



FINAL YEAR UNDERGRADUATE THESIS

**Assessing the Impacts of Supplemental Drip Irrigation
and Organic Mulching on Upland Rice Cultivation for
Efficient Water Management in Uganda**

By:

ADONGI JEREMIA ODINGA

Tel: 0773567847/0759231916

Email: adongijeremi@gmail.com

Main supervisor: Ms. Nabunya Victo

Co-supervisor: Mr. Bwire Denis

Dept. of Agricultural Mechanization and Irrigation Engineering

Faculty of Engineering

Research Thesis Submitted to the Department of Agricultural Mechanization and Irrigation Engineering as a Partial Fulfillment of An Award of a Bachelor's Degree of Agricultural Mechanization and Irrigation Engineering at Busitema University

Date: 2/3/2022

Abstract

Soil and water management with changing climate is one of the major challenges being faced by small-scale upland rice farmers in Uganda. Upland rice cultivation is relied on rainfall using traditional irrigation approaches such as basin irrigation. The variation of rainfall amount and distribution causes moisture deficient and especially with bare soils. This is the most important limiting factors affecting the productivity of upland rice since bare soil, experiences high evaporation thus high loss of moisture. This renders plants to water stress whenever sudden change in rain fall take place. The use of grass mulch and supplemental drip irrigation is climate smart approaches that can contribute to solving the above challenges.

To assess this, the research experiment was carried for 6 months from May/2021 to Nov/2021 on area of 96 m² under open field conditions with drip irrigation. This experiment was under completely randomized design with six treatments and two replications. Six treatments consisted of three irrigation applications of 100%ETc, 80ETc and 60ETc each under mulch and no mulch conditions was considered with two replications of each. Nerica 4 rice variety was used as a test crop in the research with organic mulching Different agronomic practices such as timely weeding was carried out.

The results show that crop growth and yields was high in all treatments with organic mulches. In addition, most of the root concentration was found to be in shallow soil profile of 0-20 cm and widely distributed. This shows that roots follow the redistribution of soil moisture in the profile layers. The high yield was observed under 80% irrigation water requirement than all other ETc values. In general, all treatments with mulch conditions had high yield as compared to the irrigation with no mulch conditions. Therefore, evidence that organic mulches which are eco-friendly and conserve moisture in soil that improve on crop growth, reduce on crop water stress in event of little rainfall and contributing to better final yield

Acknowledgement

I acknowledge with great pleasure the Department of Agricultural Mechanization and Irrigation Engineering especially Mr. Bwire Denis and Ms. Nabunya Victo for their support and supervision to completion of the research project. towards the development of this thesis. I indeed can't forget to appreciate my colleagues, of BSc. Agricultural Mechanization and Irrigation Engineering class of the year 2017, Busitema University, who have me support whenever I need any help. I really thank you from the bottom of my heart. May the good lord continue to bless you all.

Declaration

I **Adongi Jeremia Odinga** hereby declare that the information in this research thesis is out of my effort under the supervision of Ms. Nabunya Victo and Mr. Bwire Denis. This has never been presented to any institute of higher education for any award.

Signature.....

Date.....

Dedication

I dedicate this thesis to my family members, friends and relatives most especially my sisters, madam Abbo Mary Stela and Arem Christine, and my parents Ajwangi Catharine and Odinga Charles.

Approval

This certifies that Adongi Jeremia Odinga has successfully submitted the final year Research thesis to the department of agricultural mechanization and irrigation engineering. This is a true work of my practical hands-on under the approval of supervisors.

Ms. Nabunya Victo

Sign:

Date:

Mr. Bwire Denis

Sign:

Date:

List of Abbreviations

ADC:	Agribusiness Development Centre
CRD:	Completely Randomized Design
Ec:	Electrical conductivity
ETc:	Crop water requirement
ETo:	Reference evapotranspiration
FAO:	Food and Agriculture Organization of United Nations
IPPC:	Intergovernmental panel on climate change
LSD:	Least significant difference.
MAAIF:	Ministry of Agriculture, Animal Industry and fishery
NAADS:	National Agricultural Advisory Services
NARO:	National Agricultural Research Organization
PH:	Potential of hydrogen
RFI:	Root frequency impact
SOC:	Soil organic Carbon
Ssp:	Species
WARDA:	West Africa rice development association
WID:	Women in development
M:	Grass mulched treatment
NM:	No-grass-mulched treatment.

Contents

Abstract	i
Acknowledgement.....	ii
Declaration	iii
Dedication.....	iv
Approval	v
List of Abbreviations	vi
1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Objective	3
1.3.1 Main objective	3
1.3.2 Specific Objectives	3
1.4 Justification	4
1.5 Research Scope	4
2 LITRETURE REVIEW	5
2.1 Soil and water conservation.....	5
2.1.1 Purpose of Soil and water conservation measures.....	5
2.2 Rice production in Uganda.....	6
2.2.1 Upland Rice varieties in Uganda	6
2.2.2 Planting method	6
2.3 Agronomic practices for rice production	6
2.3.1 Seed Selection.....	6
2.3.2 Germination Test	7
2.3.3 Weeding.....	7
2.4 Irrigation.....	7
2.4.1 Irrigation Methods.....	7
2.4.2 Advantages of drip irrigation	10
2.4.3 Limitations of drip irrigation	10
2.5 Irrigation Scheduling	10
2.6 Irrigation schedule management	11
2.7 Modes of Moisture Loss.....	11
2.7.1 Deep Percolation	11
2.7.2 Evaporation.....	11
2.7.3 Transpiration.....	11

3	METHODOLOGY	13
3.1	Research site location	13
3.2	Project design and crop.....	14
3.3	Materials and Equipment.....	14
3.4	Methods and procedure.	15
3.4.1	Determining irrigation-based scheduling	15
3.4.2	To carry out soil tests.....	16
3.4.3	Specific objective three.....	16
4	DISCUSSION OF RESULTS.	20
4.1	Determination of Irrigation based schedule	20
4.2	Determination of soil properties.....	23
4.3	Determining the impact of supplemental drip irrigation and organic mulch on growth, tillers, yield and root distribution.	23
4.3.1	Average Plant height.....	23
4.3.2	Least significant difference	25
4.3.3	Impact on Rice Number of tillers	26
4.3.4	Average number of Panicles	27
4.3.5	Impact on the rice Yields.....	29
4.3.6	Average Root frequency impact	30
5	CHAPTER IVE: RECOMMENDATIONS; CONCLUSIONS AND CHALLENGES.....	32
5.1	Challenges.....	32
5.1	Conclusion.....	32
5.2	Recommendations	32
	REFERENCES.....	33
6	APPEDICES	36

Figure 1:	Pie chart showing global production of rice	1
Figure 2:	Field under furrow irrigation. (BancyM.Mati, 2012).....	8
Figure 3:	Field under basin irrigation (Bancy M. Mati, 2012)	8
Figure 4:	Field under sprinkler irrigation (Bancy M. Mati, 2012)	9
Figure 5:	Field under drip irrigation (Bancy M. Mati, 2012)	10
Figure 6:	A graph showing the location of the study area by google earth.....	13
Figure 7:	systematic experimental set up.....	14
Figure 8:	showing plant height measurement in the field.....	17

Figure 9: shows how counting of tillers was done in the field.	17
Figure 10: showing the measurement of number of panicles in the field.....	18
Figure 11: Showing weight measurement after harvesting.	18
Figure 12: Showing root mapping in the field.....	19
Figure 13: A line graph showing variation of average plant heights during the growing period.	24
Figure 14: Shows the single factor anova for plant hieght.	25
Figure 15: A line graph showing the variation of number of tillers during the growth period.	26
Figure 16: A single factor anova for average number of tillers.....	27
Figure 17: A line graph showing variation of average numbers of tillers during the growing period.	28
Figure 18: A single factor anova for average number of panicles.....	29
Figure 19: A bar graph showing the variation of average yields with treatments...30	
Figure 20: A line graph showing the root distribution with depth.	31
Figure 21: Showing field preparation	43
Figure 22: Showing how discharge and wetted area was determined in the field. .43	
Figure 23: Showing field view at the initial growth stage.....	44
Figure 24: Showing field view at the development stage.....	44
Figure 25: Showing field view at the late growth stage.	45
Figure 26: Showing sample of panicles harvested.	46
Figure 27: Showing field ready for harvesting.	46
Figure 28:Shows lab analytical photography..... Error! Bookmark not defined.	
Table 1: showing the treatments of the experiment.....	14
Table 2: Showing the variation of ET ₀ and ET _c during the cultivation period.	20
Table 3:shows soil chemical properties	23
Table 4: showing average plant heights during the growth period.....	23
Table 5:showing the LSD comparison between different treatments.....	25
Table 6: showing the average number of tillers during the growing period.....	26
Table 7: showing the average number of panicles during the growth period.....	27
Table 8: showing the LSD test for average number of panicles.....	29
Table 9:showing the average yield with the treatments.....	29
Table 10: showing the average root frequency impact with depth.	30
Table 11:shows the reference evapotranspiration.....	36
Table 12:Shows 100% crop water requirement.	37

Table 13: Shows 80% crop water requirement.	38
Table 14: Shows 60% crop water requirement.	39
Table 15: shows delivery time for 100% crop water requirement.	40
Table 16: Shows delivery time for 80% crop water requirement.	41
Table 17: Shows delivery time for 60% crop water requirement.	42
Table 18: shows the soil chemical properties.	47