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Evaluating the Effects of Drip Irrigation on Upland Rice cultivation in Uganda.

BY

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ABSTRACT.

One of the major challenges small-holder upland rice farmers face in Uganda is limited knowledge of good soil and water conservation strategies in the face of erratic climate change. Upland rice cultivation in Uganda is majorly rain-fed. The variability of rainfall distribution and the amount causes moisture deficiency, particularly in bare soils. Bare soil experiences high evaporation and moisture loss, which is one of the most critical limiting factors affecting upland rice productivity. The moist deficit causes water stress in rice crops whenever there is a sudden change in rainfall; yet rice requires a lot of water. The use of mulching and supplemental-irrigation is one of the climate-smart approaches which can contribute to soil-water conservation and effective water use for small-holder upland rice production.

The research experiment was carried out in open field with upland rice cultivation and drip irrigation for 5 months from July/2022 to Dec/2022 on an area of 72 $m^{2.}$.The experiment was a completely randomized design with eight treatments and two replications. Eight treatments consisted of four irrigation regimes; crop water requirement (ETc), 4 mm,3 mm, and rain-fed as Control and each water regime was under Mulch and no mulch conditions with two replications. Nerica 4 rice variety was grown during the research period with organic mulching. Different agronomic practices such as timely weeding and timely fertilizer application were carried out.

The results show that crop growth and yields were high in all organic mulch treatments. The majority of the root concentration was observed to be widely distributed in a shallow soil profile of 0-10 cm. This indicates that roots follow soil moisture redistribution in the profile layers. The highest yield of 3.78 kg was observed under ETc mm irrigation regime under mulch than all other treatments, with rain-fed under no mulch observed least yield of 0.55 kg. Generally, all treatments with mulch conditions had high significant yield compared to those under no mulch conditions. Therefore, it is evident that eco-friendly organic mulches conserve and retain moisture in soil profiles that contribute to improved crop growth, even with little rainfall, thereby improving the final crop yields. The results from this research are crucial for promoting upland-rice production with drip irrigation to enhance food security in Uganda and the region.

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DECLARATION

I **ALIONZI SILAS** hereby declare that the information in this thesis is out of my efforts to conduct the research under the supervision of Ms. Nabunya Victo and Mr. Bwire Denis. It has never been presented to any institute of higher education for any award.

Signature.....

Date 20th/01/2023

DEDICATION

I dedicate this thesis to my Next of keen Dr Driciru Margaret, Mr. APabo Bosco, Mr. Amangu Nason, my parents, Amayo john, Ms. Ajuru Rose for their cordial support during my academic trek.

APPROVAL

This certifies that **ALIONZI SILAS** has successfully submitted the final year undergraduate research thesis to the department of Agricultural Mechanization and Irrigation Engineering. It is a true reflection of his research work under the endorsement of my supervisors.

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Date: 18 | Jan | 2023

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List of abbreviations

AMI: Agricultural Mechanization and Irrigation

ETc: crop water requirement

ETo: Reference evapotranspiration

FAO: Food and Agriculture Organization of United Nations

WFP: World food programme

NAADS: National Agricultural Advisory Services

NARO: National Agricultural Research Organization

PH: Potential of hydrogen

RFI: Root frequency impact

M: Mulched treatment

NM: No-mulched treatment.

NERICA: New rice variety for Africa.

NOPT: Number of productive tillers

Av: Average

NOGT: Number of growing tillers

W.P: Water productivity

ANOVA: Analysis of variance

CHAPTER ONE.

1. INTRODUCTION

This chapter gives a brief background of the research focusing on food insecurity, climate change and irrigation water management for rice production. It also highlights on the justification, scope of the study, objectives, and significance of the study

1.1 Background

Rice is a source of carbohydrates (energy) to more than a third of the world's population as the most significant grain crop in the world. Globally, approximately 70% calory supply comes from rice. Rice yields ranging from 63.8g/m^2 to 411.8g/m^2 for both paddy and upland rice. The improvement of its productivity is important though there is limited research information regarding its growth characteristics (Maclean et al., n. d). Currently, Africa's population is projected to be 1.3 billion people and most African countries, especially in Sub-Saharan Africa, carry out rice production. Rice is as a crop is a promising future potential impact of contributing to poverty reduction and as a major source of food security in African nations such as Ghana, Chad, Nigeria, Ethiopia, Kenya, Tanzania, and Uganda.

Uganda is one of the countries with the high population growth rate of 3 percent annually. The country’s population projection as of 2021 was 42 million people and the projected population of 71.4 million by 2040. The goal of Uganda's Vision 2040 is to, among other things, increase per capita income from US $500 in 2013 to US $9,500 by 2040, with agriculture playing a significant role in this increase. (NPC, 2021). Uganda is an agro-based economy, the sector that employs over 70% of the population Agriculture contributed 23.7% of the GDP and 31% of export revenue in the fiscal year 2020–2021. (UBOS, 2021) The nation's agricultural industry majorly rain-fed dependent and is being threatened by climate change in which climate events such as droughts limits crop production. Therefore, the country is likely to face food insecurity issues (Profile et al., 2020)

FAO estimates that 928 million people, or about 12 percent of the world's population, experienced extreme food insecurity in 2020, which is 148 million higher than in 2019. In 2019, significantly fewer people than in 2017 could not afford nutritious diets due to the high expense of such diets and persistently high levels of income inequality. This is one of the factors that delays achieving SDG 2 which is related zero hunger (FAO, 2021)

Uganda is projected to experience severe food insecurity by the year 2050 given the present rate of population increase and food consumption patterns in the developing world. Furthermore, by 2050, the population of the globe is expected to grow by a third (FAO, WFP, 2021). The demand for food will rise as the population grows, and to meet this demand and assure food security, agricultural productivity would need to increase by 60% by 2050, necessitating agricultural transformation. However, the goal of agricultural transformation to enhance food production is made more challenging in a business-as-usual scenario by the erratic climate change in addition to the farmers' limited knowledge of sustainable agriculture, necessitating further adaptation. (NAP, 2018). To mitigate and adapt to the effects of climate

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