



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

**DEPARTMENT OF AGRICULTURAL MECHANIZATION AND
IRRIGATION ENGINEERING**

**DESIGN AND CONSTRUCTION OF AN IMPROVED MULTI-CROP
ENGINE POWERED THRESHING AND SEPERATION MACHINE
FOR LEGUMES**

BY

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EXECUTIVE SUMMARY

Threshing is one of the most important activities carried out in primary processing of legumes. It is aimed at dislodging seeds/grains from the pods and these legumes include common beans, soya beans and peas.

Most farmers in Uganda grow a number of legumes at different seasons and these crops all under the primary processing of threshing in which they majorly dependent elementary methods of threshing which are Labour intensive, time consuming and wasteful in that seeds get damaged. However, the existing machines are only limited to one crop causing machine redundancy and have low cleaning efficiency thus relying on manual power for cleaning.

The machine was aimed at minimizing the problem of machine idleness and improving the efficiency of seed separation from physical contaminants putting into consideration the physical properties of all legumes.

In this project, an optimum performance was obtained at feed rate of 0.025Kg/s giving TE=98.9%, CE=89.5% MD=0.4% and total Machine output of 52Kg/hr. for soya beans, 0.042Kg/s giving TE=98.7%, CE=92% MD=0.66% and total Machine output of 69Kg/hr. for common beans. However, there is a problem of clogging at the chaff outlet, machine immobility and bulkiness that still needs more attention.

In order to maximize the cleaning efficiency of the machine, option of incorporating a shaking sieve should be considered. Furthermore, ground tyres should adopted to permit machine mobility.

DEDICATION

This project report is dedicated to my beloved Grandmother, Mrs. Katerina E'yoru, for the moral guidance and parental love. God bless you.

ACKNOWLEDGEMENT

I am very grateful to God almighty for the wisdom and protection during the execution of this project and my academics as a whole.

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God bless you all.

DECLARATION

I, **Oneti Geoffrey**, do declare that this proposal is the original copy of the work compiled from various literatures gathered from different sources and has never been submitted before, for the award of Bachelor's degree in Agricultural Mechanization and Irrigation Engineering or any award of the same kind.

SIGNED: *Oneti Geoffrey*

DATE: *30/05/2016*



APPROVAL

This proposal has been submitted to the Department of Agricultural Mechanization and Irrigation Engineering for examination leading to the award of Bachelor of Agricultural Mechanization and Irrigation Engineering with my approval.

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ACRONYMS

FAO	–	Food and Agriculture Organization
GDP	–	Gross Domestic Product
PTO	–	Power Take Off
UEPB	–	Uganda Export Promotion Board
WFP	–	World Food Program
CGIAR	–	Consultative Group on International Agricultural Research
IITA	–	Inter-American Institute for Cooperation on Agriculture

CHAPTER ONE

1.0 INTRODUCTION

This chapter is about background to the study, problem statement, justification, objectives and scope of the study.

1.1 Background to the Study

Threshing is one of the most important activities carried out in primary processing of legumes. It is aimed at dislodging seeds/grains from the pods and these legumes include common beans, soya beans and peas.

Most farmers in Uganda use elementary methods of threshing legumes which are Labour intensive, time consuming and wasteful in that seeds get damaged.

In an attempt to solve the above problems, (Onziga. 2014) came up with a design of a motorized bean thresher which had a number of limitations

- ❖ Limited to only beans alone yet there are a number of crops that undergo threshing operation causing machine redundancy
- ❖ The machine was unable to separate the seeds from the chaff and this increases the dependency on manual power

Basing on the limitations above, my machine is aimed at minimizing the problem of machine idleness and improving the efficiency of seed separation from physical contaminants putting into consideration the physical properties of all legumes.

1.2 Problem Statement

Most farmers in Uganda grow a number of legumes at different seasons and these crops all under the primary processing of threshing which is so demanding in terms of Labour, tiresome and time consuming.

However, the designed machine (Onziga. 2014) is only limited to one crop and this prompts farmers to look for other alternatives for rest of the crops which is costly. This necessitates the design of a multi-crop thresher to eliminate the demand for other machines.

Besides the efficiency of cleaning and separation of seeds from the chaff is low (46%) which calls for an improvement so as to minimize human drudgery of manually collecting the threshed seeds for winnowing.

REFERENCES

- Amanlou, H. et al., 2012. Nutritional value of raw soybeans , extruded soybeans , roasted soybeans and tallow as fat sources in early lactating dairy cows. , 2, pp.88–94.
- Anon, Post Harvest Profile of Soybean.
- Azadbakht, M., Khoshtaghaza, M.H. & Gobadian, B., 2012. Mechanical properties of soybean pod as a function of moisture. , 8(4), pp.1217–1228.
- Bashaasha, B., 1992. Soya bean research in Uganda. , (June).
- Byron, Z. & Isaac, C., Farmers in Africa N2Africa Post-Harvest Handling Guidelines for Legumes.
- Chernykh, Y., Title : Threshing Machines. , 501(c).
- Dugje, I.Y., Omoigui, L.O. & Ekeleme, F., 2009. Farmers ' Guide to Soybean Production in Northern Nigeria. , (May).
- Gbabo, A., Gana, I.M. & Amoto, M.S., 2013. Design , fabrication and testing of a millet thresher. , 1(October), pp.100–106.
- IDDS, T., 2014. Bean threshing.
- Kharagpur, I.I.T., Module 8.
- Lawrence, K.A., 2005. Soybean : Africa ' s Potential Cinderella Food Crop.
- Ministry of Agriculture, A.I.& F., 2014. Agriculture Sector Development Strategy and Investment Plan: 2010/11-2014/15. , (July 2010).
- November, R., 2008. Soybean Drying and Storage. , (November).
- Odogola, W.R., 1994. Postharvest Management and Storage of Food Legumes,
- Onziga, E., 2014. Design and construction of an engine powered threshing machine for beans. , (May).
- Quick, G.R. & Quick, G.R., 1970. Combine harvesters for soybean research .
- Swanby, B.H., The Gates Foundation and Cargill push Soya onto Africa.
- U, I.S. & Facts, K., Managing Soybean for High Yield. , pp.1–2.
- Abdulkadir et al., 2009: The Design and Construction of Maize Threshing Machine.
- Abubakar Mohammed and Abdulkadir B. Hassan, 2012. Design and Evaluation of a Motorized and Manually Operated Groundnut Shelling Machine.
- Agidi Gbabo, Ibrahim Mohammed Gana and Matthew Suberu Amoto, 2013. Design, Fabrication and Testing of a Millet Thresher.
- A.L Jones, 1999; Danilo Mejia and Beverly Lewis eds. FAO; Phaseolus Bean: Post-harvest operations

Leterme, P. and C. Munoz (2002). Factors influencing pulse consumption in Latin America. British journal of Nutrition 88.Suppl.3,s251-s254.

Allen Dong and Roger Edberg, 1994: Small Scale Thresher. Vancouver Research institute and extension center

Gerald Shively and Jing Hao, 2012: A Review of Agriculture, Food Security and Human Nutrition Issues in Uganda..

Joseph Edward Shigley, (1986), Mechanical Engineering Design. First Metric Edition.

J.O. Olaoye, 2011: Development of Small Scale Equipment for Depulping Locust Bean

R.S. Khurmi and J.K. Gupta, 2005: A Text Book of Machine Design (pg. 122).

Simolowo, O. E., Dabor, S. E., Aigbokchai, S. O.,Awomolo, 2013: A Prototype Design And Test Analysis Of A Beans Particle Separating Machine.