SUPERABSORBENT POLYMER FROM POTATO (*Solanum tuberosum*) SKIN AS A SOIL AMENDMENT TO IMPROVE SOIL WATER HOLDING CAPACITY FOR GROWING CHILI PEPPER (*Capsicum annuum*)

EL CID M. GARCIA

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 Land and Water Resources Engineering)

JULY 2023

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURES

ABSTRACT

GARCIA, EL CID M., Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija Philippines, July 2023, **SUPERABSORBENT POLYMER MADE FROM POTATO (*Solanum tuberosum*) SKIN AS A SOIL AMENDMENT TO IMPROVE SOIL WATER HOLDING CAPACITY FOR GROWING CHILI PEPPER (*Capsicum annuum*)**

Adviser: CAROLYN GRACE G. SOMERA, Ph.D.

Historically, a major drought has affected the Philippines every three to five years with the worst impacts linked to strong El Niño cycles. Philippines experience drought so often it resulted to water scarcity in some places which severely affects the growth development of crops which then leads to malnutrition of crops. When drought is severe, simply watering the crops is not enough to sustain its moisture. Some soil amendment must be applied to compensate for the water loss during hot season or drought. Application of superabsorbent polymer (SAP) in the soil is becoming a trend to conserve water for crops as it is a material that can absorb fluids greater than their own dried weight. Thus, this present study was conducted for the purpose of synthesizing a starch-based SAP from the agricultural and/or food waste, potato peels. The produced SAP was made from the extracted starch from potato peels mixed with carboxymethyl cellulose sodium salt and aluminum sulfate. SAP was tested for its water holding capability and its effects on chili pepper in terms of plant height and leaf count using pot experiment. The result of the study revealed that the treatment that contains 10g of SAP (T_4) has the lowest water reduction, which is 188.2 mL, compared to the other treatments. While 0g SAP (T_1), 2g SAP (T_2), and 4g SAP (T_3) have water reductions of 294.6 mL, 238.4 mL, and 227.8 mL, respectively.

Furthermore, the findings of this study revealed that applying 10g of SAP on 2 kg of soil promotes better growth for chili pepper in terms of plant height and number of leaves grown throughout the experiment. Lastly, the cost of producing 1kg of superabsorbent polymer from potato peels was estimated to be ₱1556.37.

Keywords: Superabsorbent polymer; Potato peels; Agricultural waste; Water holding capacity

LITERATURE CITED

Arapoglou, D., Varzakas, T., Vlyssides, A., Israilides, C. (2010). Ethanol production from Potato Peel Waste (PPW). Waste Management, 30(10), 1898-1902. doi:10.1016/j.wasman.2010.04.017

Cannazza, G., Cataldo, A., De Benedetto, E., Demitri, C., Madaghiele, M., & Sannino, A. (2014). Experimental assessment of the use of a novel superabsorbent polymer (SAP) for the optimization ofwater consumption in agricultural irrigation process. Water, 6(7), 2056-2069. doi:10.3390/w6072056

Chang, K. (2019). Polyphenol antioxidants from potato peels: Extraction optimization and application to stabilizing lipid oxidation in foods. In: Proceedings of Proceedings of the National Conference on Undergraduate Research (NCUR), New York, NY, USA.

Faridaha, S., & Rahmi, A. R. (2019, May). Utilization of Soil Moisture Through Furrow Irrigation for the Growth of Chilli Pepper [Abstract]. International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume 8(Issue-7S2). Retrieved from https://www.ijitee.org/wp-content/uploads/papers/v8i7s2/G1083058 7S219.pdf.

Hüttermann, A., Orikiriza, L. J., & Agaba, H. (2009). Application of superabsorbent polymers for improving the ecological chemistry of degraded or polluted lands. CLEAN - Soil, Air, Water, 37(7), 517-526. doi:10.1002/clen.200900048

Islam, M. R., Hu, Y., Fei, C., Qian, X., Eneji, A. E., & Xue, X. (2011). Application of superabsorbent polymer: A new approach for wheat (Triticum aestivum L.) production in drought-affected areas of northern China. Journal of Food Agriculture & Environment, 9, 304-309.

Islam, M. R., Xue, X., Mao, S., Zhao, X., Eneji, A. E., & Hu, Y. (2011). Superabsorbent polymers (SAP) enhance efficient and eco-friendly production of corn (Zea mays L.) in drought affected areas of northern China. African Journal of Biotechnology, 10(24), 4887-4894.

Kiatkamjornwong, S. (2007). Superabsorbent polymers and superabsorbent polymer composites. ScienceAsia, 33(s1), 39-43.

Nnadi, F., & Brave, C. (2011). Environmentally friendly superabsorbent polymers for water conservation in agricultural lands. Journal of Soil Science and Environmental Management, 2(7), 206-211.n

Olad, A., Doustdar, F., & Gharekhani, H. (2020). Fabrication and characterization of a starch-based superabsorbent hydrogel composite reinforced with cellulose nanocrystals from potato peel waste. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 601, 124962. doi:10.1016/j.colsurfa.2020.124962

Ostrand, M. S., DeSutter, T. M., Daigh, A. L., Limb, R. F., & Steele, D. D. (2020). Superabsorbent polymer characteristics, properties, and applications. Agrosystems, Geosciences & Environment, 3(1). doi:10.1002/agg2.20074

Parvathy, P. C., Jyothi, A. N., John, K. S., & Sreekumar, J. (2014). Cassava Starch Based Superabsorbent Polymer as Soil Conditioner: Impact on Soil Physico-Chemical and Biological Properties and Plant Growth. CLEAN–Soil, Air, Water, 42(11), 1610-1617.

Philippine Statistics Authority. (2017). Supply Utilization Accounts (SUA) of selected Agricultural Commodities. Retrieved from https://psa.gov.ph/sites/default/files/SUA_2014-2016_0.pdf

SINOFLOC. Super Absorbent Polymer. Retrieved from https://www.sinofloc.com/product/superabsorbent/

Shrivastava, A. (2018). 1 - Introduction to Plastics Engineering, Editor(s): Anshuman Shrivastava, In Plastics Design Library, Introduction to Plastics Engineering, William Andrew Publishing, 2018, Pages 1-16, ISBN 9780323395007, https://doi.org/10.1016/B978-0-323-39500-7.00001-0

Statista Research Department. (2021). Topic: Agriculture in the Philippines. Retrieved from https://www.statista.com/topics/5744/agriculture-industry-in-the-philippines/

Tejada, S., Tuddao, V., Juanillo, E., & Brampio, E. (n.d.). Title: Drought conditions and management strategies in the Philippines. Retrieved from https://www.ais.unwater.org/ais/pluginfile.php/597/mod_page/content/79/Philippines.pdf

Walters, S., & Jha, A. (2016). Sustaining chili pepper production in Afghanistan through better irrigation practices and management. Agriculture, 6(4), 62. doi:10.3390/agriculture6040062

Woodhouse, J., & Johnson, M. (1991). Effect of superabsorbent polymers on survival and growth of crop seedlings. Agricultural Water Management, 20(1), 63-70. doi:10.1016/0378-3774(91)90035-h

Yang, L., Yang, Y., Chen, Z., Guo, C., & Li, S. (2014). Influence of super absorbent polymer on soil water retention, seed germination and plant survivals for rocky slopes eco-engineering. Ecological Engineering, 62, 27-32.

Zohourian, M. M., & Kabiri, K. (2008). Superabsorbent polymer materials: a review.