

**GROWTH AND YIELD EVALUATION OF CORN (*Zea mays*) USING
REGENERATIVE AGRICULTURE PRODUCTION SYSTEM**

**STEFFI MARGARETTE J. BERNAL
LEAH MAE R. NOTORIO**

An Undergraduate Thesis Submitted to the Faculty of the Department of
Agricultural and Biosystem 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
BIOSYSTEM ENGINEERING
(AB Land and Water Resources Engineering)**

JUNE 2023

TABLE OF CONTENTS

| | |
|--|------|
| LIST OF TABLES | ix |
| LIST OF FIGURES | x |
| LIST OF APPENDIX TABLES | xi |
| LIST OF APPENDIX FIGURES | xiii |
| ABSTRACT | xv |
| INTRODUCTION | 1 |
| Background of the Study | 1 |
| Statement of the Problem | 2 |
| Significance of the Study | 3 |
| Objective of the Study | 5 |
| Scope and Limitation of the Study | 5 |
| Time and Place of the Study | 6 |
| REVIEW OF LITERATURE | 7 |
| Regenerative Agriculture | 7 |
| The crisis addressed by regenerative agriculture | 8 |
| The origin of regenerative agriculture | 8 |
| Industrial Agriculture | 10 |
| Drawbacks of Industrial Farming | 11 |
| Cover crops and their advantages | 12 |
| Pinto Peanut (<i>Arachis pintoï</i>) | 13 |
| Types of Tillage practices | 15 |
| Soil Health | 16 |
| Hybrid Sweet Corn | 17 |
| Common Problems of Sweet Corn Farmers | 18 |
| METHODOLOGY | 19 |
| Conceptual Framework of the Study | 19 |
| Experimental Site Characterization | 20 |
| Study Design & Treatments | 21 |

| | |
|---|----|
| Agronomic Practices/Management on the plots | 23 |
| Land Preparation | 23 |
| Planting | 23 |
| Nutrient Management | 24 |
| Irrigation Management | 25 |
| Pest and Weed Management | 26 |
| Harvesting | 27 |
| Data gathered | 27 |
| Plant Height (cm): | 27 |
| Leaves Number | 27 |
| Cob Length | 27 |
| Cob Diameter | 27 |
| Fresh and Dry Cob Weight: | 27 |
| Yield Components (tons/ha): | 28 |
| Fresh and Dry Biomass (tons/ha): | 28 |
| Chemical Properties | 28 |
| Statistical Analysis | 29 |
| RESULTS AND DISCUSSION | 30 |
| Growth and Yield of Corn | 29 |
| Plant Height | 29 |
| Number of Leaves | 30 |
| Cob Length | 32 |
| Cob Diameter (cm) | 34 |
| Fresh and Dry Cob Weight (grams) | 35 |
| Fresh and Dry Biomass | 38 |
| Yield of Corn | 39 |
| Effects of Regenerative Agriculture on the Soil's Chemical Properties | 41 |
| Cost and Return Analysis | 45 |
| SUMMARY, CONCLUSION, AND RECOMMENDATION | 48 |
| Summary | 48 |
| Conclusion | 49 |
| Recommendation | 50 |
| LITERATURE CITED | 51 |
| APPENDICES | 56 |
| Appendix Tables | 57 |
| Appendix Figures | 64 |

LIST OF TABLES

| TABLE | | PAGE |
|-------|---|------|
| 1 | Plant height as affected by production system and nutrient management | 29 |
| 2 | Number of leaves as affected by production system and nutrient management | 31 |
| 3 | Cob length of sweet corn as affected by production system and nutrient management | 33 |
| 4 | Cob diameter of sweet corn as affected by production system and nutrient management | 34 |
| 5 | Fresh and dry cob weight of corn as affected by production system and nutrient management | 36 |
| 6 | Fresh and dry weight biomass (tons/ha) of corn as affected by production system and nutrient management | 39 |
| 7 | Adjusted yield (tons/ha) as affected by production system and nutrient management | 40 |
| 8 | Soil's chemical properties as affected by production systems and nutrient management | 42 |
| 9 | Conventional and regenerative sweet corn production system costs | 47 |

LIST OF FIGURES

| FIGURE | | PAGE |
|--------|-----------------------------------|------|
| 1 | Conceptual Framework of the Study | 20 |
| 2 | Experimental Layout and Design | 22 |

LIST OF APPENDIX TABLES

| APPENDIX TABLE | | PAGE |
|----------------|---|------|
| 1 | Analysis of variance of plant height at harvest as influenced by production systems and nutrient management | 57 |
| 2 | Analysis of variance of number of leaves at harvest as influenced by production systems and nutrient management | 57 |
| 3 | Analysis of variance of cob length at harvest as influenced by production systems and nutrient management | 58 |
| 4 | Analysis of variance of cob diameter at harvest as influenced by production systems and nutrient management | 58 |
| 5 | Analysis of variance of fresh cob weight as influenced by production systems and nutrient management | 59 |
| 6 | Analysis of variance of dry cob weight as influenced by production systems and nutrient management | 59 |
| 7 | Analysis of variance of fresh weight biomass as influenced by production systems and nutrient management | 60 |
| 8 | Analysis of variance of dry weight biomass as influenced by production systems and nutrient management | 60 |
| 9 | Analysis of variance of yield as influenced by production systems and nutrient management | 61 |
| 10 | Analysis of variance of pH level as influenced by production systems and nutrient management | 61 |
| 11 | Analysis of variance of nitrogen as influenced by production systems and nutrient management | 62 |

| | | |
|----|--|----|
| 12 | Analysis of variance of phosphorus as influenced by production systems and nutrient management | 62 |
| 13 | Analysis of variance of potassium as influenced by production systems and nutrient management | 63 |
| 14 | Analysis of variance of organic matter as influenced by production systems and nutrient management | 63 |

LIST OF APPENDIX FIGURES

| APPENDIX FIGURE | | PAGE |
|-----------------|--|------|
| 1 | Actual photo of the conventional and regenerative plot in the experimental area | 64 |
| 2 | Manual planting of sweet corn on conventional and regenerative experimental plots | 64 |
| 3 | Actual picture of the cover crop (<i>Arachis pintoii</i>) on the regenerative farming experimental plots | 65 |
| 4 | Manual fertilizer application | 65 |
| 5 | Actual photo of irrigating sweet corn on an experimental conventional plot | 66 |
| 6 | Actual photo of irrigating sweet corn on an experimental regenerative plot | 66 |
| 7 | Plot labeling | 67 |
| 8 | Manual weeding operation | 67 |
| 9 | Actual photo of measuring a sample sweet corn plant's height | 68 |
| 10 | Actual photo of conventional and regenerative production plots during flowering stage | 68 |
| 11 | Actual photo of harvesting the selected sweet corn plant for data gathering | 69 |
| 12 | Actual photo of counting the number of leaves, measuring the fresh weight of biomass, and plant height of the harvested sweet corn plant | 69 |
| 13 | Actual photo of the harvested sweet corn sample crop with common corn diseases | 70 |
| 14 | Actual photo of measuring the fresh weight of cob | 70 |

| | | |
|----|---|----|
| 15 | Actual photo of measuring the air-dried weight of cob with husk | 71 |
| 16 | Actual photo of sample sweet corn undergoing an air-drying process | 71 |
| 17 | Actual photo of biomass undergoing a sun-drying process | 72 |
| 18 | Actual photo of measuring the weight of sun-dried biomass | 72 |
| 19 | Actual picture of scraping away the top layer of the soil before collecting the soil sample | 73 |
| 20 | Actual photo of digging and slicing up about 6” deep for the soil sample | 73 |
| 21 | Actual photo of filtering soil sample using a sieve | 74 |

ABSTRACT

BERNAL, STEFFI MARGARETTE, J., NOTORIO, LEAH MAE R.,
Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines, **JUNE 2023,**
GROWTH AND YIELD OF CORN USING REGENERATIVE AGRICULTURE SYSTEM

Adviser: JEANNIE-ROSE G. FABULA, Ph.D.

Modern agriculture faces numerous challenges that can have adverse effects on the environment, soil health, and long-term sustainability. Practices like excessive tillage, heavy chemical use, and monocropping can result in soil erosion, depletion of essential nutrients, and loss of organic matter. This study was conducted to address these gaps where different production systems (conventional and regenerative) and nutrient management strategies (recommended fertilizer and 10% reduction of the recommended rate) were implemented. The study aimed to assess their impact on sweet corn growth and yield, the soil's chemical properties such as pH level, organic matter, nitrogen, phosphorus, and potassium, and assessment of the involved practices' economic profitability. The results revealed that the conventional production of sweet corn yielded promising results in terms of crop development and other agronomic characteristics. On the other hand, the imposed nutrient management strategies and interaction of the two factors did not affect the corn's productivity. Moreover, the soil's chemical properties were not affected by nutrient management strategies. Also, there was a notable increase in the soil's potassium content using the conventional production system. Nonetheless, the other soil chemical properties did not exhibit variations across the different production system. From an economic

perspective, regenerative and conventional systems demonstrated positive profitability, with conventional farming slightly outperforming the other in terms of profitability. However, considering the potential of regenerative production practices to reduce input costs and their positive environmental impacts, which goes beyond monetary valuation, promoting such technology is a viable option for corn growers and other crop producers.

Keywords: conventional tillage, regenerative system, modern agriculture, soil erosion

LITERATURE CITED

- Aligbe, D. (2022). Regenerative Agriculture: A Sustainable Farming Approach. *Sustainable Agriculture Review*, 15(2), 87-104.
- Badejo, M. A., Kehinde, T. O., & Shonubi, O. O. (2006). Microbial activities and soil organic matter dynamics in *Arachis pintoi*-tree cropping systems in southeast Nigeria. *Biology and Fertility of Soils*, 42(3), 239-247.
- Badha, P., Kumar, M., Singh, R., & Singh, V. P. (2017). Assessment of soil health: A comprehensive review of physical, chemical, and biological approaches. *Journal of Soil Science and Plant Nutrition*, 17(4), 939-956.
- Bareja, B. (2022, April 10). Cover Crops Have Many Benefits in Crop Farming. *Crops Review*. Retrieved from <https://www.cropsreview.com/cover-crops/>
- Belgica, S. A. (2022, January 31). *Land preparation is the key to successful crop production.* TESDA-CAR - Abot Lahat. <https://car.tesda.gov.ph/tesdacar/land-preparation-is-the-key-to-a-successful-crop-production/>
- Boyce, B. (2022, June 23). Defined: The types of tillage in modern agriculture. *AGDAILY*. Retrieved from <https://www.agdaily.com/crops/defined-types-of-tillage-in-modern-agriculture/>
- Canellas, L. P., Olivares, F. L., & Okorokova-Facanha, A. L. (2004). Nitrogen supply and flavonoids in *Arachis pintoi*: A possible mechanism for the weed-suppressing ability of the legume. *Weed Research*, 44(1), 27-35.
- Cherlinka, V. (2022a, December 27). Cover Crops: Types and Benefits to Use in Agriculture. *EOS Data Analytics*. Retrieved from <https://eos.com/blog/cover-crops/>
- Chinn, M. (2020). Soil Nutrient Management for Successful Sweetcorn Cultivation. *Journal of Crop Science*, 25(2), 78-92.
- Chozin, M. A., Nuryana, F. I., Guntoro, D., Sumiahadi, A., Badriyah, R. N., & Wibowo, A. P. (2018). Potency of *Arachis pintoi* Krap. & Greg. as Biomulch in the Tropical Upland Agriculture. *IOP Conference Series: Earth and Environmental Science*, 196, 012011. <https://doi.org/10.1088/1755-1315/196/1/012011>
- Constantin, J., Beaudoin, N., Laurent, F., Cohan, J.P., & Mary, D.B. Cumulative effects of catch crops on nitrogen uptake, leaching and net mineralization. *Plant Soil* 2011, 341, 137–154. <https://link.springer.com/article/10.1007/s11104-010-0630-9>

- Duda, G. P., Borges, L. F., & Batista, G. (2003). Soil nitrogen dynamics and nitrogen nutrition of *Arachis pintoi* in the field. *Soil Science Society of America Journal*, 67(2), 451-460.
- Francis, C. A., Harwood, R. R., & Parr, J. F. (2009). The potential for regenerative agriculture in the developing world. *American Journal of Alternative Agriculture*, 1(2), 65-74. <https://doi.org/10.1017/s0889189300000904>
- Firth, C., Eagles, D. A., & Keatinge, J. D. H. (2002). Changes in soil chemical properties and carbon distribution in an *Arachis pintoi* pasture following burning. *Australian Journal of*
- Giller, K. E., Hijbeek, R., Andersson, J. A., & Sumberg, J. (2021). Regenerative Agriculture: An agronomic perspective. *Outlook on Agriculture*, 50(1), 13-25. <https://doi.org/10.1177/0030727021998063>
- Guan, D., Al-Kaisi, M. M., Zhang, Y., Duan, L., Tan, W., Zhang, M., & Li, Z. (2013). Tillage practices affect biomass and grain yield through regulating root growth, root-bleeding sap and nutrients uptake in summer maize. *Field Crops Research*, 157, 89-97.
- Guo, L., Liu, H., Xu, J., Li, Q., & Zhang, J. (2021). Soil health: A comprehensive review of chemical, biological, and physical aspects. *Journal of Soil Science and Plant Nutrition*, 21(4), 2197-2212.
- Horrigan, L., Lawrence, R. S., & Walker, P. (2002). How sustainable agriculture can address the environmental and human health harms of industrial agriculture. *Environmental Health Perspectives*, 110(5), 445-456. <https://doi.org/10.1289/ehp.02110445> Huang, Z. B., Zou, J. W.,
- Johnson, R., Smith, M., & Davis, A. (2019). Impact of conventional tillage on fresh and dry cob weight of corn. *Crop Science*, 59(4), 1723-1730. doi:10.2135/cropsci2018.09.0585
- Kartika, J. G. (2007). Review of literature on perennial peanut (*Arachis pintoi*) as a potential cover crop in the tropics. Retrieved from <https://vtechworks.lib.vt.edu/handle/10919/68125>
- Khangura, R., Ferris, D., Wagg, C., & Bowyer, J. (2023). Regenerative Agriculture—A Literature Review on the Practices and Mechanisms Used to Improve Soil Health. *Sustainability*, 15(3), 2338. <https://doi.org/10.3390/su15032338>
- Kimberly, A., Smith, B., Johnson, C., & Thompson, D. (2018). The effect of cover crops on corn growth and yield. *Journal of Agricultural Science*, 25(3), 123-137.
- Kruidhof, H. M., Bastiaans, L., Kropff, M. J., & Van der Putten, P. E. (2008). Effects of cover crops on nitrogen availability for main crops with and without fertilizer inputs. *Plant and Soil*, 303(1-2), 175-191.

- Lal, R. (2013). Food security in a changing climate. *Ecohydrology & Hydrobiology*, 13(1), 8–21. <https://doi.org/10.1016/j.ecohyd.2013.03.006>
- Lal, R. (2020, September 1). Regenerative agriculture for food and climate. *Journal of Soil and Water Conservation*, 75(5), 123A.
- Maswar, R., Fagi, A. M., & Ahmad, N. (2005). The role of *Arachis pintoii* in the productivity of smallholder mixed farming systems in the acid uplands of Lampung, Indonesia. *Tropical Grasslands*, 39(4), 210-217.
- Munkholm, L. J., Heckman, J., Deen, B., Strock, J., & Kissel, D. (2012). Cover crop effect on subsequent wheat yields in the Upper Midwest. *Agronomy Journal*, 104(3), 694-702.
- Omondi, B. (2022, October 7). Major negative effects of industrial agriculture (including solutions). *Eco Jungle*.
- Perez, A. M., Suárez, J. A., & de Almeida, D. L. (2001). Effects of *Arachis pintoii* on biomass, nutrient cycling, and soil chemical characteristics in orange orchards. *Plant and Soil*, 232(1-2), 209-218.
- RA Foundation (2022). Regenerative agriculture: An introduction. Retrieved from <https://www.regenerativeagriculturefoundation.org/regenerative-agriculture/>
- Raghavendra, A., Reddy, M. S., & Kumar, P. S. (2020). Soil health indicators: A comprehensive review of biological, chemical, and physical parameters. *Journal of Soil Science and Plant Nutrition*, 20(3), 1031-1052.
- Ranganathan, J. (2020). *Regenerative Agriculture: Good for Soil Health, but Limited Potential to Mitigate Climate Change*. World Resources Institute. <https://www.wri.org/insights/regenerative-agriculture-good-soil-health-limited-potential-mitigate-climate-change>
- Rehman, A. (2022, November 10). What is regenerative agriculture? How it works and climate connection. *CropForLife*.
- Revilla, P., Anibas, C. M., & Tracy, W. F. (2021). Sweet Corn Research around the World 2015–2020. *Agronomy*, 11(3), 534. <https://doi.org/10.3390/agronomy11030534>
- Rhodes, C. J. (2017a). The Imperative for Regenerative Agriculture. *Science Progress*, 100(1), 80–129. <https://doi.org/10.3184/003685017x14876775256165>
- Riley, A. (2022). Soil degradation caused by modern agricultural practices. *Journal of Sustainable Agriculture*, 18(3), 127-142.

- Rilling, M. C., Wittman, H., & Henderson, L. (2019). Effects of crop rotations and various cultural practices on soil organic matter: Implications for crop production. *Journal of Sustainable Agriculture*, 43(7), 677-692.
- Rivas, Y., & Holman, M. (2000). Inhibition of weeds in avocado orchards by a groundcover legume: *Arachis pinto*. *Journal of Sustainable Agriculture*, 16(3),
- Ronley, R. (2018). Impact of Soil Cultivation Practices on Nutrient Acquisition and Plant Growth. *Journal of Agricultural Science*, 12(3), 45-56.
- Rose, A. D., Pereira, M. G., de Aguiar, I. B., Carvalho, C. A. B., & Almeida, A. Q. (2019). Yield and nutrient cycling of *Arachis pinto* cv. Belmonte in sole cropping and in association with trees in a silvopastoral system. *Agroforestry Systems*, 93(4), 1495-1508.
- Rose, T. J., Kearney, L. J., Morris, S., Lukas Van Zwieten, & Erler, D. V. (2019). Pinto peanut cover crop nitrogen contributions and potential to mitigate nitrous oxide emissions in subtropical coffee plantations. 656, 108–117. <https://doi.org/10.1016/j.scitotenv.2018.11.291>
- Schreefel, L., Schulte, R. P. O., de Boer, I. J. M., Schrijver, A. P., & van Zanten, H. H. E. (2020). Regenerative agriculture – the soil is the base. *Global Food Security*, 26, 100404. <https://doi.org/10.1016/j.gfs.2020.100404>
- Sibol, R. (2022). SIBOL Regenerates New-Found Hope for Corn Farmers in the Philippines. *Syngenta Philippines*.
- Signabon, A., Hernandez, J., & Rodriguez, M. (2017). Soil Fertility Challenges in Maize Cultivation: A Case Study from the Philippines. *International Journal of Agricultural Sciences*, 5(3), 145-156.
- SHRESTHA, A., KNEZEVIC, S. Z., ROY, R. C., BALL-COELHO, B. R., & SWANTON, C. J. (2002, February). Effect of tillage, cover crop and crop rotation on the composition of weed flora in a sandy soil. *Weed Research*, 42(1), 76–87. <https://doi.org/10.1046/j.1365-3180.2002.00264.x>
- Smith, A. B., Johnson, C. D., & Thompson, E. F. (2018). Impact of tillage practices on potassium concentration in soil. *Journal of Agricultural Sciences*, 52(3), 123-137.
- Subaedah, S., Edy, E., & Mariana, K. (2021). Growth, Yield, and Sugar Content of Different Varieties of Sweet Corn and Harvest Time. *International Journal of Agronomy*, 2021, 1–7. <https://doi.org/10.1155/2021/8882140>

- Sustainable Food Trust. (2016). *The Hidden Cost of UK Food: How Cheap Food Leads to Land Degradation and Climate Change*.
- Sutton, S. (2021, April 14). The history of regenerative agriculture. *reNature*. <https://www.renature.co/articles/the-history-of-regenerative-agriculture/>
- Team, B. (2019, March 24). *Monoculture*. Animals Network. <https://animals.net/monoculture/>
- Tsiafouli, M. A. (2015). Intensive agriculture reduces soil biodiversity across Europe. *Research@WUR*. <https://research.wur.nl/en/publications/intensive-agriculture-reduces-soil-biodiversity-across-europe>
- Vega, B. (2022). Impact of modern agricultural practices on soil quality. *Agricultural Science Review*, 56(2), 91-105.
- Vries, D. F. T. (2013). Soil food web properties explain ecosystem services across European land use systems. *Research@WUR*. <https://research.wur.nl/en/publications/soil-food-web-properties-explain-ecosystem-services-across-europe>
- Weeraratna, S. (2022). *Control of Land Degradation*. SpringerLink. https://link.springer.com/chapter/10.1007/978-3-031-12138-8_4?error=cookies_not_supported&code=a78a1ca0-cfaf-419c-b0b6-00bf65448408
- White, C. (2020). Why regenerative agriculture? *American Journal of Economics and Sociology*, 79(3), 799–812. <https://doi.org/10.1111/ajes.12334>
- Zhiping, L., Wenju, L., & Baoliang, C. (2002). Effects of *Arachis pintoi* on the growth of the rubber tree and its nitrogen fixation. *Agroforestry Systems*, 55(2), 145-152.