SOIL SALINITY EFFECTS OF DAIRY AND POULTRY WASTEWATERS IN MAIZE/MELON PRODUCTION PLOT.

By

SALMAN YUSUF

MATRIC NO: - 2003/14880EA

BEING A FINAL YEAR PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.)DEGREE IN AGRICULTURAL AND BIO RESOURCES ENGINEERING.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

November, 2008.

DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by Salman Yusuf. It has not been presented before for any degree or diploma or certificate at any university of institution. Information derived form personal communications, published and unpublished works of others were duly referenced in the text.

Salman Yusuf
2003/14880EA

29/11/08
Date

CERTIFICATION

This project entitled " Soil Salinity Effects of Dairy and Poultry Wastewaters in Maize /Melon production plot" by **SALMAN YUSUF** meets the regulations governing the award of the degree of Bachelor of Engineering (B. ENG.) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

------------------------------ 18/11/08
Date

Mr. Peter Adeoye
Project Supervisor

------------------------------ 20/11/08
Date

Engr. Dr. (Mrs.) Z.D Osunde
Head, Department of Agricultural
And Bioresourecs Engineering.

------------------------------ 18/11
Date

External Examiner

DEDICATION

I dedicated this project to the glory of God Almighty, the FOUNTAINS of all knowledge and also to every knowledge seeking individuals in University all over the world.

I also dedicated to my loving Sheikh Alh. Ibraheem Moh'd L-awal Afenifere Omoyoruba Grand Khalifat Al-Khlas (World Wide) for his seizeless encouragement, Moral, Financial and spiritual support given to me during the academic programme.

ACKNOWLEDGEMENTS

I, am sincerely grateful to Almighty Allah, for seeing me through all obstacles. I have encountered during the period of my studies. I must confess that I have done nothing of my own strength. He actual did everything for me.

My thanks goes to my cordial level adviser and he also my supervisor Mr. Peter Adeoye, for finding time to go through this research work and making useful comments and suggestion.

I wish to acknowledge my profound gratitude to the head of the department. Engr. Dr. (Mrs) Z.D Osunde and all highly intelligent lecturers; Engr. Prof. M.G Yisa, Engr. Prof. E.S.A Ajisegiri, Engr. Dr. N. A. Egharevba, Engr. Dr. Alabadan, Engr. Dr. Balami, Engr. Dr. O. Chukwu, Engr. P.A. Idah, Engr. (Mrs) Mustapha, Engr. Sadiq, Engr. John, Engr. Segun and Engr. Solomon. For their contributions to my knowledge during studying under them. May Allah guides, Bless, and increase them in knowledge.

My Sincere appreciation also goes to my beloved parents Alhaji and Alhaja Salman for their struggle to ensure that I become somebody in future and also my profound gratitude goes to Salman Muftau Adebayo, Salman Olatunji AbdulRasaq, and Salman Omobolanle AbdulRashed for their kindness and support throughout my academic programme.

An immeasurable depth of appreciation goes to Architect Zakariyah Yusuf for his financial assistance rendered during my studies.

Also, my acknowledgment is not complete without mentioning some individual like Alfa Yunus Sakariyah, Alfa Ibraheem Sakariyah, Abdul Rahamon Abdulahi, Abdul Rasaq Zubair, Abdul Waheed Zubair, Bros. Mukaila, Musa Rasaq, Abdul Lateef Ayepe, Abdul Lateef Alfa Mohammed (Almod Computer Center Minna), Lateefat Abdul Wahbi and Sister Modupeola Salami.

My appreciation goes to all my friends, and course mates for all the care, understanding and unit they displayed during our stay on campus. I talk about the likes of Adeyi AbdulRasaq M. Uthman AbdulWaheed; Adeola Mutalib, Muffy, Momood B. Ibraheem, and may almighty Allah reciprocate all our good deeds with bountiful reward in exaltation (Amin)

Finally, to my lovely wife Salman Abidemi Sofiat Ajoke and my Children Musharafdeen Olarewaju Salman and Halimat oluwafunmilayo Salman, there support and courage makes me feel fulfilled in life.

Once again, glory is to Allah, the lord who taught (the use of the pen and taught man that which he knew not. May Allah increase us all in knowledge (Amin.).

ABSTRACT

The effect of soil salinity of dairy and poultry wastewater in Maize/Melon production studied in this work help to ascertain the effect of farm animals waste obtained from (dairy and poultry) to the soil senility which enable the possibility of evaluation the behavior and responses of the saline or alkaline soil to the plant before and after the irrigation schedule on each plot of Agricultural land with respect to the grains planted on its. Standard method of attaining this experiment were followed considering the inter row spacing and intra row spacing and then depth of soil for incorporating the grains, this study shows that maize/melon in responded best in the soil irrigated with dairy and least in the soil irrigated with mixture of both dairy and poultry wastewaters and average performance in poultry waste water only. Inview of the average value obtained from the soil salinity which is determined by the E.C of the soil, this study show indicate that the E.C of the soil obtained ($2.34\Omega^{-1}m^{-1}$) at the initial stage before the irrigation schedule meet up with the satisfactory soil requirement for growing the plant. However, average values obtained from dairy waste, poultry waste, mixture of dairy and poultry waste and the control plot after the fourth irrigation are given to be $11.25\Omega^{-1}m^{-}$, 12.45 $\Omega^{-1}m^{-}$, 11.85 $\Omega^{-1}m^{-}$ and 5.25 $\Omega^{-1}m^{-}$ respectively. The result of this analysis gives possible evidence that it is better to irrigate a plant soil with dairy wastewater in order to improve its growth and yield.

TABLE OF CONTENTS

Contents **Pages**

CHAPTER THREE

LIST OF TABLES

LIST OF PLATES

CHAPTER ONE

1.0 INTRODUCTION

Soil salinity is a measure of the total amount of soluble salt in soil. As salinity levels increase plant extract water less easily from soil thereby aggravating water stress conditions. High soil salinity can also cause nutrients imbalances, result in the accumulation of elements toxic to plant, and reduce water infiltration. Salinity to tolerance is influence by plant, soil and environmental factors and their interrelationships. Generally, fruits, vegetables and ornamentals crops are more salt sensitive than forage or field crops. In addition, certain varieties, cultivars, or rootstalks may tolerate high salt levels than others. Plants are more sensitive to high salinity during seedling stages immediately after transplanting and when subjected to other.

Knowledge of soil characteristics is very important for crop production. The soil is a reservoir for water and chemicals, including plant nutrients and provide a medium to support the plants for irrigation, the water holding - capacity and salt content of the soil must be considered. The presence of soluble salt in the root zone can be a serious problem especially in arid region, salinity is usually of little concerned in humid region because rainfall is sufficient to leach out any accumulated salt, however, all water form surface stream and underground sources contains a dissolved salt.

The salt applied to the soil remains in the soil unless it is flushed out in drainage water or is removed through the harvested crop. Usually the quantity of salt removed by crop is so small that it will not make a significant contribution to salt removal. The principal effects of salinity are to reduce the availability of water to the plant. In case of extremely high salinity, there may be curling and yellowing of the leaves, firing (make hole) in the margins of the leaves or actual death of the plant may result. Saline soil, are found throughout Nigeria. These salts originated from the natural weathering of minerals or from fossil salt deposits left from ancient sea bed. Salts accumulate in the soil as irrigation water or groundwater seepage evaporates, leaving minerals behind. Irrigation water often contains salt picked up as water moves across the landscape, or the salts may come form human induced sources such as municipal runoff or water treatment. As water is diverted in basin, salts levels increased as the water is consumed by transpiration or evaporation.

As the salt is most usually damaging to young plants but not necessarily at the time of germination, although salt concentration can slow seed germination by several days or completely inhibit it. Because soluble salts moves more readily with water, evaporation moves salt to the soil surface where they accumulate sometimes becoming visible as powdering white salt crust.

Crops can be graded into three categories of salt tolerance in which both maize and melon fall to one of the three, when grown under irrigation: tolerant, moderately /semi tolerant and sensitive to salt

1.1 Aim and Objective

The objectives of this work are:

1. To determine the growth rate and yield in maize/melon when planted under dairy and poultry wastewaters irrigation system.
2. To determine the chemical composition of the soil under cultivation to know the effects of the wastewaters on salinity condition of the soil.

1.2 Scope of the Study

The study is on the effect of soil salinity of dairy and poultry waste water in maize /melon production. It covers the study growth rate and the chemical composition of the soil. A control experiment using rain fed method will be practiced under the same condition to ascertain the effect of wastewater reuse.

1.3 Statement of the Problems.

The main purpose of irrigation is normally to replenish the soil moisture so that water is made available to plants under certain circumstances although less commonly in temperate area. Irrigation is also used to provide a means of leaching salt form the rooting zone in order to prevent salinity problems and improve soil structure.

Salinity problems are caused from the accumulation of soluble salts in the root zone, these excess salts reduced plant growth and the vigor by altering water uptake and causing ion specific toxicities or in balances. Salt affected plants are stunted with dark green leaves which, in some cases, are thicker and more succulent than normal. In high soil salinity may lead to leaves burn and defoliation.

1.4 Justification of the Study

Dairy and poultry wastewaters increase or decrease the soil salinity and have considerable effect on the growth and yield of plant crop. The performance of maize and melon under wastewater irrigation system of dairy and poultry determine its used for its production. Though, maize and melon thrive well in arid and moderate salt soil, but the study will confirm this.

CHAPTER TWO

2.0 Literature Review

2.1 The Main Purpose of Irrigation

In some part of the world, the amount and rainfall are not adequate to meet the moisture requirement of crops and irrigation is essential to grow crops necessary to meet the needs of food and fibre. Irrigation is an old age art, as old as civilization. The increasing need of crop production for the growing population is causing the rapid expansion of irrigation throughout the world.

2.2 Suitability of Water for Agriculture Use.

Although irrigation has been practiced throughout the world for several millennia, it is only in this century that the importance of irrigation water quality has been recognized. The design approach to irrigation with reclaimed water depends upon whether emphasis is placed on providing a water supply or providing wastewater treatment. Legislation and literature provide much information on the extra – agricultural use of water this information is not precise with respect to the suitability irrigation water. Irrigation leads to significant changes in soil condition, some of which are long lasting, and not all of which may be beneficial in agriculture terms.

Few studies have been made of long term changes in soil under irrigation studies of changes in soil aeration have been made by Willy and Tanner (1963), and these indicate that it takes some day for the oxygen diffusion rate of the surface soil to recover following irrigation. They also showed that surface application of water by flooding saturate the top soil and therefore impair aeration more than sprinkle method.

Chemical and organic changes in soil conditions might also be anticipated under irrigation. In arid area, or where water quality is poor, accumulation so salts and trace elements may present a serious problem. Bicarbonate, sulphate, sodium, and boron may all reach toxic levels, and careful control of application rates, moisture conditions and waters quality is essential to remove these by leaching. One of the main indications of soil chemical conditions under irrigation is the exchangeable sodium percentage.

Anderson et, al (1982) found that levels of this rate progressively during the fourteen to seventeen years of irrigation with sodium rich water in south – west Mexico. At the same time organic matter fall. The problems of such changes are not nutritional ; sodium tends to destabilize the soil structure, blocking the soil pores, and inhibiting water movement

The effect of irrigation upon crops yield are more widely appreciation, and many studies have been known the benefits of reducing moisture stress.

(Feddes and Wijik, 1976) The benefit probably drives not only from the increase supply of water and increase transpiration rate. But also form added nutrient uptake

2.3 Measuring Soil Salinity

Saline soils contain large amounts of water soluble salts which inhibit seed germination and plant growth the salts are white and chemical neutral compound and include chloride, sulphates, carbonate, and sometimes nitric of calcium, magnesium, sodium and potassium .

Salinity is measured by passing an electrical current through a soil solution extracted from a saturated soil sample. The ability of the solution to carry a current is called electrical conductivity (E.C)

Electrical conductivity (EC) is measured in decemen per meter (dsm^{-1}), which is the numerical equivalent to the old measure of millimhos per centimeter (table 2.2)

The lower the salt content of the soil, the lower the decemen permeter (dsm^{-1}) rating and the less the effect on plant growth.

2.4 Managing Soil Salinity

In principle, soil salinity is not difficult to manage. Drainage either natural or man made. Determine salinity level by collecting a representative soil sample to about 30.5cm (12 inches) depth and having it analyzed in the lab. If the salinity level to high for the desired vegetation, remove slat by leaching the soil with clean (low slat) water. Application of 15.25cm (6inches) of water will reduce salinity levels approximately 90% (salinity and plant tolerance by Jankofu by – Amachery, July 1997).. The table 2.1 below shows the three categories.

T able 2.1 Relative Salt Tolerance of Common Field and Orchard Crops.

Tolerant	**Semi tolerant**	**Sensitive**
Barley	What oats	Apple
Barmuda (dub) grass	Sorghum	Orange
Cotton	Maize	Lemon
Spinach	Rice	Pear
Date palm	Tomato	Field beans
Sugar beet	Cabbage	Green beans

Source: A.M Michael (2006)

The table (2.2) describes general plant responses to different soil salinity ranges. It may not be possible to leach salt from soil in these situations select plants which are tolerant of the salinity level in soil. Varietal difference and environmental condition may make plants measure or least salt tolerant than indicated in the tables

For harvested crops, threshold values indicates soil salinity level where plants begin to experience yield reducing effect. Above the threshold, salinity levels associated with expected yield losses of 10%, 25% and 50% are indicated.

Table :2.2 General Guidelines for Plant Responses to Soil Salinity .

Salinity (Ec_e, dsm^{-1})	**Plant response**
0 to 2	Mostly negligible
2 to 4	Growth of sensitive plants may be restricted
4 to 8	Growth of many plants is restricted
8 to 16	Only tolerant plant grow satisfactory
Above 16	Only a few, very tolerant grow satisfactory

Sources R.M Waskom et;al 2006

2.5 Quantifying Salt Tolerance

Plant tolerance to soil salinity is expressed as the yield decrease with given amount of soluble salts compared with yield under non saline conditions. Threshold salinity levels have established for most crops and represent the minimum salinity level (EC_{sc}) above which salinity unites growth and/or yield. These values represent general guidelines, since many interaction among plant, soil, water, and environment factors influence salt tolerance.

2.5.1 Factors Affecting Salt Tolerance.

Plant factors for some plants soil salinity influence growth at all growth stages, but for many crops sensitivity is varies with the growth stages. For example, several grain crops (eg., Maize, Rice, Wheat, Corn and barley) are relatively salt tolerant at germination and maturity but are very sensitive during early seeding and, in some cases, vegetative growth states. In contrast, sugar beat, safflower, soybean, and many bean crops are sensitive during the germination. This effect depends on variety, especially with soybean. The amount of growth reduction and/or yield lost offen depends on the variety.

Soil factors in general, crop grown on nutrient deficient soils are more slat tolerant than the same crops grown in soils with sufficient nutrients. Lover growth rates and lower water demand are likely causes for the increased tolerance to soil salinity. In these cases nutrient deficiency is the most limiting factors to maximum yield potential; thus, nutrient additions would increase salt tolerance. Because saline and sodic soils have pH > 7.0, micronutrient deficiencies can be more common.

Over fertilization with N can decrease salt tolerance in some crops because of increased vegetative growth and water demand. At recommended rates, little or no effect on soil salinity or salt tolerance is observed with either organic or organic nutrient addition. Continued over application of manure, as well as N and K fertilizers, can increase sole salinity, especially in poorly drained, irrigated soils.

Proper irrigation management is essential to reducing soil salinity effects on plant growth and yield. Total salt concentration in the soil solution is the highest when the water content has been reduced by avapotraspiration. With irrigation. With irrigation, soil solution salts are diluted and Ecse decreases. If soil salinity increase above the threshold levels during dry periods, more frequent irrigation will be required to prevent water and salinity stress and, thus negative effects on plant growth and yield. Also, the percentage of plant available water decreases with increasing salinity (higher osmotic potential), requiring more frequent irrigation. Excessive irrigation reduces accretion especially in poorly drained soils, and can reduce salt tolerance in some plants.

Environmental factors under hot, dry conditions, most crops are less salt tolerant under cool, humid conditions because of greatly increased evapotraspiration demand. These climate effects of temperature and humidity on salt tolerance are particularly important with the most salt sensitive crops.

Source: (John .L. Havlin, el;al 2006)

Table (2.3) Salinity Tolerance of Common Field Crops Grown in Nigeria

Crops	Threshold value Ec_e(dsm^{-1})	10% yields loss Ec_e (dsm^{-1})	25% yields loss Ec_e (dsm^{-1})	50% yield loss Ec_e (dsm^{-1})
Barley	8.0	9.6	13.0	17.0
Beans field	1.0	1.5	2.3	3.6
Canola	2.5	3.9	6.0	9.5
Corn (grain)	2.7	3.7	6.0	7.0
Oats (grain)	5.2	6.7	9.0	12.8
Rice (grain)	5.9	7.7	12.1	16.5
Safflower	5.3	8.0	11.0	14.0
Sorghum	4.0	5.1	7.1	10.0
Sugar beets	6.7	8.7	11.0	15.0
Sunflower	2.3	3.2	4.7	6.3
Friticale (grain)	6.1	8.1	12.0	14.2
Wheat	4.7	7.0	9.5	13.0

Sources: Amacher, 1997

Both crop plants, maize and melon were classified under moderate or semi tolerance crops, as the tables above testified .

Maize *(Zeamays)* is a cereals product which grow within the temperature range of 10^0C to 40^0C. The optimum temperature being around 30^0C. It requires a good deal of sunshine and low level of humidity, otherwise it is prone to disease and inadequate pollination. The crop will reach maturity within 90 to 200 days of planting. (Benz, B.F el;al 1999)

Melon, *Cucumeropsis edulis* is a vegetable product. Melon had long been discovered to have originated from Asia and was firstly transportation in Italy and extended to France before the sixteenth century. Melon are somehow related to the family of summer squash, which includes as a fruit vegetable plant which is always intercropped with maize. There are many varieties of melon which include water melon. (*citrus vulgaris*), rock melon, honey dew and prince melon. In, Nigeria. Many type of melon are grown, some are grown for their succulent fruit such as grown, some are grown for their succulent fruit such as water melon which some are grown for the purpose of see. Melons are of various uses to farmers and consumers, melon can be used for vegetable oil production, for soap, and for the production of melon cake. Melon is usually grown in the soil which is very rich in organic matter (fertile soil) and can be planted by the beginning of raining season usually between march, April and June. Akobundu (1987)

2.6 Salinity Management in Irrigated Agriculture

Salinity is defined as the salt concentration present in soil or in water per unit of volume or weight salinity usually involved two deferent kinds of problems the negative effect on plant growth causes an increase osmotic pressure; and the effect on soil structure rupture and the depletion of both soil in filtration and water holding capacity produced by the excess of changeable sodium (sodicity) sometimes both effects (salinity and sodicity) may appear together in addition, high values of trace elements (e.g boron and cadmium,) may alter plant growth. (Brinkman and Rhoadas, 1990.)

The increase in salinity levels, either in the root zone or in runoff and seepage irrigation water, appears as a result of alteration of the hydrologic balance of the surface water, influence by soil and water management practices carried out during a certain period of time. Thus, both salinity prevention and control can be performed by appropriate water management.

Formation of saline soils in nature usually result from the combination of geologic, metrologic and hydrologic factors. The main processes involved in salinization are evaporation, capillary rise when a shallow water table layer is present, weathering, and the input of salts with the irrigation water.

Salinity management must be considered at two levels (Tyagi; 1996): In the root zone and at a regional level or irrigable zone level. Several possible actions are recommended for addressing the first level.

1. Using chemical amendments with the goal of improving soil physical chemical properties ,adding chemicals with soluble calcium to replace the exchangeable sodium.

2. Applying irrigation scheduling appropriate to maintain a specific moisture content in soil, and to provoke a periodic leaching of salts, always keeping an adequate drainage.

3. Alternating the use of saline and fresh water or mixing them, depend on the soil water conditions and crop conditions.

Need to improved irrigation systems and their management and to increase uniformity and water application efficiency is as relevant

Effects of saline conditions on the growth and nutrient uptake of many crops have been reviewed

2.7 Yield / Salinity Relationship

Many arid or semi – arid soil contain concentration of soluble salt that have a negative impact on the efficiency of water use. In irrigated agriculture, salinity is probably the second most important yield constraint to irrigation. In addition to a direct osmotic effect and a possible toxicity of specific ions soil salinity and salt present in the irrigation water may have a serious impact of physical properties such as infiltration, water holding, and aeration, especially if the soil or the water is rich in exchangeable sodium.

The most desirable characteristics in selecting a crop for irrigation with saline water are high marketability, high economic value, ease of handling, tolerance to salts and specific ions, ability to maintain quality under saline conditions and compatibility in a crop rotation (Graltan and Rhoadas. 1990). However, no crop is outstanding in all of these categories. For example, the economic value per crop area is negatively correlation with crop salt tolerance (Ranbir, C. 1998), and many high value crops are sensitive to specific ions. Because saline condition reduced both plant growth and seasonal evapotranspiration. It is important to develop information on crop water production functions under saline conditions.

Ranbir C. established four crops response whose application depends on information experimentally generated. Few studies have reported any differential yield

2.9 Composition of Poultry Wastewater.

The successful use of organic manures (whether it is compost, green manure or animal waste) as a nitrate source required more experience and better knowledge about the manure, the crop, and the environmental condition than the use of chemical fertilizers (e.g urea).

General properties of nitrate from organic sources. The availability of nitrate decline as manures age or are composted.

Table2.5: Nutrients Contents (Dry Basis) FF Selected Manures and Compost

Organic material	Total nitrite	P_2O_5	K_2O
Poultry manure		**Ibc/ton**	
- Fresh broiler	80	50	50
- Fresh layer	80	120	70
- Aged layer	40	160	80
Diary /steer manure			
Fresh diary separator solids	40	15	10
Aged steer corral scrapings	25	30	60
Green manure			
- Cowpea	70	20	80
- Leucaena	75	7	40
- Pigeon pea	25	12	30
- Sugar cane	7	1	10
Composts			
- Broiler tricehull	40		50
- Diary	25		25
- Diary/poultry	30		65
- Water/hyacinth	40		40
- Municipal waste	40		30

Source: Hobson and Robert (1987)

Available Nitrate (PAN), phosphorus is expressed as total (P_2O_5), potassium is expressed as total potash (K_2O).

Table 2.8 reports the average nutrient contents of poultry manure sampled and tested in virginia's farm 1989 to 1992.

Nutrients value of litter can vary 30 to 50% depending on type of bird, feed and moisture contents, and the clean – out technique and schedule of individual operations.

Adding the enzyme phytase to feed ratios increases the utilization of phosphorus in the feed and reduces the need to supplement ratios with inorganic phosphorus. This phytase can reduced total phosphate content of poultry litter 20 – 40%.

Table 2.6 Average Nutrient Values of Poultry Manure Tested in Virginia 1989 to 1992

Manure type	Available N Broadcast	Available N incorporated Immediately	P_2O_5	K_2O	Ca	Mg	%Moisture
Dry broiler litter	37	42	62	29	41	8	28
Dry turkey litter	37	42	64	24	43	7	35
Layer or breeder	21	25	65	24	123	8	43
Liquid poultry	27	41	41	31	40	5	93

- Nutrient values are presented in pounds /1000 gallons. Al other values are pound/ton available nitrogen estimated base on application to a springs or fall crop. (G.L Mullins et;al 2002)

2.9.3 Additional Benefits Organic Matter and pH

Soil organic matter has a positive effect on soil structures, tilt, water holding capacity, aeration, pH buffering, cation exchange capacity and microbial activity. Poultry litter contains a considerable amount of organic matter due to the manure and bedding material.

Litter can also have an impact on soil pH and liming due to varying amounts of calcium carbonate in poultry feed. (G.L Mullins et;al 2002)

CHAPTER THREE

3.0 Materials and Methods

3.1 Location and Description of the Project Area

The project research was conducted on a piece of farmland located at Gbaganu village in Chanchaga Local Government Area of Niger State. The geographical location of the farmland is latitude ($9^0 34^1$) North and longitude ($6^0 361^1$) East (Falade; 2005). The average annual rainfall, of Minna in 2006 and 2007 is 158.45mm.

The farm land has an area of 211.8m^2 (i.e. 17..374m by 12.192m). soil sample were taken and few analysis were carried out on the sample of soil obtained form the farm land, the result was in chapter four

3.2 Methodology

The research involves planting, irrigation, and collection of samples of soil for analysis.

3.2.1 Field Preparation

The field of about 17.374meter (length) by 12.192 meter (breadth) was prepared on 26th may, 2008, Nine ridges were made with hoes, the length of the ridges is 17.374 meter each and with inter row spacing of 30cm each.

The crops planted were maize intercropped with melon in an intercrop system. The maize was first planted on 26th may, 2008. And left it on the field for two weeks, after which the melon was then planted on 9th June, 2008. The buried of asbestos to a depth of 2m beyond the root zone depth of the crops to be planted, to ensure clear separation.

3 seeds of maize were planted on a single row at a depth of 3cm on the ridges. The intrarow spacing of the planted maize was 30cm.

Melon seeds were planted in between the germinated maize seeds on the same ridges. 3 melon seeds were planted on the ridge at a depth of 3cm.

3.2.2 Irrigation (Wastewater Application)

The two wastwaters for irrigation were diary and poultry wastewaters. Dairy water was collected on the 20th June, 2008 from Maizube farm, along Bida Minna road. The poultry water was collected on the same day but from Abu Turab poultry farm, located in Minna.

Both the dairy and poultry wastewaters were collected in a 25 liter Jerry can each and were later poured into open containers and left for 5 days. That was done to allow the waste biodegradation.

The Nine Ridges were Allocated as Itemized Below

	Applied waste water
Ridges	Control
Ridge one and two	Dairy Waste water
Ridge three and four	Poultry waste water
Ridge five and six	Combined
Ridge eight and Nine	

In between 2 and 3, 4 and 5 and 6 and 7 the asbestos was buried at a depth of 2m beyond the root zone of the crops to be planted, to ensure clear separation.

During application, the wastewater were poured in a watering-can and then distributed manually onto the various row as listed above.

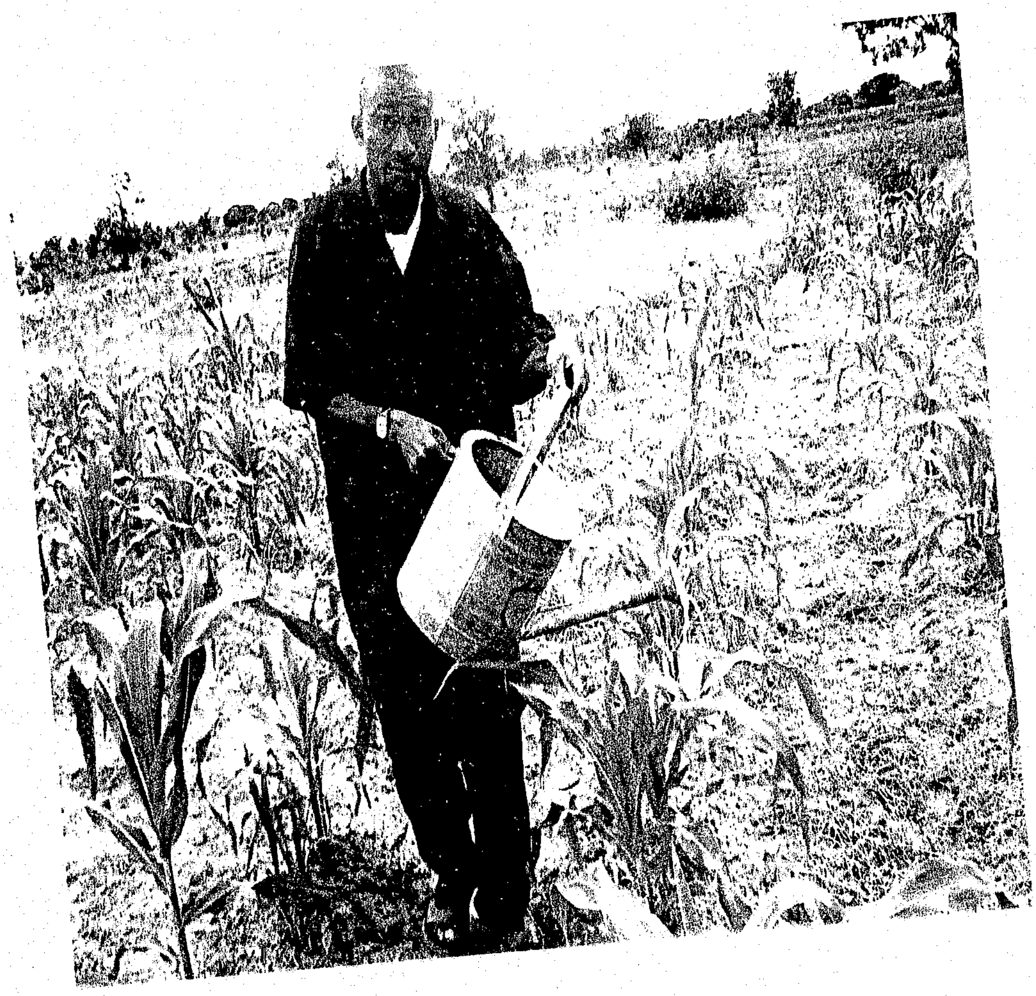

Plate 1: Application of wastewater on the farm plot

Applications were done at interval of fifteen days starting from 25th June, 2008.

3.2.3 Soil sampling. (Soil sample collection)

In order to carryout the salinity effect of the applied waste water, sample of the soil from the field were collected and tested, three days after each application to ensure reaction . The collection of samples was done seven days after every wastewater application. Although, the first soil sample were collected and analyzed before planting and that took place on the 9th may, 2008 while the first soil sample to be collected after application was done on 2nd July, 2008.

3.3 Determination of Bulk Density by Clod Method

3.3.1 Procedure

The clod soil samples were taken at five different places from the field of study and were transferred to the cans labeled A, B, C, D, E, from where they were taken to the soil science laboratory in school of agricultural and agricultural technology Minna, for bulk density determination on the same day.

The clods of soil were excavate and air dried for 24hours after which each of the clod samples was tied to a thin thread around it and weighed (Ws) from where the weight of clod soil was obtained, the clod samples was dip briefly in melted paraffin was at 600C in order to water proof the clod, the coated clod was weighed and the weight of paraffin coating was calculated.

The clod was suspended from the balance arm and was submerged completely in beaker of water from which the weight was recorded.

3.3.2 Bulk density Formula

Sb/ = Mc/Vc__________________________ (3.1)

Where

M_c = mass of clod soil = weight of clod/g

V_c = volume of clod = volume waxed clod/cm

Volume waxed/cm3 = $\frac{W_{cp} - W_{cpw}}{Dw}$

Where W_{cp} = weight of clod + paraffin

W_{cpw} = weight of clod + paraffin + weight of water

D_w = density of water at temperature of determination (1.0)

Also

Volume waxed /cm^3 = Wp/Dp

Where Wp = weight of paraffin

Dp = density of paraffin

(Approximately 0.9)

3.4 Determination of Textural Classification or Particle Size Analysis by Hydrometer Method.

3.4.1 Apparatus Used

1. Multimix machine with baffled "milkshake"
2. Glass cylinders of approximately melitre capacity for containing soil suspension during settling.
3. Special hydrometers for measuring density of soil suspension.
4. Thermometers for measuring temperature of the suspension.
5. A 2 mm sieve.
6. Reagent used: sodium hexametaphosphate dispersing agent of 5%.

3.4.2 Procedure

Weight 51.0g of air-dry soil which has been passed through a 2-mm sieve and transfer to a milkshake mixcup (A 51.0g air dry sample represent approximately 50.0g of oven –dry soil). If the soil is estimated to contain 75% or more sand, 101.0g of soil are used. Add 50cc. of 5.0% sodium hexametaphosphate along with 100cc of distilled water. Mix with a stirring rod and let sample set for 30 minutes.

Stir the soil suspension for 15 minutes with the multimix machine. Transfer the suspension from the cup to the glass cylinder with the hydrometer in the suspension; add distilled water to the lower blue line. The volume will then be 1130cc. use upper line (1250cc) when 100 grams are used remove hydrometer.

Cover top of cylinder with the hand and inverted several times until al soil is in suspension. Place cylinder on flat surface and note time. Immediately place soil hydrometer into suspending. Slide slowly into suspension until hydrometer is floating. The first reading on the hydrometer is taken at 40 seconds after cylinder is set down. Remove hydrometer and record temperature of suspension with a thermometer.

After the first hydrometer reading let the suspension stand for 3hours and take second reading. Also take the temperature of the suspension. The first reading measures the percentage of silt and clay suspension. The second reading indicates the percentage of 2 micron (total) clay in the suspension.

Results are corrected to a temperature of 68^0 Fahrenheit. For every degree over 680F add 0.2 to hydrometer reading before computation and for under 68^0F subtract 0.2 from hydrometer reading (see sample calculation). Avoid extremes such as 50^0 or 100^0. Also subtracts 2.0 from every hydrometer reading to compensate for added dispersing agent.

A check on (or a substitute for) the 40 seconds reading can be made by sieving the entire suspension through a 300-mesh sieve to remove sand. Dry the sand in an oven at 100^0C. Silt to remove any remaining silt and weight. Multiply weight by 2 and this is the percentage or and in the soil.

3.4.3 Samples Formula and Calculation

Given

(1a) hydrometer reading at 40 seconds Hp = 18

(1b) temperature at 40 seconds T1 = 750F

(2a) hydrometer reading at 3 hours H2=8

(2b) temperature at 3hours T2 = 630F

(3) Temperature correction to be added

To hydrometer reading = 0.2 (T-68)

Where T = degree Fahrenheit.

However, the textural classification of the soil in the filed of study in obtained by using the formula below.

$C = R - R_L + 0.36T$

Where

C = Corrected Hydrometer Reading

R = Soil Hydrometer Reading

R_L = Blank Hydrometer Reading

T = Room Temperature $20^{o}c$

Sample A, at Location 1

Hydrometer reading at 40 seconds is given by

$C_{40sec.} = R - R_L + 0.36T$

$= 8 - (-1) + 0.36T\,(32)$

$= 8+1+11.52$

$C_{40sec} = 20.52$g/l.

Percentage silt + clay = $\frac{C_{40sec.} \times 100}{W}$,

Where

W= weight of sample = 50g

$\frac{20.52 \times 100}{50}$

$= 20.52 \times 2$

% silt + clay = 41.04 %

Percentage sand = 100 – (% silt + clay)

= 100 – 41.04

= 58.96%

Corrected hydrometer reading at 2 hours

$C_{2hr\,s} = R - R_L + 0.36T$

$= 0 - (-1) + 0.36\,(32)$

$= 1 + 11.52$

$= 12.52 g/l$

Percentage clay = $\frac{C_{2hr\,s} \times 100}{W}$

$= 12.52 \times 2$

% clay $= 25.04\%$

% silt =% (silt +clay) -% clay

$= 41.04 - 25.04$

Silt $= 16.00\%$

Sample B, at Location 2

Corrected Hydrometer reading at 40 seconds is given by

$C_{40sec} = R - R_L + 0.36T$

$= 8 - (-1) + 0.36\,(32)$

$= 8 + 1 + 11.52$

$C_{40sec} = 20.52 g/l$

$$\% \text{ silt} + \text{clay} = \frac{C_{40sec} \times 100}{W}$$

$$= \frac{20.52 \times 100}{2}$$

$$= 20.52 \times 2$$

$$= 41.04\%$$

Percentage sand = 100 - % (silt + clay)

$$= 100 - 41.04$$

$$= 58.96\%$$

Corrected Hydrometer reading at 2 hours

$$C_{2hrs} = R - R_L + 0.36T$$

$$= 0-(-1) + 0.36\,(32)$$

$$= 1+11.52$$

$$= 12.52 g/l$$

$$\text{Percentage clay} = \frac{C_{2hrs} \times 100}{W}$$

$$= \frac{12.52 \times 100}{50}$$

$$= 12.52 \times 2$$

% clay =25.04%

Percentage silt = % (silt + clay) - % clay

= 41.04 – 25.04

% silt = 16.00%

Sample C at Location 3

Corrected Hydrometer reading at 40 seconds is given by

$C_{40sec} = R - R_l + 0.36T$

= 10-(-1) 0.36 (32)

= 10+1+11.52

= 11+11.52

C_{40sec} = 22.52g/l

$$\% \text{ silt + clay} = C_{40sec.} \times \frac{100}{50}$$

= 22.52x2

% silt + clay = 45.04%

Percentage sand = 100-% (silt clay)

= 100-45.04

% sand = 54.96%

CHAPTER FOUR

4.0 Results and Discussion.

4.1 Presentation of Results

The result obtained from the laboratory analysis of the soil samples collected before and after four scheduled irrigation system are shown in Table 4.1, 4.2, 4.3, 4.4 and 4.5.

The soil samples also collected for laboratory analysis of bulk density and textural classification are also shown in Table 4.6, 4.7a, and 4.7b respectively below.

Table 4.1 Raw Soil Sample Before any Irrigation Take Place.

S/NO.	PARAMETERS	1	2	3	4	5
1.	**Clay %**	16	16	16.9	17.1	16.8
2.	**Sand %**	45	45	45.9	46.2	45.8
3.	**Silt %**	29	29	29.9	30.2	29.7
4.	**Soil Redox Potential (Eh/Mv)**	112	112	117	119	113
5.	**Soil Organic matter (g/kg)**	129.7	129.7	129.8	162.2	128
6.	**Porosity (m^3/m^3)**	0.57	0.57	0.61	0.68	0.57
7.	**Electoral conductivity ($\Omega^{-1}m^{-1}$)**	2.25	2.25	2.10	2.85	2.26
8.	**SO_4^{2-} (mg/g)**	35	35	31	39	35

Corrected hydrometer reading at 2 hours.

$C_{2hrs} = R - R_L + 0.36T$

$= -1 - (-1) + 0.36\,(32)$

$= 0 + 11.52$

$C_{2hrs} = 11.52 g/l$

$\% \text{ clay} = 11.52 \times \frac{100}{50}$

$= 11.52 \times 2$

$= 23.04\%$

$\% \text{ silt} = \% (\text{silt} + \text{clay}) - \% \text{ clay}$

$= 45.04 - 23.04$

$\% \text{ silt} = 22.00\%$

9.	**PO_4^{3-} (mg/g)**	33	33	32	38	33
10.	**Alkalinity mgcaco₃/g**	103	103	100	109	102
11.	**pH**	8.2	8.2	8.4	8.9	8.3
12.	**Nitrate (mg/g)**	14	14	11.2	17.6	14.4
13.	**SAR**	0.234	0.234	0.197	0.310	0.241
14.	**ESC (mg/g)**	-0.946	-0.946	-0.823	-0.641	-0.924

Table 4.2 After First Irrigation.

/NO.	PARAMETERS	D1	D2	P1	P2	M1	M2	C1	C2
	Soil Redox Potential (Eh/Mv)	230	226	251	249	251	257	113	119
	Soil Organic matter (g/kg)	253	241	301	296	295	319	130	169
	Porosity (m^3/m^3)	0.61	0.65	1.00	1.10	1.21	1.14	0.58	0.61
	Electoral conductivity ($\Omega^{-1}m^{-1}$)	3.51	3.42	3.96	3.72	3.48	3.86	2.65	2.89
	SO_4^{2-} (mg/g)	59	46	87	83	79	65	38	45
	PO_4^{3-} (mg/g)	65	61	89	91	78	94	38	65
	Alkalinity mgcaco₃/g	338	329	365	351	361	385	114	112
	pH	8.3	8.2	8.3	8.3	8.3	8.3	8.2	8.2

.	Nitrate (mg/g)	41	36	46	48	47	52	15	13
0.	SAR	0.346	0.322	0.3800	0.400	0.461	0.429	0.239	0.21
1.	ESC (mg/g)	-0.842	-0.856	-0.881	-0.874	-0.889	-0.895	-0.921	-0.82

D1 and D2 = Dairy wastewater on first and second ridges experiment

P1 and P2 = Poultry wastewater on first and second ridges experiment

M1 and M2 = Mixture of Dairy and poultry wastewater on first and second ridges experiment

C1 and C2 = Control ridges of experiment

Table 4.3 After Second Irrigation.

S/NO.	PARAMETERS	D1	D2	P1	P2	M1	M2	C1	C2
1.	Soil Redox Potential (Eh/Mv)	351	347	384	361	365	369	116	121
2.	Soil Organic matter (g/kg)	391	384	450	429	438	441	136	181.5
3.	Porosity (m^3/m^3)	0.71	0.78	1.06	1.18	1.16	1.19	0.60	0.70
4.	Electoral conductivity ($\Omega^{-1}m^{-1}$)	6.31	6.28	6.88	6.71	6.68	6.95	3.05	3.88
5.	SO_4^{2-} (mg/g)	121	109	141	140	130	137	42	50
6.	PO_4^{3-} (mg/g)	94	89	119	101	104	112	41	78
7.	Alkalinity mgcaco₃/g	612	603	629	611	614	637	165	151
8.	pH	8.4	8.3	8.5	8.4	8.4	8.3	8.3	8.4

.	Nitrate (mg/g)	81	75	86	89	87	91	18	19
0.	SAR	0.501	0.482	0.531	0.561	0.61	0.69	0.251	0.258
1.	ESC (mg/g)	-0.652	-0.661	-0.641	-0.629	-0.514	-0.518	-0.874	-0.865

Table 4.4 After Third Irrigation.

S/NO.	PARAMETERS	D1	D2	P1	P2	M1	M2	C1	C2
1.	Soil Redox Potential (Eh/Mv)	470	468	502	492	491	496	119	122
2.	Soil Organic matter (g/kg)	527	525	581	572	561	592	136.5	169.5
3.	Porosity (m^3/m^3)	0.78	0.84	1.15	1.38	1.39	1.32	0.62	0.71
4.	Electoral conductivity ($\Omega^{-1}m^{-1}$)	8.76	8.40	9.90	9.84	9.78	9.96	3.80	5.10
5.	SO_4^{2-} (mg/g)	168	164	195	183	178	192	48	59
6.	PO_4^{3-} (mg/g)	121	113	197	184	192	211	65	101
7.	Alkalinity mgcaco$_3$/g	871	865	879	872	877	881	198	184
8.	pH	8.6	8.5	8.6	8.5	8.5	8.4	8.4	8.4
9.	Nitrate (mg/g)	119	114	123	128	127	132	23	26
10.	SAR	0.625	0.618	0.72	0.761	0.791	0.81	0.27	0.29
11.	ESC (mg/g)	-0.416	-0.425	-0.410	-0.413	-0.385	-0.372	-0.791	-0.875

Table 4.5 After Forth Irrigation.

NO.	PARAMETERS	D1	D2	P1	P2	M1	M2	C1	C2
	Soil Redox Potential (Eh/Mv)	590	584	625	608	607	611	120	128
	Soil Organic matter (g/kg)	677	670	733	716	718`	725	140	185.5
	Porosity (m^3/m^3)	0.85	0.93	1.23	1.54	1.51	1.49	0.68	0.74
	Electoral conductivity ($\Omega^{-1}m^{-1}$)	11.4	11.1	12.2	12.7	12.1	11.6	4.7	5.8
	SO_4^{2-} (mg/g)	203	198	334	321	314	336	67	74
	PO_4^{3-} (mg/g)	157	142	221	211	209	221	89	112
	Alkalinity mgcaco$_3$/g	1122	1118	1123	1119	1120	1126	212	194
	pH	8.7	8.5	8.7	8.6	8.6	8.5	8.4	8.5
	Nitrate (mg/g)	145	143	148	153	151	154	27	34
0.	SAR	0.786	0.769	0.865	0.892	0.91	0.94	0.28	0.31
1.	ESC (mg/g)	-0.232	-0.248	-0.234	-0.251	-0.216	-0.219	-0.726	-0.79

Table 4.6 Bulk Density (Clod Method) Result of the Soil Samples.

Sample Description	Weight of clod/g	Weight of waxed clod/g	Volume of waxed clod/ cm^3	Volume of wax/cm^3	Bulk density g/cm^3
A	10.38	11.87	10.00	1.66	1.245
B	11.74	13.98	11.00	2.49	1.380
C	11.81	13.14	10.00	1.48	1.386
D	9.58	11.18	9.50	1.78	1.241
E	14.38	16.79	11.00	2.61	1.714

The calculation used to generate the above table is in the appendix.

Table 4.7a Particle Size Result of the Soil Samples.

Sample Description	40 seconds Hydrometer reading	Temperature at 40 seconds (O^oc)	2 Hours Hydrometer reading	Temperature at 2 hours (O^oc)
Blank	-1	32	-1	32
A	8	32	0	32
B	8	32	0	32
C	10	32	-1	32

Table 4.7b Textural Classes of the Soil.

Sample Description	% sand	% silt	% clay	Textural classes
A	58.96	16.00	25.04	Sandy clay loam
B	58.96	16.00	25.04	Sandy clay loam
C	54.96	22.00	23.04	Sandy clay laom

However, the textural classes for the sample are sandy clay loam. Therefore from above table, textural classes results obtained, the production of maize/ melon using dairy and poultry wastewaters is reliable for effective and maximum yield to the maize/ melon.

4.2 Discussion of Results.

Electrical conductivity, Alkalinity, sodium absorption ration and pH value are some of the parameter of the soil discussed in this study. These parameters are laboratory analysed to compare the obtained value with the standard value including the corresponding effect on plant growth.

4.2.1 Electrical Conductivity (E.C)

At initial stage, the Electrical Conductivity of the soil at which the waste with respond to the plant was experimented result in 2.34 $\Omega^{-1}m^{-1}$. The electrical conductivity of the soil increased with number of irrigation. Carried out on the soil as well as the type of waste (dairy or poultry) used for the irrigation. Taking the parameters in turn and under different irrigation materials, the following analysis were observed.

When the soil was irrigated with dairy wastewater, there was an average value of 11.25 $\Omega^{-1}m^{-1}$ after the fourth irrigation. There was an increase from increase from initial values at each stage of the irrigation process. At this level of electrical conductivity, only tolerance plant grows satisfactorily but maize and melon do not belong to tolerant plant.

With reference to Table: 2.1 which shows that only tolerant plant can grow satisfactorily between 8-16 $\Omega^{-1}m^{-1}$ (Waskom, R.M et,al 2006) it could be possible that the dairy constituents such as animal feaces, urine and other organic materials contained in the wastewater are the reason(s) why this plant grow successfully (satisfaction) under the soil condition of 11.25 $\Omega^{-1}m^{-1}$, but on the other hand, melon could not survive in this condition due to the inability adapt with the environmental factors such as sun intensity, temperature, humidity and other factors that affect the rapid growth of the melon.

The value of electrical conductivity for poultry wastewater irrigation also increase with the number of irrigation carried out having on average maximum value of 12.45 $\Omega^{-1}m^{-1}$ after fourth irrigation. This value only support tolerant plant growth. (only tolerant plant can thrive under 8-16 $\Omega^{-1}m^{-1}$ condition which is inline with the previous work of Waskom 2006).

The soil electrical conductivity for mixture of (dairy and poultry) irrigation also increase in this stage and have an average maximum value 11.85 $\Omega^{-1}m^{-1}$ after the fourth irrigation.

In all type of irrigation material used, the electrical conductivity increased and has adverse effect on the plant grown on such soil as they are semi-tolerant plant.

4.2.2 Alkalinity

The alkalinity in wastewater results form the presence of the hydroxides, carbonate, and bicarbonates of elements such a calcium, magnesium, sodium, potassium, or ammonia of these, calcium and magnesium bicarbonates are most common. Barite, silicates, phosphates and similar compounds can also contribution to the alkalinity. The effect of diary, poultry wastewater and mixture of both on the soil salinity presented below. The average alkalinity of the soil sample used for the exponent before any irrigation took placed was 103.4

Dairy irrigation to determine alkalinity change on the soil sample application of dairy wastewater irrigate to the crop grown, there was a rapid increase in the alkalinity of the soil and eventually got an average value of 1120 after the fourth irrigation. The value of the alkalinity after fourth irritation was so high which could be because of the presence of metallic hydroxide carbonates and bicarbonate in the diary.

Poultry wastewater irrigation to determine alkaline change on the soil, the soil as well had subsequent increased in the alkalinity value from initial value stated above to final average value of 1121 after the fourth irrigation.

Mixture of the diary and poultry wastewater to determine alkalinity change on the soil the value of the alkalinity of the soil increased for every irrigation and recorded a final average value of 1123.

All the materials used in irrigating the soil gave a very high and close values. The result shows how effective the irrigation material are in term acidic neutralization.

4.2.3 Sodium Absorption Ratio (SAR):

Sodium absorption ratio of a soil before any irrigation took place on the soil; the average sodium absorption ratio value of the soil was 0.2432. With irrigation of the soil with different material, different value were obtained after each irrigation and the final average value for each were as presented below.

Dairy wastewater irrigation effect on the sodium absorption ratio of soil, the irrigation of the soil with diary brought about increased value after every irrigation. After the fourth irrigation, the soil had an average value of 0.7775 for the sodium absorption ration.

Poultry wastewater as an irrigation material to effect sodium absorption ratio of the soil, the soil sodium absorption ratio increased from initial value of 0.2432 to a final average value of 0. 8785, after fourth irrigation with poultry wastewater.

Sodium absorption ratio values change under the irrigation with mixture of diary and poultry wastewater, the sodium absorption ratio of the soil had the highest value after the fourth irrigation when compared to other irrigation material. The final average value afer fourth irrigation was 0.925.

Sodium absorption ratio (SAR), along with pH, characterizes salt affected soils. The SAR of a soil extract takes into consideration that the adverse effect of sodium is moderated by the presence of calcium and magnesium ions. When the SAR raises above 12 to 15, serious physical soil problem arise and plants have difficultly absorbing water (Munshower, 1994)

Therefore, since the values obtained form irrigating materials of dairy, poultry and the mixture of both dairy and poultry wastewater were not up to 12-15 that means the Sodium Absorption Ration of soil is okay.

Plate 2: Salinity effect on the crop

Plate 3: The Row suspected to have been affected by salinity

4.2.4 pH Value:

The average initial value of pH value of the soil studied in this work before any irrigation was observed to be 8.4, while irrigation of the soil, the value increased but with very little margin under various irrigating material.

Dairy wastewater irrigation effect on pH value of the soil, the soil recorded a final average value of 8.6 after the fourth irrigation with diary. When compared to the initial value of 8.4, the margin is small and had little effect on the pH value of the soil. The soil not been too alkaline but preferably neutral.

Poultry wastewater irrigation on the pH value of the soil, the average value recorded after the fourth irrigation with poultry wastewater was 8.65. The value as well shows the neutrality of the soil been not as well shows the neutrality of the soil been not far form 7, pH value of water.

Mixture of diary and poultry wastewater as irrigation material, with final value of 8.55 after the fourth irrigation and when compared to the initial value of 8.4 shows that, the irrigating material has no much effect on the pH value of the study area.

CHAPTER FIVE

5.0 Conclusion and Recommendation.

5.1 Conclusion

The project study provides us opportunity to understanding the fundamental concept of wastewater application in the maize/melon production and also the concept of irrigation.

Experiment was carried out at Gbegannu village has been achieved within 102 days (i.e from May to September, 2008.) the application of various aspect including dairy and poultry wastewater application, collection of soil sample for salinity analysis and the yield of planted have been monitored.

It can be concluded from the discussion of result that using dairy wastewater irrespective of causing increase in electrical conductivity of the soil, the plant was it provide better yield. Therefore, concluded that using dairy wastewater to irrigate the soil it was more advantage than using poultry or mixture of both dairy and poultry wastewater to irrigate the plants.

5.2 Recommendation.

Since the stated aims and objectives has been achieved in this project work by comparing the growth yield of the maize/melon produced using control experiment, dairy and poultry wastewater for the experimental results obtained for analysis of soil samples shown in table 4.1 to 4.5.

It is therefore recommended that dairy wastewater should be adequately used in production of maize/melon due to effective out put.

REFERENCES

Akobundu, E.Y. 1987: Production of Margarine like Product from Egusi seed. *J Food Agric* **2**(5) PP 131-132.

Anderson, JJ, Barrett, G.W., Clank, C.S, Elio, V.J and Majeti, V.A (1982) Metal concentration in tissues of meadow voles from sewage treated fields, *Journal of Environment quality* , M 273-7

Ayers, R.S and westcot, D.W. 1985: Water quality for Agricultural irrigation and Drainage paper No. 29, Rev. I FAO, Rome Italy. PP 110-120

Benz, B.F., John, E.S and Robert, H.E. 1999: Histories of Maize Grain Arsenic for regions of Bangladesh irrigation paddies with Elevated Arsenic in Groundwater, *Environ. Sci. Technool* 40 (16): 4903-4908. DOJ: 10.1021/es06022i (http://dx.doi.org/10.1021/es06022i)

Brinkman, S.R and Rhoadas, J.D. 1990: Irrigation with saline groundwater and Drainage water Israel pp 20-40

Feddes, R.A. and wijk, A.J.M (1976). An integrated model approach to the effect of toaster management on crop yields, Agricultural water management, 1,3-30

Hobson, P.N and Robertson A.M (1987). Waste treatment in Agriculture applied science publishers, London.

Waskom, R.M., Davis, J.G., Bauder, T.A, and Cordon, G.E (2006). New scientist, Interview: Drinking at the west's Toxic well (http://www.newsscientist.com/article/mg1g025450. 600.html)

Willy, C.R and Tanner, C.B (1963). Membrane cover electrode for measurement of oxygen concentration in soil, soil science society of America proceeding, 27, 511-15

Graltan, S.R and Rahoadas, J.D 1990: irrigation with saline groundwater and Drainage water Israel 20-40.

Hammer, M.J 1997: Water and wastewater Technology John Wiley and sons NewYork. PP 16-35

Jankotuby, A., Rich, K. and Boyd, K. 1997: Salinity and plant Tolerance *Journal of Health Population and Nutrition* **24**(2): 142-163

John, L.H., James, D.B., Samuel, L.T and Werner, L.N 2006: Soil fertility and fertilizers introduction to nutrient management. Seventh Edition pp 85-89

Mullins, G.L Professor, crop and soil environmental science and **Bendfeldt E.S.** Associate extension agent agriculture and natural resources: publication number 424-034 posted January 2002

Michael, A.M, and Ojha, T..P. 2006: Principle of Agriculture Engineering. Volume II. Surveying, Irrigation, Drainage soil and water conservation PP. 478-479.

Olaleye O.A (2007). The effect of short-time storage in physico-chemical properties of diary waste water in department of Agricultural Engineering.

Ranbir, C. 1998: Soil salinity and water quality, "A Reviews of Arsenic (III) in Groundwater". Critical reviews in *Environmental control* **21** (1): 1-39

Raymond, W.M., and Donabue, R.L 1998: An introduction to soils and plant growth six edition, 99. 34-37.

Tangi, K.K. 1990: Agricultural salinity Assessment and management. ASCE, New york. Pp. 40-48.

Tyagi, N.K. 1996: Salinity Management in irrigated Agriculture, M.S Thesis, Areizona state university, Tempe. Pp. 20-22

APPENDIX

Determination of bulk density in the table 4.6

Sample A

S_b = Ms/vs

Where

Sb = bulk density at sample A

Ms = Weight of clod/g = 10.38g

Vs = Volume of clod sample, Cm^3

i.e Vs = Volume of waxed – volume of wax/cm^3

Vs = 10.00 – 1.66 = 8.34cm^3

$$Sb = \frac{10.38}{8.34}$$

Sb = 1.245g/cm3

Sample B

S_b = Ms/vs

Ms = weight of clod/g = 11.74g

Vs = 11.00 -2.49 = 8.51cm^3

$$S_b = \frac{11.74}{8.51}$$

Sb = 1.380g/cm3

Sample C

S_b = Ms/vs

Ms = weight of clod/g = 11.81g

Vs = 10.00 -1.48 = 8..52cm^3

$$S_b = \frac{11.81}{8.52}$$

Sb = 1.386g/cm3