



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT AGRICULTURAL MECHANISATION AND IRRIGATION

ENGINEERING

**DESIGN AND CONSTRUCTION OF A BICYCLE OPERATED
BOOM SPRAY PUMP**

BY

MUSANA EMMANUEL

BU/UP/2017/150

musanaemmanuel50@gmail.com

0779138570/0759288474

NAME OF SUPERVISOR

MR. IGGA HUZAIRU

*A final year project proposal report submitted in partial fulfilment of the requirements for
the award of the BSc. of Agricultural mechanization and irrigation engineering at
Busitema University.*

DECLARATION

I **MUSANA EMMANUEL** declare that this final year project report is a result of my own efforts and tremendous work done. It has never been submitted to Busitema University or any other institution of higher learning for any academic award.

NAME: MUSANA EMMANUEL

REG NO: BU/UP/2017/150

SIGNATURE:

DATE:

APPROVAL

This is to certify that this project report was written under the guidance of my supervisor on the topic “**Design And Construction Of A Bicycle Operated Boom Spray Pump**” and is now ready for submission to the department of Agricultural mechanization and irrigation Engineering at Busitema University.

SUPERVISOR: Mr. IGGA HUZAIRU

SIGNATURE:

DATE:

DEDICATION

I dedicate this report to my parents, Mr. Kozaala Denis and Mrs. Kozaala Josephine, and to TEST For Uganda family for the continuous support towards my Education.

ACKNOWLEDGEMENT

Let me convey my heartfelt appreciation to my supervisor, Mr. Igga Huzairu for his advice as well as guidance during the preparation of this report.

I also take this chance to thank all my lecturers who have imparted both practical and theoretical knowledge in me for the period of four years. It is due to this knowledge that I have been able to come up with this report.

Not forgetting my classmates, and friends who have always been with me in all areas of my stay at Busitema university for the period of four years.

Let me also extend my thanks to loving parents who have supported my education, encouraged me, guided me, and mentored me since I began schooling till now.

I would like to extend my sincere thanks to THE ALMIGHTY GOD who has gifted me with life and has enabled me to reach this academic height as HE has been the provider of all the necessary requirements.

May HIM, the most high bless you all.

Abstract

Spraying is one of the agricultural practices that are needed to ensure optimum crop growth and increase in the yields. It refers to the process of applying liquid chemicals to the crops or agricultural field with an aim of supplying essential nutrients, controlling pests and diseases and controlling unwanted weeds in the agricultural field. The demand of agricultural products increases day by day due to the rampant increase in the world's population. So food production should be looked at with a keen eye in order to provide sufficient food to the population at a fair price to everybody. Agricultural practices are gradually changing from depending on human power and draft animal power to majorly mechanical power. This is because of the increasing maintenance costs of animal draft and human power. therefore, it is mechanical power that has become economical and can facilitate the efficient usage of resources such as land, inputs, and others. 69 percent of the population of people in Uganda are employed by agriculture with 89 percent of it being small family farmers who produce around 80 percent of total annual agricultural output. Most of these small house hold farmers face a lot of problems during farming and they end up producing poor quality produces that do not comply with the international market standards. This has exponentially affected the reliability of the country's economy on agriculture. Most Small scale farmers use knapsack sprayers to spray where the sprayer has to be mounted on back and requires the lever to be operated manually in order to spray. Continuous weight on back of the farmer leads to back pain and manual pumping leads to wastage of efforts of the farmers. Therefore, farmers get biased with the process of spraying. Even the sprayers that could have solved these problems(like tractor boom sprayer) are so expensive to purchase or hire. The bicycle operated boom spray pump was therefore designed, fabricated and tested not only solve the problems above, but also have a small width which increases its applicability in different varieties of crops grown. There is increased encouragement of the use of non conventional spray pump, time spent during spraying will be reduced and it also encourages usage of the available materials. The machine consists of the bicycle, the piston pump and the 20 litre tank, the driver and driven sprockets, the crank mechanism, four nozzles, the control valve, and the integrated horse pipes. The machine is mechanically powered by pusing the bicycle and chaging the rotary motion of the sprockets into the reciprocketing motion that is transferred to the pump. This pressurizes the liquid chemicals within the cylinder of the piston hence aiding its movement through the pipes. the machine was tested in the field giving a field efficiency of 92.5% and application rate of 130.8 litres per acre with a discharge of 0.6672 litres per minute.

Table of Contents

DECLARATION..... i

APPROVAL ii

DEDICATION..... iii

ACKNOWLEDGEMENT.....iv

Abstract..... v

1 CHAPTER ONE 1

1.1 INTRODUCTION 1

1.2 BACKGROUND..... 1

1.3 Problem statement..... 2

1.4 Objectives..... 3

1.4.1 Main objective 3

1.4.2 Specific objectives 3

1.5 Justification..... 3

1.6 Scope of the study..... 3

2 Chapter two: Literature review 5

2.1 Introduction 5

2.2 Chemical spraying..... 5

2.2.1 Types of sprayers 6

2.2.2 Basic components of a sprayer..... 9

2.3 Published work on non-conventional spray pumps. 12

2.4 Overall advantages of the study over the existing..... 14

2.5 Design of standard machine components..... 15

2.5.1 Design analysis of a bicycle 15

2.5.2 Crank mechanism 16

2.5.3 Drive Mechanism 18

3 Chapter three: Methodology 20

3.1	Description of the sprayer	20
3.1.1	Main components of the machine.	20
3.1.2	Design considerations	21
3.1.3	Operation of the machine	21
3.1.4	Conceptual drawing of the proposed design	22
3.2	Specific objective one; To design and fabricate/assemble the bicycle operated boom sprayer.	22
3.2.1	Pump selection	22
3.2.2	Design of the crank and speeds of the pump	25
3.2.3	Power transmission	25
3.2.4	Design of the power requirement of the operator	27
3.2.5	Material selection	28
3.2.6	construction of the prototype	28
3.2.7	Nozzle selection considerations	29
3.3	Specific objective II; To test the performance of the sprayer and determine the operational efficiency.	29
3.3.1	Nozzle discharge (sprayer calibration)	30
3.3.2	Field capacity, C_a of the sprayer	30
3.3.3	Theoretical field capacity, C_t	30
3.3.4	Field efficiency, E_f	30
3.4	Specific objective III; Cost benefit analysis of the bicycle operated boom spray pump 31	
4	RESULTS AND DISCUSSIONS	33
4.1	Specific objective one; To design and fabricate/assemble the bicycle operated boom sprayer.	33
4.1.1	Pump selection	33
4.1.2	Design of the crank and speeds of the pump	36
4.1.3	Power transmission	37

4.1.4	Design of the power requirement of the operator	40
4.2	Fabrication and assembly of the machine components	42
4.2.1	Assembly of the machine.	45
4.3	Specific objective II; To test the performance of the sprayer and determine the operational efficiency.	46
4.3.1	Nozzle discharge (sprayer calibration)	46
4.3.2	Field capacity, C_a of the sprayer	47
4.3.3	Theoretical field capacity, C_t	47
4.3.4	Field efficiency, E_f	48
4.4	Specific objective III; Cost benefit analysis of the bicycle operated boom spray pump	48
5	CHAPTER FIVE :CONCLUSION, CHALLENGES AND RECOMMENDATIONS	51
5.1	Conclusion.....	51
5.2	Challenges	51
5.3	Recommendations	51
6	References.....	52

List of figures

Figure 1 shows Animal Drawn Hydraulic Boom Sprayer 12

Figure 2 shows Agricultural pesticides sprayer and weeder..... 13

Figure 3 shows an animal drawn operated by diesel engine..... 13

Figure 4 shows mechanically operated multi nozzle wheel spray pump..... 14

Figure 5 shows a design and fabricated bicycle boom spray pump Figure 6 shows testing of the machine in the garden52

Figure 7 shows determination of nozzle output Figure 8 shows side front and top view of the machine.....52

List of tables

Table 1 shwos the different parts of the machine fabricated42
Table 2 shows the results obtained from testing the machine46
Table 3 shows the budget of the materials spent on the machine48
Table 4 shows the NPV cash flow50