

**EFFECT OF FERTILIZER COMBINATIONS ON SOIL CHEMICAL
PROPERTIES, GROWTH AND YIELD OF CASSAVA (*Manihot esculenta* Crantz)
IN OGUN STATE**

BY

OYEBADE BLESSING AFOLAKE (PG 16/0606)

B. Agric (ABEOKUTA)

**A Dissertation submitted to the Department of Soil Science and Land Management,
College of Plant Science and Crop Production, Federal University of Agriculture
Abeokuta, In Partial Fulfillment of the Requirements for Award of Degree of Master
of Agriculture in Soil Chemistry.**

May, 2021

DECLARATION

I hereby declare that this Thesis was written by me and is a correct record of my own research work. It has not been presented in any previous application for any degree of this or any other University. All citations and sources of information are clearly acknowledged by means of references.

.....

OYEBADE BLESSING AFOLAKE

.....

Date

CERTIFICATION

We certify that this dissertation titled “Effect of Fertilizer Combinations on Soil Chemical Properties, Growth and Yield of Cassava (*Manihot esculenta Crantz*) in Ogun State” is the outcome of the research carried out by Oyebade, B. A. in the Department of Soil Science and Land Management, Federal University of Agriculture, Abeokuta, Ogun State.

.....
Prof. J. O. Azeez
(Major Supervisor)

.....
Date

.....
Prof. F. K. Salako
(Co-Supervisor)

.....
Date

.....
Dr. (Mrs) J. N. Odedina
(Co-Supervisor)

.....
Date

.....
Dr. G. Ezui (IITA)
(Co-Supervisor)

.....
Date

.....
Prof. C. O. Adejuyigbe
(Head of Department)

.....
Date

.....
Prof. M. O. Atayese
Dean, College of Plant Science and Crop Production

.....
Date

ABSTRACT

Cassava (*Manihot esculenta Crantz*) is a heavy feeder crop that exploits large volume of soil for nutrients, hence the continuous cultivation of cassava result in nutrient depletion, unless adequate fertilizer input such as inorganic fertilizer is used. This necessitated testing the effect of eleven different fertilizer types: Control (no fertilizer), recommended rate of nitrogen (N), phosphorus (P), potassium (K), half recommended rate of N, P, K, NPK + Micro-nutrients, NP, NK, PK, half N + P, K, half P + N, K, half K + N, P and half K + P on cassava growth and yield, and on the dynamics of soil chemical properties ($\text{NH}_4^+\text{-N}$, $\text{NO}_3^-\text{-N}$, electrical conductivity, pH and available phosphorus). Two locations used for the experiment were Directorate of University Farms of the Federal University of Agriculture, Abeokuta and farmer's field at Idi-olu, Ikenne Local Government of Ogun state. The experiment was a Randomized Complete Block Design consisting of the 11 fertilizer treatments in 2 locations replicated three times. Cassava variety TME 419 was planted at 1 m \times 0.8 m spacing. Data collected on soil chemical properties, plant height, stem girth, number of leaves and, yield components of cassava were subjected to Analyses of Variance (ANOVA) using Genstat Discovery Edition 9.2 and treatments means were separated using Duncan's Multiple Range Test ($p < 0.05$). Results showed that application of different fertilizer treatments improved soil ammonium with half NPK having the highest value of 80.95 mg kg⁻¹ compared to 35.09 mg kg⁻¹ on the control plots in both sites. Throughout the observation period, different fertilizer treatments improved soil nitrate having a percentage increment of about 10% over the control in both sites. Electrical conductivity was increased by the application of NPK + micro nutrient treatments having 13% increase in respect to the control in both sites. Soil pH was also increased with NK fertilizer having the highest value of 6.82 compared with the control (6.50) in both locations. Half N + PK treated plots had the highest P content in both locations. In

terms of cassava height and girth, application of full NPK performed better and NPK + Micro-nutrient treatments recorded the highest number of leaves per plant in both sites. Application of N, P and K fertilizer treatments resulted in higher root, stem and leaf yield compared with the control. In both locations, there was an increase (25.54%) in cassava yield as a result of the application of full NPK relative to the control. Soil pH, available P and Electrical conductivity had a positive correlation to root yield in both locations. This study concluded that application of N, P and K fertilizers resulted in higher growth and yield of cassava, improves soil chemical properties and therefore recommended for cassava production.

DEDICATION

This research work is dedicated to the Almighty God whose love never fails.

ACKNOWLEDGEMENTS

My profound gratitude goes to the one who has brought me thus far and made this research work a reality, the Almighty God, I return All Glory and Praises to Him.

My deepest appreciation goes to my major Supervisor, Professor J. O. Azeez. Having you as my major supervisor was never a regret or a mistake, thank you for encouraging my research work. I would also like to thank my co-supervisors, Prof. F. K. Salako (Department of Soil Science and Land Management) and Dr. J. N. Odedina (Department of Plant Physiology and Crop Production) for your comments, suggestions, advice and time towards the success of this research.

I owe my special thanks to my tutors in person of Dr. S. Hauser, Dr. G. Ezui and Dr. C. Kreye (IITA) for the great opportunity given to partake as a postgraduate student under the project “Africa Cassava Agronomy Initiative” (ACAI) and the cooperation of the team of researchers working in the above project headed by Prof. F. K. Salako and Dr. M. A. Busari.

I will not fail to appreciate the Head of Department, Soil Science and Land Management, Prof. C. O. Adejuyigbe and the Departmental Staff; Prof. J. K. Adesodun, Prof. (Mrs) O. A. Babalola, Prof. B. A. Senjobi, Dr. A. A. Soretire, Dr. (Mrs) F. A. Olowokere, Dr. (Mrs) C. O. Oyegoke, Dr. G. A. Ajiboye for their impactful knowledge. Thank you and God bless. Big thanks to Soils of Forest Inlands in Africa (SOFIIA) Nigeria for its support and contributions during the course of my laboratory work and also to the Laboratory Technologists and attendant for their assistance and contributions towards my laboratory analysis. God bless you all.

It is difficult to shape up my emotions into words. To my Big Sister and adviser Mrs Omobolaji Magret Thanni. Thank you very much for all the sacrifices you’ve made and for

bringing out the best in me and in this research. May the wisdom, knowledge and understanding of God never depart from you. I owe my most sincere gratitude to Mrs O. O. Onasanya and Mrs O. O. C. Ayodele for been accommodating and given me a conducive room for the success of my write-up. Thank you and God bless.

I will also like to sincerely appreciate my ACAI colleagues Ologunde Olanrewaju, Adebayo Oluwasegun, Akinsumbo Olayinka and Iyanda Ademola for the immense advice and assistance for making this research a success. To my co-colleagues Mrs T. B. Odelana (nee Olowoboko), Mr G. O. Bankole and Mr A. C. Aghorunse, I say thank you very much for your love, patience, advice and contribution during the course of working together in the laboratory.

A special thanks to my family. Words cannot express how grateful I am to my Parent and Parent in-laws, Mr and Mrs A. A. Oyebade and Mr and Mrs I. A. Omotunde for all the sacrifices you've made on my behalf. Thank you and God bless you. I also appreciate my siblings, Mr and Mrs P. A. Adedoyin, Miss J. O. Oyebade for their encouragement, advice and perseverance. And to my lovely Kid sister, Miss F. B. Oyebade, for been a nanny during the course of this research, may God almighty reward you. Thanks so much for always being there for me. I would also like to appreciate Miss Victoria Omotunde for her love and care towards me. I sincerely acknowledge the assistance of Miss Mopelola Atobajaye and Miss Esther Kuforiji for also been a nanny during the course of this research. May helpers continue to locate you and may God crown all your efforts with success (AMEN).

My deepest appreciation goes to my beloved husband, Mr Henry Adeoye Omotunde, thank you for supporting me, for your lovely advice, encouragement at all times and most especially bringing out the best in me. And to my Lovely Daughters, Miss Helen Ademide Omotunde

and Miss Henrietta Iremide Omotunde for being well behaved girls and always cheering me up. I love you both.

TABLE OF CONTENT

Contents

Title page.....	i
Declaration.....	ii
Certification.....	iii
Abstract.....	iv
Dedication.....	vi
Acknowledgment.....	vii
Table of contents.....	x
List of Tables.....	xv
List of Figures.....	xvi
CHAPTER ONE.....	1
1.0 INTRODUCTION.....	1
1.1 Justification.....	2
1.2.1 Main Objective.....	4
1.2.2 Specific Objectives.....	4
CHAPTER TWO	6
2.0 LITERATURE REVIEW	6
2.1 Origin and botanical description of cassava.....	6

2.2	Role of inorganic fertilizers on growth and yield of cassava.....	9
2.2.1	Phosphorus (P).....	12
2.2.2	Nitrogen (N).....	14
2.2.3	Potassium (K).....	16
2.2.4	Calcium (Ca).....	17
2.2.5	Magnesium (Mg).....	18
2.2.6	Zinc (Zn).....	18
2.2.7	Sulfur (S).....	19
2.2.8	Copper (Cu).....	19
2.2.9	Iron (Fe).....	20
2.2.10	Manganese (Mn).....	20
2.2.11	Boron (B).....	20
2.3	Effect of some soil chemical properties on the growth and yield of cassava.....	21
2.3.1	Soil pH.....	22
2.4	Climatic and soil requirement of cassava.....	22
2.5	Fertilizer combinations in cassava production.....	23
	CHAPTER THREE.....	25
3.0	MATERIALS AND METHODS	25
3.1	Experimental location.....	25

3.2	Experimental treatments.....	25
3.3	Experimental design.....	27
3.4	Source of material.....	27
3.5	Land clearing and plot dimension.....	27
3.6	Planting date.....	27
3.7	Pre-planting soil analyses.....	27
3.8	Plant spacing and density.....	28
3.9	Fertilizer application.....	28
3.10	Soil sampling period at 16, 24, 32 and 40 weeks after planting.....	28
3.11	Soil chemical analyses at 16, 24, 32 and 40 weeks after planting.....	30
3.11.1	Determination of ammonium nitrogen.....	30
3.11.2	Determination of nitrate nitrogen.....	31
3.11.3	Determination of available phosphorus.....	32
3.11.4	Determination of pH and Electrical conductivity.....	33
3.12	Growth parameters.....	33
3.13	Weeding.....	33
3.14	Measurement of yield components.....	34
3.15	Statistical analysis.....	34
	CHAPTER FOUR.....	35

4.0	Results.....	35
4.1	Pre-planting soil analyses.....	35
4.2	Dynamics in percent change in some soil chemical properties in response to the application of fertilizers.....	37
4.2.1	Percent change in soil ammonium nitrogen concentration due to N-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	37
4.2.2	Percent change in soil nitrate nitrogen concentration due to N-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	39
4.2.3	Percent change in available phosphorus concentration due to P-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	41
4.2.4a	Percent change in pH of soil concentration due to N-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	43
4.2.4b	Percent change in pH of soil concentration due to P-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	45
4.2.4c	Percent change in pH of soil concentration due to K-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	45
4.2.5	Percent change in inorganic nitrogen concentration due to N-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	48
4.3	Relative response of cassava fresh root yield to increasing fertilizer combination applications.....	50

4.3.1	Relative contribution of N-fertilizer on cassava fresh root yield.....	50
4.3.2	Relative contribution of P-fertilizer on cassava fresh root yield.....	50
4.3.3	Relative contribution of K-fertilizer on cassava fresh root yield.....	50
4.4	Correlation analysis of the relationship between some soil chemical properties and cassava yield.....	54
4.4.1	Relationship between some soil chemical properties and cassava yield in FUNAAB	54
4.4.2	Relationship between soil chemical properties and cassava yield in Ikenne	54
CHAPTER FIVE		57
5.0	Discussion.....	57
5.1	Conclusion.....	62
REFERENCES		63

LIST OF TABLES

Tables

1	Fertilizer rates and application.....	26
2	Physical and chemical properties of soil used for the experiment.....	36
4.3.1	Relative contribution of N-fertilizer on cassava fresh root yield.....	51
4.3.2	Relative contribution of P-fertilizer on cassava fresh root yield.....	52
4.3.3	Relative contribution of K-fertilizer combinations on cassava fresh root yield...	53
4.4.1	Correlations between some soil chemical properties and cassava yield in FUNAAB.....	55
4.4.2	Correlations between soil chemical properties and cassava yield in Ikenne.....	56

LIST OF FIGURES

Figures

1	Experimental plot layout.....	29
4.2.1	Dynamic in Percent change in soil ammonium nitrogen concentration due to N-fertilizer applications to soil grown to cassava. N-fertilizer splits were applied at 4, 10 and 16 WAP in FUNAAB and Ikenne.....	38
4.2.2	Dynamic in Percent change in soil nitrate nitrogen concentration due to N-fertilizer applications to soil grown to cassava. N-fertilizer splits were applied at 4, 10 and 16 WAP in FUNAAB and Ikenne.....	40
4.2.3	Dynamic in Percent change in available phosphorus concentration due to P-fertilizer applications to soil grown to cassava in FUNAAB and Ikenne. P-fertilizer was applied at planting.....	42
4.2.4a	Dynamic in Percent change in pH of soil concentration due to N-fertilizer applications to soil grown to cassava in FUNAAB and Ikenne. N-fertilizer splits were applied at 4, 10 and 16 WAP.....	44
4.2.4b	Dynamic in Percent change in pH of soil concentration due to P-fertilizer applications to soil grown to cassava in FUNAAB and Ikenne. P-fertilizer was applied at planting.....	46
4.2.4c	Dynamic in Percent change in pH of soil concentration due to K-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	47
4.2.5	Dynamic in percent change in inorganic nitrogen concentration due to N-fertilizer applied to soil grown to cassava in FUNAAB and Ikenne.....	49