Nueva Ecija, Philippines.

DAM, B. V., GOFFAU, M., HILMI, M., and NAIKA, S., 2005. Cultivation of Tomato. Digigrafi, Wageningen, Netherland. Retrieved on December 1, 2018 from http://www.cultivationoftomato.seeds. irrigation.

DARCY, L. 2018. What Is Soil Conditioner: Using Soil Conditioner In The Garden. Retrieved on October 25, 2018 from https://www.gardeningknowhow.com/garden-how-to/soil fertilizers/what-is-soil-conditioner.htm.

DEGIRMENCI, V., KAYA, C., and KIRNAK, H. 2002. Growth and Yield Parameters of Bell Peppers with Surface and Subsurface Drip Irrigation System Under Different Irrigation Levels.pdf. Retrieved on October 9, 2018 from https:// www. researchgate.net/publication/285797174.

DE GRACIA, R.S. 2016. Effect of Drip and Furrow Irrigation System on the Growth and Yield of Tomato under Greenhouse Condition. Central Luzon State University. Nueva Ecija, Philippines.

DEL ROSARIO, Z. 2018. Construction of Vertical Garden for Hot Pepper (*Capsicum frutescens L.*) Production using Different Compost Proportions under Protected Structure. Central Luzon State University. Nueva Ecija, Philippines.

DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES (DAFF), 2013. Production Guideline: Sweet Pepper.PDF file, Retrieved on October 8, 2018 from http://www.nda.agri.za/docs/Brochures/sweetpepper.pdf&ved.

DORE, J. 2009. Aphid Attack!. Retrieved on May 30, 2019 from https://www.growveg.com/guides/aphid-attack/.

EAST WEST SEEDS PHILIPPINES, 2015. Emperor f1Sweet Pepper. Retrieved on October 9, 2018 from http://ph.eastwestseed.com.

ECHALUSE, R.G. 2004. Modified Irrigation Scheduling for Bell Pepper Production. Central Luzon State University. Nueva Ecija.

FOLNOVIC, T. 2019. Vermicompost's Role in Farming. Retrieved on January 6, 2019 from blog.agrivi.com/post/Vermicompost-s-role-in-farming.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO), 2018. Pepper . Retrieved on October 9, 2018 from http://www.fao.org/land-water/database-and-software/crop-information/pepper/en/FAO.2017.

GARCIA, I. 2014. Root aphids. Retrieved on May 30, 2019 from https://www.cannagardening.com.

GERBER, C. 2013. Why is soil so important. Retrieved on November 8, 2018 from https://garden.lovetoknow.com/wiki/Why_is_Soil_So_Important.

GRANT, A. 2018. Why a pepper plant won't produce flowers or fruit. Retrieved on May 24, 2019 from https://www.gardeningknowhow.com/edible/vegetables/pepper /pepper-not-producing-.htm.

HAEFELE, S. M., KNOBLAUCH, C., KONBOON, Y., & WONGBOON, W. 2011. Effect and fate of biochar from rice residues in rice-based system. Retrieved on December 1, 2018 from http://researchgate.net/publication/230559791_ Effect _and_fate_of_biochar_from_rice_residues_in_rice-based_system.

HARRINGTON, J. 2018. Why My Green Peppers Won't Grow. Retrieved on June 10, 2019 from https://www.homeguides.sfgate.com/green-peppers-wont-grow-99988.html

HORTOMALLAS, 2016. 5 Reasons You Should Consider Staking Plants. Retrieved on October 27,2018 from https://www.google.com/amp/s/www.hortomallas.com/en/5-reasons-you-should-consider-staking-plants/amp/.

HUANG, J., MILLA, V., RIVERA, E., and Wang, M. 2013. Agronomic properties and characterization of rice husk and wood biochar and their effect on growth of water spinach in a field test. Retrieved on October 9, 2018 from https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S071895162013000200002.

JACOBS, D.F., LANDIS, T., LUNA, T., and WILKINSO, K.M., 2014. Chapter 6 GROWING MEDIA.pdf. Retrieved on January 6, 2019 from http://www.academia.edu/20150340/.

JAZLINH, 2015. How to Make & Use a Rice Hull Carbonizer: With Tips, Benefits, & Con's. Retrieved on October 26, 2018 from https://www.google.com/amp/s/jazlinh .wordpress.com/2015/09/03/how-to-make-use-a-rice-hull-carbonizer-with tips-benefits -cons/amp/.

JEON, W. T., LEE, J. K., OH, I. S., and SEONG, K. Y. 2008. Effect of Green Manure and Carbonized Rice Husk on Soil Properties and Rice Growth.pdf. Retrieved on October 19, 2018 from https://www.researchgate.net/publication/264142450_Effect_of_Green_Manure_and_Carbonized_Rice_Husk_on_Soil_Properties_an Rice_Growth.

JOHNNY. 2016. Bell Pepper Greenhouse Production.PDF file. Retrieved on October 8 2018 from https://www.johnnyseeds.com/growers-library/vegetables/peppers-bell-greenhouse-production.htm&ved.

LEDUC, S. N.D. 7 Benefits of Vermicomposting. Retrieved on June 8 2019 from https://www.doityourself.com/stry/7-benifits-of-vermicomposting.

MAGAHUD, 2015. Biomass-maintains-soil-nutrients-study. Retrieved on October 26, 2018 from http://www.philrice.gov.ph/biomass-maintains-soil-nutrients-study/.

MASON, S. 2016 .Soil conditioners are explained. Retrieved on October 25 2018 from https://web.extension.illinois.edu/cfiv/homeowners/981128.html.

NUEVA ECIJA FRUITS AND VEGETABLES SEED CENTER (NEFVSC) Leaflet. 2011. Maikling Gabay Sa Produksyon Ng Sili.

ORGE, R.F and M. SARONG. 2016. Effect of Rice Hull Biochar on the Fertility and Nutrient Holding Capacity of Sandy Soils. Retrieved on December 1, 2018 from https://papers.ssm.com/sol3/papers.cfm?abstract_id=2730687.

ORGE, R.F. N.D. Biochar-based Technology for Enhanced Productivity, Efficiency, Resilience & Adaptive Capacity of Smallholder Rice-based Farming Communities in the Philippines. Retrieved on January 25, 2019 from http://www.naro.affrc.go.jp.

RICE TECHNOLOGY BULLETIN. 2005. Carbonized Rice Hull.pdf. Retrieved on September 25, 2018 from https://terapreta.bioenergylists.org/files/Farmcarbonisat ionmachine.pdf&ved.

RHOADES, H. 2018. Using Chicken Manure Fertilizer In Your Garden. Retrieved on January 6, 2019 from https://www.gardeningknowhow.com/composting/manures/ chicken-manure fertilizer.htm.

THOMAS, T. 2018.How to grow bell pepper in container gardening. Retrieved on October 25, 2018 from https://homeguides.sfgate.com/grow-bell-peppers container-gardening-68304.html.

TILLEY, N. 2018. Cow Dung Fertilizer: Learn the Benefits Of Cow Manure Compost Retrieved on January 6, 2019 from https://www.gardeningknowhow /composting /manures/cow-manure-compost.htm.

VILLABLANCA, E. 2013. The Numerous Beneficial Uses of Carbonized Rice Hull. Retrieved on October 26, 2018 from http://readingdotroom.blogspot.com/2007/09 /numerous beneficial-uses-of-carbonized_22.html?m=1.

WILCOX S.E, and B.RAMSING. 2015. Container Gardening. University of Maryland, College of Agriculture and Natural Resources. Retrieved on December 1, 2018 from http://www.containergardening./net-college-of-agriculture-and-natural-reso -urces.

WHITLOCK, L. 2016. How to grow peppers – part 2. Retrieved on May 24, 2019 from https://www.canr.msu.edu/resources/how_to_grow_peppers_part_2.