DESIGN, FABRICATION AND PERFORMANCE TEST OF BICYCLE OPERATED SELF-PROPELLED MULTI-NOZZLE SPRAYER

LACAS, JOSE ANGELO H.
MANUEL, IVAN 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)

JUNE 2023

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURES

LIST OF RAW DATA AND COMPUTATIONS APPENDICES

ABSTRACT

LACAS, JOSE ANGELO H. and **MANUEL, IVAN P.**, Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, **June 2023, DESIGN, FABRICATION AND PERFORMANCE TEST OF BICYCLE OPERATED SELF-PROPELLED MULTI-NOZZLE SPRAYER.**

Adviser: John Vincent A. Nate. M.Sc.

Most of the Filipino farmers own small farms, typically around 2 ha, due to financial constraints. Despite the emergence of more efficient modern sprayers, they often rely on traditional ones. However, these traditional sprayer's, such as the knapsack sprayer, require improvements in terms of discharge uniformity, losses and chemical concentration monitoring.

This study aims to design, fabricate and evaluate a bicycle-operated self-propelled multi-nozzle sprayer. It was designed in 2d and 3D formats using Computer Aided Drafting and was fabricated using locally available materials. Performance evaluation was conducted using three different nozzles: 8-hole, 4 hole and 1-hole nozzles. The parameters evaluated included discharge rate, distribution uniformity, application capacity, and field efficiency. The machine operated in an onion farm area at Brgy. Bagong Sikat, Gabaldon, Nueva Ecija for data gathering.

After nine replications, results indicated that among three treatments, treatment 1, which involved the use of the 8-hole nozzle, performed the best in terms of all the evaluated parameters. It has the highest discharge rate, application capacity and uniformity of distribution with .0769 L/s, .117 L/m^2, and 83.56% uniformity respectively. The 4-hole nozzle followed closely behind, with discharge rate, application capacity and distribution

uniformity of .067 L/s, .103 L/m^2 and 81.45% uniformity respectively. Additionally, the machine also had an 80% field efficiency.

The developed machine was found to be functional under dry conditions, and its applicability extends to all bicycle-operated farm machineries. However, to make the machine usable in wet conditions, replacing the motor for power provision would be necessary. Furthermore, adjustment to other machine components like increasing its vertical clearance can also expand its range of applications. These changes, however, may raise the machine cost. But considering the broader application to other farming scenarios, the investment in said changes would be worthwhile.

Keywords: bicycle operated self-propelled multi-nozzle sprayer; discharge uniformity; nozzle; moving mechanism; application capacity

LITERATURE CITED

Bank, W., & Search for more papers by this author. (n.d.). *Transforming Philippine Agriculture*. Other Agricultural Study. Retrieved November 15, 2022, from https://elibrary.worldbank.org/doi/abs/10.1596/34012

Bell, C. E., Cudney, D. W., Poole, G. J., & Orloff, S. B. (2018). *Herbicide treatment table*. Herbicide Treatment Table / Onion and Garlic / Agriculture: Pest Management Guidelines / UC Statewide IPM Program (UC IPM). https://ipm.ucanr.edu/agriculture/onion-and-garlic/herbicide-treatment-table/#:~:text=TIMING%3A%20May%20be%20applied%20to,broadleaf%20weeds%20and%20annual%20grasses.&text=TIMING%3A%20After%20the%20last%20irrigation,the%20top%20of%20the%20crop.

Benito, R. B., & Orge, R. F. (2006). *The effect of dilution volume, water temperature and pressing time on ...* researchgate.net. Retrieved December 5, 2022, from https://www.researchgate.net/publication/286177398_The_effect_of_dilution_volume_water_temperature_and_pressing_time_on_oil_yield_from_thevetia_kernel_during_extraction

Da-Afid. (2018, July 26). *Philmech Tech to improve onion production*. Official Portal of the Department of Agriculture. Retrieved November 16, 2022, from https://www.da.gov.ph/philmech-tech-to-improve-onion-production/

De Padua , Amongo, Quilloy, Suminstrado, & Elauria. (2021). *Development of a local unmanned aerial vehicle (UAV ... - iopscience*. IOP Science. Retrieved December 5, 2022, from https://iopscience.iop.org/article/10.1088/1757-899X/1109/1/012022

Erokhin, V., & Gao, T. (2020, August 10). *Impacts of covid-19 on trade and economic aspects of food security: Evidence from 45 developing countries*. MDPI. Retrieved December 5, 2022, from https://www.mdpi.com/1660-4601/17/16/5775

Esheteu Bekele, E., Azerefegne, F and Abate, T. (2006). Facilitating the Implementation and Adoption of Integrated Pest Management (IPM) in Ethiopia. Planning Workshop, 13-15 October 2003, Melkassa Agricultural Research Center, EARO. Jointly organized by the Association for Advancement of IPM (ASAI) and the Ethiopian Agricultural Research Organization (EARO). DCG, Miljøhuset, Oslo.

Etana, M., Aga, M., & Fufa, B. (n.d.). *Major onion (allium cepa L.) production challenges in Ethiopia ... - core*. core.ak.uk. Retrieved November 14, 2022, from https://core.ac.uk/download/pdf/234662809.pdf

FAO Statistics (2005) FAOSTAT data. http://faostat.fao.org/faostat/. Cited 2006

FAQs. (2023) *What is fabrication? (definition, advantages, disadvantages and examples)*. TWI. https://www.twi-global.com/technical-knowledge/faqs/what-is-fabrication

Gregorioa, G., & Rico, A. (2020). *Investigation of technical performance and efficiency of different ...* AgEconSearch. Retrieved November 14, 2022, from https://jam.tabrizu.ac.ir/article_9589.html?lang=en

Khokhar, K. M. (n.d.). *Environmental and genotypic effects on bulb development in onion – a review*. Taylor & Francis. Retrieved November 15, 2022, from https://www.tandfonline.com/doi/abs/10.1080/14620316.2017.1314199

Khosa, J. S., McCallum, J., Dhatt, A., & Macknight, R. C. (n.d.). *Enhancing onion breeding using molecular tools - wiley online library*. Wiley Online Library. Retrieved December 5, 2022, from https://onlinelibrary.wiley.com/doi/full/10.1111/pbr.12330

Lanzotti, V. (2005). *Bioactive saponins from allium and aster plants - phytochemistry reviews*. SpringerLink. Retrieved December 5, 2022, from https://link.springer.com/article/10.1007/s11101-005-1254-1

Llanto, G. M., & Ballesteros, M. M. (n.d.). *Land issues in poverty reduction strategies and the Development Agenda: Philippines*. EconStor. https://www.econstor.eu/handle/10419/127806

Lonkar, A. S., Gaodi, M. A., Wankhede , A. S., & Gandete, S. D. (2016, March). ACADEMIA. Retrieved November 5, 2022, from https://d1wqtxts1xzle7.cloudfront.net/54662002/IRJET-V3I3117-with-cover-page-v2.pdf?Expires=1670244458&Signature=VGPUXRpxSK-3wkFc3OCWOXHRERE7cKEZZA8fx6Xuku-~k7vdtXAbBEQb~zYmRC4xprs-AzJvHXUpLb-HYlIWCUMmo2DMOKzN76uqH~1dubtOEH4rH8FpQcdb6HuBDpyfEcFSuhortIoCfLA8nGg2EcL9e~taHh-HGC6HfHFYmJVJ9xYwRU6Nsk5xclWwclXs0iduQijMwEoETizMQOIsROgIiXj8hZchPSn2XyhZGttGd6ANDHdHiHy5lq7LpUMqmwBZlwEDAo-yHVB-pQD-sK3snBNh8y6gaDSE~lHM6TO4hAO4ZCkRb0~guWdb~k1cZR6wkVBj1Eo6D~Ca8OXAVA__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

Napier, T. (2006). *Spray application in onions - department of Primary IndustriesTo*. www.dpi.nsw.gov.au. Retrieved November 16, 2022, from https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/99222/spray-application-in-onions.pdf

Nelson, G. C., & et al.. (2013). *Climate change effects on agriculture: Economic responses to ... - PNAS*. pns.org. Retrieved November 14, 2022, from https://www.pnas.org/doi/10.1073/pnas.1222465110

Oki, Loren. (2016, September 30). *Measuring distribution uniformity and calculating run time*. California Center for Urban Horticulture. https://ccuh.ucdavis.edu/measuring-DU-run-time

Orge, R. F., & Benito, R. B. (2006). *Investigation of technical performance and efficiency of different ...* Retrieved December 5, 2022, from https://jam.tabrizu.ac.ir/article_9589.html?lang=en

Pascual, M. P., Lorenzo, G. A., & Gabriel, A. G. (2018, January 11). *Vertical farming using hydroponic system: Toward a sustainable onion production in Nueva Ecija, Philippines*. Open Journal of Ecology. Retrieved November 4, 2022, from https://www.scirp.org/html/3-1380876_81678.htm?pagespeed=noscript

PAES 112:2000, Agricultural Machinery – Lever-Operated Knapsack Sprayer – Specifications

PAES 157:2011. Agricultural Machinery – Power Sprayer for Mango – Specifications

PAES 157:2011. Agricultural Machinery – Power Sprayer for Mango – Methods of Test

PAES 113:2000. Agricultural Machinery – Lever-Operated Knapsack Sprayer – Methods of Test

PNS/BAFS 332:2022, Knapsack Sprayer – Methods of Test

PNS/BAFS 331:2022, Knapsack Sprayer – Specifications

Poratkar, S. H., & Raut, D. R. (2013, March). *Development of Multinozzle Pesticides Sprayer Pump*. ACADEMIA. Retrieved November 2, 2022, from https://d1wqtxts1xzle7.cloudfront.net/34457195/absorber-with-cover-page-v2.pdf?Expires=1670246881&Signature=hGCR61gxFyWMKHyp5tHok7M0-fGYuJUUacljV0o7BuMslqkCYMmqPZIU1VDFBiSP8HdSBJueassbLIsJQgeMqP hFdUzAzsO~wdqeov8qw1Db6I2rbcn9h-O2L8xxGTkLEbDwS8NMDyJ5~oxTQBMv7zdXZl4RQzxnu8QbyvcRdR3X5BNc xEkC1TBwSew3QsicVzwNn-5k2pIs~aEkQybl6ZdDzffKvAtXlygG55avZIV4KUaTa61NStfI4GD8xZLoQDfjjv Xt2uC5VWOOoomZomMr5eSpcY~FWrxD4W9uD4l2HpzQ5oQ9V4WKuyXJJIjy HQaRQgTshYOO7cHT9bw9Hg__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

Some investigations on a side lever operated knapsack sprayer from mechanical and ergonomic considerations. (1996). Retrieved November 5, 2022, from http://www.idr.iitkgp.ac.in/jspui/bitstream/123456789/2958/1/NB11984_Abstract.pdf