DEVELOPMENT OF MANURE SPREADER MACHINE

ALARCIO, CHERIE O.

An Undergraduate Thesis Manuscript 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 BIOSYSTEM ENGINEERING
(AB Land and Water Resources Engineering)

JUNE 2023

TABLE OF CONTENTS

	PAGE
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF APPENDIX TABLES	x
LIST OF APPENDIX FIGURES	xi
ABSTRACT	xii
INTRODUCTION	1
Background of the Study	1
Statement of the Problem	3
Objectives of the Study	3
Significance of the Study	4
Scope and Limitation of the Study	5
Time and Place of the Study	5
REVIEW OF RELATED LITERATURE	6
Manure/Fertilizer	6
Conventional Spreading of Manure	7
Machine Spreading of Manure	7
METHODOLOGY	13
Conceptual Framework of the Study	13
Research Activities	14
Benchmarking Activity	15
Design and Development of Manure Spreader Machine	15
Design Considerations	15
Computer-Aided Design (CAD) Modelling	15
Fabrication of Prototype Unit and Functional Testing	16
Performance Testing & Evaluation	17
Test samples	17
Performance Testing	18
Performance Evaluation	18
Experimental Design and Statistical Analysis	21

RESULTS AND DISCUSSION 23

SUMMARY 36

CONCLUSION 37

RECOMMENDATION 37

LITERATURE CITED 39

LIST OF TABLES

TABLE		PAGE
1	Factors used in performance testing of machine	18
2	Machine specifications of the developed manure spreader	24
3	Manure Application Rate at different operating speeds and discharge opening, ton/hr	29
4	Mean Application Rate in terms of Discharge Opening, ton/hr	30
5	Discharge rate at different operating speeds and discharge openings, kg/hr	30
6	Mean discharge rate in terms of operating speed, kg/hr	31
7	Mean discharge rate in terms of discharge opening, kg/hr	31
8	Effective field capacity at different operating speeds and discharge openings, m^2/hr	32
9	Mean effective field capacity in terms of operating speed, m^2/hr	33
10	Field efficiency at different operating speeds and discharge openings, %	34

LIST OF FIGURES

TABLE		PAGE
1	Hopper with centrifugal spreader disk	8
2	Schematic view of developed manure spreader	9
3	Side view of tractor-operated manure spreader	10
4	Manure Spreader with chain drive	11
5	Manure spreader operated by a tractor with an adjustable frame	12
6	Conceptual Framework of the Study	13
7	Flow of research activities	14
8	Conceptual drawing of the Manure Spreader	16
9	Experimental layout of Manure Spreader	22
10	Exploded view of the prototype machine	23
11	Prototype manure spreader	24
12	Machine components of the developed manure spreader	25
13	Process Flow Diagram	28
14	Average fuel consumption rate of the manure spreader at different settings, L/hr	35

LIST OF APPENDIX TABLES

APPENDIX TABLE		PAGE
1	ANOVA for the Manure Application Rate	42
2	ANOVA for the Discharge Rate	42
3	ANOVA for the Effective Field Capacity	43
4	ANOVA for the Field Efficiency	43
5	Bill of Materials used in the Fabrication of the Machine	44

LIST OF APPENDIX FIGURES

APPENDIX FIGURES		PAGE
1	Fabrication of the manure spreader	45
2	Collection of Cow Manure	45
3	Functional testing of the developed manure spreader	46
4	Mixture of cow and goat manure as test samples	46
5	Manure Sample (20 kg)	47
6	Testing of Manure Spreader	47
7	Measuring of fuel consumption	48
8	Manure at the hopper bin	48
9	Collection of the remaining manure at hopper after test	49
10	Distributed manure using the prototype machine	49
11	Three samples of manure for moisture content determination	50
12	Moisture content laboratory evaluation of the manure sample	50
13	Detailed Drawing of Manure Spreader	53

ABSTRACT

ALARCIO, CHERIE O., Department of Agricultural and Biosystems Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, **June 2023, DEVELOPMENT OF MANURE SPREADER MACHINE**

Adviser: WENDY C. MATEO, Ph.D.

Organic fertilizers such as manure can be used to minimize the problem of soil degradation caused by extensive application of synthetic fertilizers. But the application of manure in the country still relies on the manual method which is a tedious and time-consuming process. Thus, this study aimed to develop a manure spreader machine that can be attached to a two-wheel tractor. The developed machine has a dimension of 3335 x 1165 x 1133 mm (L x W x H) and is composed mainly of a hitch point frame, hopper bin, shredding assembly, discharge assembly, and locking mechanism. The performance of the machine showed that it can have a maximum application rate of 10555.56 kg/ha at 3-4 kph speed – full discharge opening setting. In terms of discharge rate, effective field capacity, and field efficiency, 5-6 kph speed, and full opening combinations give the highest values, while 3-4 kph speed and half opening combinations received the lowest values. Based on statistical analysis, it was revealed that there is a significant difference in overall means in discharge openings and operating speed, but no significant difference among means in combinations of components. However, given the lower fuel consumption rate, a 3-4 kph operating speed is recommended.

Keywords: manure; development; spreader; application rate; field efficiency

LITERATURE CITED

Anil, A. V, Sagar, A. S., kiran, A. V, & Rushikesh, G. R. (2020). Design & Fabrication of Manure Spreader. In *IJSRD-International Journal for Scientific Research & Development*| (Vol. 8). www.ijsrd.com

Bello, *, Saliu, R. ;, Nebo, M. ;, Ayodele, E. ;, & Aa. (n.d.). *Field calibration of a fertilizer spreader using four organic manures*.

CALIBRATION OF MANURE APPLICATION EQUIPMENT ON-FARM. (n.d.).

Development of Tractor Mounted FYM Spreader. (2022). *Indian Journal of Ecology*, 405–409. https://doi.org/10.55362/ije/2022/3537

EIGHTEENTH CONGRESS OF THE REPUBLIC OF THE PHILIPPINES. (n.d.).

Farm Machinery and Equipment. Lecture5. Field capacity, efficiency, economics of machinery used with numerical/problems http://ecoursesonline.iasri.res.in/mod/page/view.php?id=477

International Atomic Energy Agency, & Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. (n.d.). *Guidelines for using fallout radionuclides to assess erosion and effectiveness of soil conservation strategies*.

Iqbal, Achmad, M., & Sapsal, M. T. (2019). Organic Fertilizer Applicator Performance Test on Rice Field. *IOP Conference Series: Earth and Environmental Science*, *355*(1). https://doi.org/10.1088/1755-1315/355/1/012112

Mahabub, S., Khan, M., Mazed, H., Sarker, S., & Tareque, M. (2016). Effect of Cow Manure on Growth, Yield and Nutrient Content of Mungbean. *Asian Research Journal of Agriculture*, *2*(1), 1–6. https://doi.org/10.9734/arja/2016/29297

Onte, S., Singh, M., Kumar, S., & S. Pyati, P. (2019). Impact of Organic Nutrient Management on Crop Quality, Yield and Soil Health: A Review. *International Journal of Current Microbiology and Applied Sciences*, *8*(05), 394–402. https://doi.org/10.20546/ijcmas.2019.805.047

PAES 146 - Fertilizer Applicator - Test. (n.d.).

Philippine, T. (2004). *DEPARTMENT OF AGRICULTURE DEPARTMENT OF AGRICULTURE Bureau of Soils and Water Management Bureau of Soils and Water Management DEPARTMENT OF ENVIRONMENT DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES AND NATURAL RESOURCES D DEPARTMENT OF SCIENCE AND TECHNOLOGY EPARTMENT OF SCIENCE AND TECHNOLOGY DEPARTMENT OF AGRARIAN REFORM DEPARTMENT OF AGRARIAN REFORM N N ational Action Plan ational Action Plan*.

Ponsica, E. P., Escalada, R. G., & Quirol, B. F. (1983). Effects of Animal Manure Application on the Growth and Yield of Corn. *Annals of Tropical Research (Philippines)*, *5*(3–4), 110. https://agris.fao.org/agris-search/search.do?recordID=PH8511212

Sapkale, P. R., Mahalle, S. B., & Bastewad, T. B. (n.d.). *Performance evaluation of tractor operated manure spreader*.

Sathiamurthi, P., Anaamalaai, A. S., Ahamed Buhari, M. R., Anburaja, A., & Ajmal Thahasin, M. (n.d.). *DESIGN AND FABRICATION OF MANURE SPREADER*. www.ijstr.org

Sengottaian, K., Mohanrajhu, N., Palani, S., & Jayabalan, C. (2019). Design of manure spreader machine for agricultural farm field. *International Journal of Innovative Technology and Exploring Engineering*, *9*(1), 4280–4284. https://doi.org/10.35940/ijitee.A4877.119119

Singh, R. C., & Singh, C. D. (2014). *African Journal of Agricultural Research Design and development of an animal drawn farmyard manure spreader*. *9*(44), 3245–3250. https://doi.org/10.5897/AJAR2013