EVALUATION OF POULTRY AND CATTLE MANURES AS SOIL AMENDMENT IN THE PRODUCTION OF COWPEA AND SORGHUM

BY

RAJI SHERIFF YUSUF

2003/14877EA

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA NIGER STATE

NOVEMBER, 2008

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG.) AGRICULTURAL AND BIORESOURCES ENGINEERING FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER, 2008

CERTIFICATION

This project entitled "Evaluation of Poultry and Cattle Manure as a Soil Amendment in the Production of Cowpea and Sorghum in Minna Niger State" by Raji Sheriff 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 and human development.

---------------------------- 13/10/08
Mr. Peter Adeoye
Project Supervisor

---------------------------- Date

Dr. (Mrs) Z.D. Osunde
Head, Department of Agricultural Bioresources Engineering

---------------------------- Date

---------------------------- 19-11-08
External Examiner

---------------------------- Date

DECLARATION

I herby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any university of institution. Information derived from personal communication. Published and unpublished works of others were duly referenced in the text.

--------------------------------------   13-9-2009

Raji Sheriff Yusuf   Date

2003/14877EA

DEDICATION

I solemnly dedicate this project to God Almighty, the giver of life. And to my parents Alhaji Raji Yusuf and Alhaja Safurat Yusuf and Arch. Bashir Yusuf

ACKNOWLEDGEMENT

My acknowledgement goes first to the almighty God for giving me sufficient grace, strength, knowledge and understanding throughout my stay in school even at unbearable conditions

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ABSTRACT

This project work attempt to ascertain the effect of cattle and poultry manures on cowpea [*Vigna Unguiculata*] and sorghum [*sorghum bicolor* [L] Moench growth, application of manures at the same rate are made on individual portion excluding control portion. 10kg of poultry manure alone (PA) and cattle manure alone (CA) and also combination of both poultry and cattle manures (PAC) i.e. 5kg of poultry and 5kg of cattle were applied at 2 weeks interval for four successive period with evaluation based on growth parameters of height, stem diameter, leaf area and effects on soil nutrients such as N.P.K and Ca were also observed. Application of manures resulted in increase in growth parameters after successive application, the study showed that the potential values of organic manure varied according to sources and rate of application with better growth performance coming from cattle manure for sorghum production at the rate of 10kg per portion. Soil nutrient such as N, P, K, Ca and pH and also sodium absorption rate [SAR] were enhanced by the application of the manures due to the higher nutrients contents of the organic waste – amended soils.

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CHAPTER ONE

1.0 INTRODUCTION

Animal manures and compost (organic fertilizer) i.e. poultry and cattle manure inclusive have been used since the earliest civilizations for improving soil property. In years gone by, these fertilizers were the only, sources of nutrient for crops cowpea and vegetable production. However, vines organic fertilizers contain relatively low concentrations of nutrients and handing them is labour intensive, they have been largely replaced by inorganic fertilizers as nutrient source on many farms.

Their beneficial effort on soil physical properties is a major advantage they have over inorganic fertilizers. Certainly manure from cattle and poultry production should be used in gardens and lands because of the high content of nutrient responsible for high yield in farm production.

Generally, poultry manures are high in nutrient and cattle manure is relatively low in nutrients. The composition of manure depends very much on the quality of the feed the feed the animal eats. The richer the feed is in nitrogen, the richer the manure is in nitrogen (N). Similarly, the more phosphorus (P) and potassium (K) there is in the feed, the more there is in the manure.

Therefore manure should not be stored for a long time and it must be worked in the soil as soon as possible after spreading on the land. The effect of manure on soils is manifold, it can increase the nutrient availability; alter chemical properties of the solid such as salinity, sodicity, pH, and organic matter as well as physical property of the soil such as bulk density, aggregate stability, aggregation, crust strength and water infiltration. Manure application also needs to be done using the appropriate method because the manure results in qualitative and qualities differences in the transformation of nutrients in the soil therefore the efficiency of poultry and cattle manure in its soil amendment also affects the physical properties an microbial activities of the soil. Time has therefore come when one must worry about the impact of organic manure (poultry and cattle) on the soil and crop production and also its effect on the environment, one's health, plants and the costs that could be saved not all owing the manure to go to waste.

Maintenance of good soil health and optimal growth is depended upon proper soil nutrient management. Therefore, the major objective of a nutritional management is to fertilize soils in such a manner to have a sufficient quantity of nutrients in the soil available to plant so that no one become yield limiting. The use of soil test is suggested as a means of determining nutrient availability status in soil. The result from this test will provide a producer with guidelines on how much fertilizer material will be needed for successful crop growth and yield. It should be noted that soil test are site specific and any given soil sample should not be use to base fertilizer needs for soil in additional fields or farms not tested.

Cowpea, *Vigna unguiculata,* is a legume grown in savannah region, the tropic and sub – tropics. It is largely grown in west and central African Countries. It value lies with high protein content, it ability to tolerate drought, and the fact that it values lies with high protein content, it ability to tolerate drought, and the fat that it fixes atmospheric, allowed it to grow on an improve poor soil. The ability of cow pea plant to tolerate drought and poor soil makes it an important crop in the savannah region where these constraints restrict other crops.

Sorghum, *sorghum bicolor* (L) Moench, is a genus of numerous species of grasses, some of which are raised for grain and many of which are use of fodder plant either cultivated or as part of pasture. The plant are cultivated in warmer climate would wide. Species are native to tropical and sub tropical regions of all continents in addition to Oceania and Australia. Numerous 'sorghum' species are use for food (as grain and sorghum or 'sorghum molasses') fodder, and the production of alcoholic beverages. Most species are drought tolerance and heat tolerant and are especially in arid regions.

Application of excess nitrogen in the interest of ensuring nutritional sufficiency through out a growing season. In recent years, several researches have attempt to characterized animal manure and study nutrient losses from the manure at different stages, from collection to land application for crop production.

Considerations such as appropriate rate, timing, and method of application and expected crop response are important when using manure as a source of plant nutrient. Under or over application should be avoided. Crop may suffer from deficiency and injury as a result of under application and over application respectively, both leading to reduced yield. Not all nutrients in manure are readily available for uptake by plant roots. Much of N and P in manure is combined with organic substances and become available to plants when these substances decay. In contrast, all of the K in manure is readily available for plant uptake. In chicken manure, about 90% of the total N and P is available for plant uptake in the year of application. However, in cattle manure, only about 20% of the total N and 40% of the total P becomes available in the year of application (this figures are the cattle manure with composition similar to that listed in table one; they availabilities of N and P increases with increase in quality of the manure).

Cowpea and sorghum are among the crops grown in arid region of the country (Nigeria) due to the fact that they are drought resistance and can survive poor soil nutrient availability. Therefore the cultivation of cowpea and sorghum yield a good result since the climate, soil and the environmental conditions support the plantations

1.1 Objective of the Study

The objectives of this study are:

i. To evaluate the effect of poultry and cattle manure on cowpea and sorghum production and

ii. To analyze the salinity effect of the two organic manures on the soil cultivated with cowpea and sorghum

1.2 Statement of the Problem

The various implications and problems associated with the use of cattle and poultry manure in crop production is to show the impact of poultry and cattle manure as organic fertilizer to the populace and farmers and reduce the amount of waste and also to reduce the health implication of the organic fertilizers (poultry and cattle) which now give rise to balancing the effect of the organic fertilizers in it soil amendment state and also soil hydraulic conductivity.

1.3 Justification of Study

The advancements being made in science and technology and indeed Agricultural Engineering today are contributing immensely to continued global and industrial growth and development. Therefore it is of importance to show the importance and the economic implication and it health implications in the use of poultry and cattle manure.

Therefore this project is being embarked upon to look closely and analyse the impact of organic manure (poultry and cattle) as wastes and its effect on the production of cowpea and sorghum.

1.4 Scope of the Study

This project is to be base on the impact of cattle and poultry manure on a small piece of land in Niger State. Taking into consideration it effect as a soil amendment which can now be transfer to bigger field after the evaluation as been done on a small piece of land.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Poultry Manure as a Fertilizer

Animal manures have been used effectively as fertilizers for centuries. Poultry manure has long been recognized as perhaps the most desirable of these nature fertilizers because of its high nitrogen content. In addition, manures supply other essential plant nutrients and serve as a soil amendment by adding organic matter. Organic matter persistence will vary with temperature, drainage, rainfall, and other environmental factors. Organic matter in soil improves moisture and nutrient retention. The utilization of manure is an integral part of sustainable agriculture.

The most common procedure for determining the amount of manure to add per acre is to consider the manure's nitrogen content and the nitrogen needs of the crop. Some typical compositions for poultry manure are listed in table 2.1 Nitrogen recommendations for selected crops and a range of manure application rates for these crops are presented in table 2.2

In areas where phosphorus movement off-site can lead to eutrophication of surface waters, phosphorus rather than nitrogen may be the factor determining application rate of manure.

Table 2.1: Average Nutrient Composition of Chicken Manures

Manure type	Total N	Ammonium (NH_4-^{N})	Phosphorus (as P_2O_5)	Potassium (as K_2O)
Broiler	lb/ton			
Fresh (no litter)	26	10	17	11
Broiler house litter[2]	72	11	78	46
Broiler house litter[2]	31	7	54	31
Stockpiled litter [2]	36	8	80	34
Fresh(no litter)	26	6	22	11
Undercage scraped[3]	28	14	31	20
Highrise storeed4	38	18	56	30
	lb/1,000 gallons			
Liquid slurry5	62	42	59	37
Anaerobic lagoon sludge	26	8	92	13
	lb/acre-inch			
Anaerobic lagoon liquid	180	155	45	265

Source: Zublena, and Barker

2.2 Poultry Manure Characteristics

The first step in good management of any product, whether for resource use of waste disposal, understands the nature of the material. The material itself often will dictate the allowable methods and rates of use or disposal. A practical approach to poultry manure handling one of the problems all producers face in handing manure is the highly variable physical and nutrient characteristics of the product. In the poultry industry, further variation is introduced by differences in species, housing systems, and birth age. Even within a specific operation, the characteristics of the manure will influenced greatly by the ration, the use of bedding, the manure handling system.

Table 2.2: Poultry Manure Characteristics

type of poultry and manure (volumes per 100 birds)	Moisture %	Volume u.ft/day	Volume cu.ft./yr	Total N %	Crop N lb/ton	P2O5lb/ton	K2Olb/ton
Layers (solid manure)	60	0.41	149	1.60	21.5	56.0	20
Layers (liquid manure)	90	0.35	128	0.96	12.9	33.6	12
Broilers	35	0.36	106	1.85	21.4	30.0	20
Breeders	35	0.64	234	1.96	22.6	60.0	20
Turkey (hens)	35	1.46	450	1.85	21.4	30.0	20
Turkey (toms)	35	1.67	514	1.85	21.4	30.0	20
Turkey (broilers)	35	1.03	303	1.85	21.4	30.0	20

Source: Zublena, and Barker

2.3 Poultry Manure Handling Systems

The four main components of a manure handling systems are collection, storage, treatment and use/disposal.

2.3.1 Collection

In floor housing systems, the manure mixes with the bedding to form litter. There is no separation of the manure from the birds, but producers rely on the absorptive capacity of the bedding to maintain a good environment for the birds. In cage housing systems, manure falls into pits or on to conveyors. In pit systems, the manure remains in the barn until cleaning, while the conveyor systems allow more frequent removal of manure from the birth housing area.

2.3.2 Storage

All handling systems involve some storage of the manure between the time it is excreted by the bird and final application or disposal. A storage system allows producers to hold manure until a convenient and optimum time for use of the product. Many livestock and poultry producers use long-term manure storages to avoid winter spreading and make maximum use of the available nutrients.

In floor housing systems, the litter is removed at the end of each cycle and may be stockpiled until it is used. A similar system is used in deep pit houses, while manure from conveyor systems is stored in lagoons or concrete tanks. When manure is stored or stockpiled, consideration must be given to the potential for nuisance and environmental problems.

2.3.3 Treatment

The Alabama cooperative extension service defines treatment as any system used to reduce the pollution potential of the waste or to otherwise alter its original condition. Other than the normal biological decomposition processes (usually anaerobic) that occur during storage, very little treatment of poultry manure occurs in Alberta. Treatment of manure costs money and often does not produce a very valuable product. As long as we have the capacity to make good and safe use of our manure, there likely won't be strong interest in treatment systems. A more detailed discussion of treatment will follow in the manure handling alternatives section

2.3.4 Use/Disposal

At this time, the most practical use of manure is to spread it on agricultural land where the organic matter and nutrients can be beneficial to the soil and plants. When manure is applied at a rate greater than that which the soil and crops can use, we view this as manure disposal. In disposal situations, producers really are using their fields as landfill sites. Those nutrients that aren't used by the crops can be release into the atmosphere and local water supplies where they can cause significant environmental impacts. While disposal seems like an inexpensive handling system, it very likely is not sustainable.

2.4 Use of Poultry Manure

If the most practical use of manure is to apply it to agricultural land, the best way to manage this resource, then, it to ensue that the timing, rate and method of manure application provide optimum growing conditions for plants. This means that manure should be applied as close to the growing season as possible, given weather and storage constraints. On annual crop land, manure usually is applied in the fall, after harvest, or in the spring, before seeding. Spring application probably is best for protection on forage or pasture land can take place over the whole growing season, but should occur during periods when runoff potential is low and plant growth is strong.

The application equipment should be designed to distribute the materials as evenly as possible at a location in the soil where plants can use the nutrients. Solid manure is spread on the soil surface, while liquid manure can be spread, sprayed, or injected.

Incorporation of the manure into the soil is a recommended practice. This will reduce the losses of nitrogen to the air and air and eliminate the potential for nutrients to be carried away by runoff water. Since incorporation is not possible during winter months, on forage crops, or in no-till cropping regimes, extra care must be taken when manure is applied to these fields. In all cases, the potential odour nuisance of the manure should be considered in decisions regarding the timing and method of application.

For best resource management, the rate of manure application should be based on the principle of nutrient management. Nutrient management involves balancing the nutrients added to the soil by fertilizers and manure with the nutrients removed from the soil by crops. The nutrients supplied by crop residues, mineralization and existing soil fertility are included in this balance, as are the nutrients lost through leaching, volatilization and soil microbial activity. Using the nutrient management concept, producers can apply manure and fertilizers at rates that will contribute to optimum plant growth.

Excess addition of nutrients, a situation that commonly happens during manure disposal, can lead to significant environmental impacts. Nitrogen is the nutrient that has attracted the most attention among people monitoring the environment. Excess nitrogen can be lost to the air as ammonia, a pollutant, while the nitrate form is very mobile and can be leached into groundwater. For this reason, nitrogen usually is the limiting nutrient in determining manure applications rates.

Phosphorus is less mobile than nitrate nitrogen and tends to bind with soil particles after it is incorporated. However, phosphorus is a serious problem in surface water supplies and can be carried into these sources by erosion or runoff from unincorporated manure. In some areas, phosphorus has replaced nitrogen as the nutrient causing the greatest concern. Potassium levels can be high in soils where heavy manure application has occurred, but this nutrient generally does not cause environmental problems.

2.5 Manure Handing Alternatives

There are a number of reasons why producers are examining alternatives to the standard practice of spreading manure on agricultural land. Many poultry producers live on land bases that are not large enough for them to apply manure on the basis of nutrient management or even waste disposal. These producers must rely on the use of neighbours' land for manure application and rarely are compensated for the cost of this process. In some areas, the total production of livestock and poultry manure is greater than the area of land available for the use of this material. Other producers are interested in adding value to the manure or reducing the costs and environmental impacts of normal manure handling practices.

2.5.1 Marketing Manure

Although growing acceptance as a valuable soil amendment and increasing costs of other fertilizers should increase the commercial value of manure, producers certainly can speed this process through more aggressive marketing of their production. This involves both selling manure as a resource and finding customers who wish to purchase. Arrangements with neighbours where manure is applied to land from which feed is purchased would be one example. Using custom operators or better equipment to ensure that manure is applied properly would help sales. Groups of producers could work together on collecting and distributing manure. Marketing takes more time and effort than producers typically have devoted to manure handling, but it may become necessary and the possible benefits are substantial.

2.5.2 Composting

Composting of organic by-products and wastes is rapidly gaining favour all over North America. Indeed, the composting of poultry mortality is the subject of another presentation of this workshop. In the case of poultry litter, composting produces a more uniform and odourless materials that can be used as a soil conditioner and slow release nutrient source in a wide variety of applications. Composting reduces the weight, volume and moisture content of manure, a huge advantage for any producer paying to have manure hauled to neighbouring land. The process also tends to prevent the germination of weed seeds, a problem often associated with the used of manure.

Given these advantages, why aren't all poultry producers composting their manure? Composting costs money, even in simple windrow systems, and the product produced by this process often is not valuable enough to justify the extra expense unless standard manure handling practices have become too costly. There are good markets for compost in the horticulture and reclamation sectors, but the business is competitive and margins are small. Identifying and entering these markets can require tremendous effort. One application that has significant potential for producers living near urban or industrial areas is the mixing of poultry manure with municipal or industrial organic wastes to produce compost. The manure would be a nitrogen source that could be added to high carbon wastes to create favourable C: N ratios. In these co-operative ventures, the other partners would share the costs of composting and assist with marketing the product.

These partners often find disposal of organic wastes to be very expensive and would be happy to contribute financial support to alternatives.

2.5.3 Treatment

A number of other manure treatment and processing alternatives are available, but these are rarely economical or practical. Treatment of manure with chemicals and aeration tends to reduce the odour, but can be very expensive and generally adds no value. The production of biogas for the anaerobic decomposition of poultry manure is physically possible, but it is a complicated and expensive process that is far from economical at our current energy prices. There has been extensive use of poultry litter for cattle feed in the past, but food safety concerns could preclude the use of this alternative. Unless the costs and returns of these treatments and processes change radically, they are unlikely to become practical alternatives in the near future.

2.6 Solid Cattle Manure

The application of cattle manure to farmland is an economical and environmentally sustainable mechanism for increasing crop production. Nutrients in cattle manure can replace commercial fertilizers. However, the value of manure is more than the accumulated value of the individual nutrients. Cattle manure is an excellent soil amendment capable of increasing soil quality. Manure can increase crop yields by providing large inputs of nutrients and organic material. Therefore, the value of the manure can best be thought of as the overall crop yield and quality response over several years.

Cattle manure is a combination of feces and manure, bedding material, wasted feed, and water. In solid form as pen manure, it has a high organic matter content. The organic fraction of manure plays an important role in increasing soil organic matter and tilth, improving soil structure and water infiltration. Many of the nutrients in the manure, however, are tied up in the organic fraction and must go through a decomposition process to be converted to the inorganic forms available for plant uptake.

Getting the maximum value out of cattle manure requires applying the manure at proper rates and frequency. Over application can lead to transport of nutrients into the groundwater through leaching or overland flow. As well over application can lead to losses of ammonia and nitrous oxide into the atmosphere. Contamination of the soil can also occur in situ, as excessive loading of nutrients, sodium and other soluble salts can reduce soil quality and productivity.

Table 2.3: Nutrient Concentration in Cattle Manure

	Solid Beef Manure (Lb/tonne)	Commercial fertilizer (Lb/tonne)
Nitrogen (N)	7-36	1030
Phosphorus (P)	2-6	500
Potassium (K)	7-17	1160
Sulphur (S)	0.1-3	540

Source: Schoenau, 1997

2.6.1 Cattle Manure as Fertilizer

Cattle manure has most of the nutrients required for plant growth. The manure can replace or reduce the need for commercial nutrients in crop production. However, the nutrient composition of manure varies considerably. The composition of manure differs for fresh or composted manure. It also varies with type of cattle, age, composition of feed, rations, climate, and type of bedding, manure storage and manure handling. Compared to commercial fertilizers, the relative nutrient concentration of cattle manure is quite low. This decrease the distance the manure can be economically transported. The low concentration rates to apply an equivalent amount of nutrients.

In addition to the quantity of nutrients in the manure, it is important to know the form of the nutrients. Animal manure has nutrients in the inorganic and the organic form. Solid manure has a high percentage of nutrients in the non-plant available organic fraction. The organic form of the nutrients must undergo mineralization (decomposition) to convert it to the inorganic form. Solid cattle manure typically has 10% to 20% of the nitrogen immediately available in the inorganic fraction. A variable amount of the organic N becomes available through mineralization during the year of application, depending on the carbon: nitrogen ratio. For example, if mixed with it, the large amount of carbon relative to nitrogen will slow the release of available nitrogen and may result in limited increases in soil available nitrogen in the first year or two following application. The inorganic form of nitrogen in manure is found as ammonium nitrogen (NH_4-N). Lab tests will normally test for total N and ammonium nitrogen. Approximate organic N can be determined by subtracting ammonium-nitrogen (NH4-N) from total N. The availability of phosphorus in cattle manure is estimated to be about 50% compared to commercial phosphorus fertilizer and the response to the phosphorus depends on the availability of other nutrients in the manure such as nitrogen.

2.6.2 Manure Sampling

The only way to determine the content and form of the nutrients in cattle manure is to sample the manure. Manure samples should be collected and sent to an analytical lab for analysis. Instant analysis techniques may be limited to analyzing for only one or two elements and there could be shortcomings in accuracy and precision. The nutrient content or manure is highly variable. Solid manure samples can be taken from holding variable. Solid manure samples can be taken form holding areas or manure piles prior to application. Composite samples (7-15) should be mixed and sent to the laboratory for analysis.

2.6.3 Matching Nutrient Demand to Nutrients Supplied

Applying manure to meet the crop requirements for N may be accomplished without P overload initially as most prairies soils have a high pH and high phosphorus sorption capacity that immobilizes the P in the soil. However, if the soil phosphorus sorption capacity becomes saturated due to repeated applications in excess of crop removal, further additions of phosphorus may remain in a soluble, more mobile form. Sandy soils are the most susceptible to over application. Preventing soil erosion and overland water movement by maintaining soil cover through soil conservation practices such as direct seeding will prevent phosphorus from entering water systems.

Efficient, economic and environmentally sustainable manure application over the long term requires balance between manure nutrient application and crop nutrient demand. Determining application rates for the manure requires establishing target yields. Establishing target yields will determine the nutrient requirements of the crop. Required nutrients must be supplied either by the soil or the manure. Matching the nutrient requirements of the crop to nitrogen supplied by the manure and soil maximizes grain yield and protein without leaving excess nitrates in the soil.

Over application can occur by applying higher rates than the crop can take off over time. Since all nutrients aren't available in the year of application, repeated applications in excess of crop uptake are one method of over application. Over application can lead to nutrient saturation and losses. Excess nitrates in the soil are readily soluble in water and move with water. Nitrogen can also be lost to denitrification as either N_2 or N_2O is of concern because it is a powerful greenhouse gas. Phosphorus is not as mobile as nitrates and tends to accumulate in the top layer of soil. Therefore, P is not as susceptible to deep leaching but can be lost with surface runoff and erosion.

Manure testing will give the operator a good indication of the nutrients applied to the field, but it can be difficult to determine the actual rate of applied available nutrient. Since the solid cattle manure cannot be injected into the soil, nutrient losses through volatilization, denitrification, and surface runoff are variable. Also, since the nutrients in cattle manure slowly become plant available it is hard to match the nutrients applied to the crop demand. The nutrients from a single application will slowly become available for plant uptake over a number of years. Soil testing is a critical tool in preventing over application of cattle manure.

2.6.4 Composting

Solid cattle manure can be applied either as fresh manure or as compost. Applying the manure as compost is an efficient method for handling cattle manure.;

Applying compost may be preferable to fresh manure for the following reasons:

- Composted manure can be applied more uniformly land efficiently through the reduction of mass and volume.
- The nutrients are in a more stable form, more similar to that of soil humus
- Proper composting can eliminate viable weed seeds and pathogens in the product.
- Odors during application are minimized.

2.7 Sorghum

Sorghum is a genus of numerous species of grasses, some of which are raised for grain and many of which are used as folder plants either cultivated or as part of pasture. The plants are cultivated in warmer climates would wide. Species are native to tropical and sub tropical regions of all continents in addition to Oceania and Australia.

2.7.1 Cultivation and Uses

Numerous sorghum species are used for food has grain and sorghum syrup or "sorghum molasses " fodder and the production of alcoholic beverages. Most species are drought tolerant and heat tolerant is especially important in arid regions. They form an important component of pastures in many tropical regions. Sorghum species are an important food crop in Africa, Central America, and south Asia and is the "fifth most important cereal crop grown in the world" Africa slaves introduced sorghum into the U.S in the early 17th century.

Yields from open-pollinated varieties under rain-fed conditions range from 0.31-1.0 tons/ha under ideal inputs, soil and water conditions and higher densities or planting. Resource poor farmers prefer varieties incorporating the characteristics of resistance to insects, diseases through, birds, and with acceptable yields of both gain for human consumption and fodder for livestock feed. Although yields of traditional varieties are low, they are sustainable under conditions which would make maize production unfeasible and unprofitable commercial producers prefer dwarf varieties suitable for harvest by combine. Grain sorghums are generally grown in regions which are too dry or too hot for successful maize production. They are adapted for the drier climates due to general factors (Bennet et.al 1990);

1.The ability to remain dormant during drought and then resume growth.

2. Leaves roll up as they wilt reducing the area of leaf exposed for transpiration.

3. Leaves and stalks contain an abundance of waxy coating which protects then from drying.

Many countries have investigated the options for composite wheat sorghum flour but few have found commercial adoption. Sorghum does not contain the plastic protein gluten, and thus the functional properties of sorghum for what base the bread and biscuit type products limits it inclusion level to a practical maximum of 10-15 percentages be fore changes in the structure of the product can be positively identified. Inclusion is dependent upon availability of sorghum appropriate varieties and the relative price of what and sorghum at the mill gate.

Many urban consumers consider sorghum to be a substitute to crop of low quality. This low social status for the gain constrains its desirability in commercial products designed for urban consumers. In regions where the crop is not staple, it may have low acceptability relative to maize due to its different organoleptic properties, unpleasant colour, aroma, after taste and stomached feel.

2.8 Cowpea

Cowpea is a legume that is extensively grown throughout sub-saharan Africa. It is a subsistence crop, often intercropped with sorghum, maize and peal milled. The grain provides valuable protein and the leaves are used as a nutritious vegetable. [IPM CRSE, 2000]. Some two hundred can farmers grow cowpea, some two hundred millions Africans consume cowpea many may be a majority of these farmers are women. Cowpea grain, nutritious and inexpensive serves as a source of cheap protein for both rural and urban consumers. The cowpea grain contains about 25 percent of protein and 64 percent of carbohydrate [bresanni, R., 1985]. Even the goats and the cattle benefit from cowpea, this genuinely Africa crop, for the hay left over the grain is harvested as a high-value nutritious forage [A Biotech, 2002].

Cowpea is one the of the most ancient crops known to man. Its origin and domestication occurred in African near Ethiopia and subsequently was developed mainly in the farms and African savannah [Duke,. A Cited by UCSAREP1995]. Nowadays it is a legume widely adapted and grown throughout the world [Summer Field et al., 1999]. However, Africa predominated in production.

Cowpea is one of common names in English. Cowpea, bachapin bean, black-eye pea, southern Crowder pea, china pea and cow gram, in Afrikaans: akkerboon.

Flowers are self pollinating and may be white, dirty yellow, pink, pale blue or purple in colour. They are arranged in reamed or intermediate in florescence in alternative pairs. Flowers open in early day and closes approximately midday, after blooming they wilt and collapse. Pollination insect activities are open l in the number o pod set the number of seeds per pod or both; however, there are no recommendations for the use of pollinating insect on cowpea [McGregor,., 1986]

Cowpea is considered more tolerant to drought than soybean because of its tendency to form a deep tap root. It has a competitive riche in sandy, soils, does not tolerate excessively wet conditions, and should not be grown on poorly drained soils. One of the most remarkable things about cowpea is that it thrives in dry environments; available cultivations produce a crop with as little as 300mm rainfall. This makes it the crop of chance for the sahelian zone and they dry savannahs, though cultivars that flourish in the moist savannahs are available as well. [Bean/cowpea CRSP West African Mission].

Varieties of cowpea are said to be tolerant of aluminum and to be adapted of poor soil if pH is between 5.5 and 6.5 on the whole, it is tolerant of alkaline and salinity condition, but intolerant of excess amount of Boron. (SAREP 1996). Cowpea crop often responds favourably to added phosphorus, although there was non-significant increase in cowpea grain yield up to nitrogen application rate of 30kg/ha (Agbenin et al, Cited by UC SAREP1996). Length of growing season varies with type: 100 days in determinate type, 110 days in semi-determinate, 120 days in ranking type. The climate will also have effect on the length of growing season. The hotter the weather, the shorter the maturity period (Van Rij, ., 1999)

Cowpea is a most versatile African crop: it feeds people, their livestock and the next crop. In the Americas, also known as "black-eye pod", cowpea is a high protein food, and very popular in West Africa. The plant itself can be dried and stored until needed as fodder for livestock. As a nitrogen-fixing legume, cowpea improves soil fertility, and consequently helps to increase the yields of cereal crops when grown in rotation cowpea is referred to as the "hungry-season crop" given that it is the first crop to be harvested before the cereal crops are ready. It is a crop that offers farmers great flexibility. They can choose to apply more inputs and pick more beans, or- if cash and inputs are scarce-they can pick fewer beans and allow the plant to produce more foliage. This means more fodder for livestock, so that lower bean yields are balanced by more livestock feed, which in turn translates into more meat and milk. This flexibility in use that makes cowpea an excellent crop under the challenging climatic conditions faced by African farmers (Okike, 2000).

2.9 Effects of Manure on Soil and Crops

Manure is a useful soil amendment that can serve as a low cost source of organic fertilizer for crop production and as a soil conditioner that may improve the chemical and physical conditions of the soil (Sommerfeldt et al., 1988;). However, this remains realistic only as long as manure is managed properly. Unrestricted repeated applications of large volumes of manure might deteriorate the quality of soils and reduce crop production (Larson, 1991).

chemical properties of the soil such as salinity, sodicity, pH, and organic matter as well as physical properties of the soil such as bulk density, aggregate stability, crust strength, and water infiltration.

2.9.2 Nutrient Availability, Loading And Losses

The use of manure or compost results in qualitative and quantitative differences in the transformation of nutrients in the soil. This affects nutrient availability to crops. Either directly be contributing to the nutrient pool or indirectly by influencing the soil chemical and physical environment (Egrinya et al., 2001). If manure is applied according to soil tests and crop nutrient requirement it can optimize the availability of the nutrients in the soil. Manure application also needs to be done using the appropriate method. Unnecessary nutrient loading and losses can occur following over application and not using the appropriate method of manure application. For example. Meek et al. (1982) reported that high rates (180 tha-1 every two years over a nine-year period of time) of cattle manure applications to field plots of a calcareous Holtville salty clay soil in an irrigated desert region in California led to large losses of N, increased levels of K and increased availability of P.

2.9.3 Nutrient Availability

The availability to plants of nutrients particularly N from applied manure can be influenced by the forms of the nutrients contained in the manure, and methods and times of application. For example, studies in Saskatchewan have shown that the total N content of hog manure from earthen storage units ranges from 15 to 50 pounds per 1000 gallons

(7 to 23 kg per 3800 liters) of which 30 to 90% is ammonium (Schoensu et al. 2000). Ammonium is a form of inorganic nitrogen that is immediately available for crop use. Of the N contained in the organic form about 20 to 30% is estimated to be mineralized and become plant available inorganic form of N in the year of application. In the same studies (Schoenau et al., 2000) reported that solid manure from cattle pens had only 10 to 20% of the total N present in the inorganic (ammonium) form. Beauchamp (1983) suggested 50, 75, and 10% of the total N for liquid dairy cattle, liquid poultry, and solid farmyard manures, respectively. As such the forms of N present in manure affect N availability to plants; manure with higher content of immediately available ammonium offers greater short term crop response.

Method and time of application may influence nutrient availability due to the varying levels of losses associated with different methods and times of application. In a study that compared liquid dairy cattle manure and N fertilizer Beauchamp (1983) found that the availability of N from liquid dairy cattle manure that was side-dressed and not incorporated was about 33% of that from anhydrous ammonia. The N availability from liquid dairy cattle manure applied before planting and incorporated 4-5 days later was 50% of that from urea; and injected liquid dairy cattle manure at either planting or side dress times resulted in increasing the availability of manure N to 60% of fertilizer N. this variability in N availability from the manure is attributed to different degrees of ammonia volatilization, with surface applications having high volatilization loss and leading to lower N availability (Beauchamp. 1982 & 1983. safely et al., 1980)

Based on his findings, Beauchamp (1983) developed a flow chart. Showing the contribution of liquid dairy cattle manure N when applied to soil to N available to a crop.

With the assumption that manure would be applied and only incorporated after 1 week in the spring, he suggested that approximately one-half of the totals N in the manure would be available to the crop in the year of application. He also reported that the availability of the liquid dairy cattle manure was about one-half that of the fertilizer N. likewise. Schoenau et al. (2000) reported the availability of N form liquid hog manure effluent (of which about 50% of the N was present as ammonium) was in the range of 60 to 70% of that observed for urea applied at equivalent rates of added N in the field in east-central Saskatchewan.

2.9.4 Loading and Losses

Due to the inherent high variability in the nutrient contents and forms of manure (Schoenau, et al., 2000), there is a wide range of nutrient loading at a given rate of manure application. Also, although manure contains many nutrients, it may not provide the appropriate balance according to the relative requirements of different crops for different nutrients and this contributes to the variability in the loading of nutrients from manure. A good example would be cattle feedlot manure that has a lower N to P ratio (4:1 to 5:1) than crops (6:1 to 8:1) (Intensive livestock operations committee, 1995). Under these conditions, when manure applications are based on crops' N requirements this tends to provide P in excess of crop P requirements. If such management continues over a long time, it could result in P loading in soils and lead to an increased risk of P movement into Water bodies via processes such as erosion, runoff, and leaching (Lennox et al., 1997.)

Losses of nutrients following manure application seem unavoidable but the degree varies depending on the form and method of manure application. Studies have shown manure N to be the most susceptible nutrient that is lost to the atmosphere, mainly via ammonia volatilization followed by denitrification. (Bouldin et al., 1984). N can also be lost in the form of nitrate via leaching.

2.9.5 Chemical Composition

Several studies have been conducted to understand the effects of manure application on soil chemical properties.

2.9.6 Salinity And Sodicity

Eleven annual applications of cattle feedlot manure at the rate of 90 Mg.ha-1yr-1 increased the electrical conductivity of a soil in southern Alberta by about 6 dS.m-1 and the sodium adsorption ratio by about 3 mmol0.5. (Chang et al. 1991) and reported that repeated annual applications of manure, which had high salt content, caused a build-up of soluble salts in the soils to the extent of lowering crop productivity. Reported that four annual applications of solid dairy manure at an average rate of 158 Mg. ha-1 reduced the yields of sudan grass due to salinity. Similarly, attributed the low yield of sorghum observed, following three annual solid feedlot manure applications at the rate of 67 Mg.ha-1 to increased salinity resulting from the relatively higher rate as compared to 22 Mg.ha-1

2.9.7 pH and Organic Matter

Whalen et al. (2000), in an 8-week study conducted in the laboratory, reported an immediate increase in the pH of two acid soils (Hazelmere silt loam from Beaverlodge and Davis silt loam from Fort Vermillion. Alberta) following fresh cattle manure application. An application of 40 g (oven dry bases) manure kg-1 of soil and manure mixture increased the pH of the beaver lodge soil from 4.8 to 6 and that of Fort

Vermillion from 5.5 to 6.3 fresh or composted animal manure applications were shown to have a similar effect of increasing soil pH in previous studies (Iyamuremye et al., 1996; Eghball, 1999).

Whalen et al. (2000) suggested that the increase in pH of an acid soil following manure addition was only partially due to buffering from bicarbonates since they did not detect carbonate in either the manure or soils examined in their study. They proposed that compounds other than carbonates and bicarbonates, such as organic acids with carboxyl and phenolic hydroxyl groups, have important roles in buffering soil acidity and increasing the pH of acid soils amended with manure. Their conclusion was that the effects of manure on soil pH would depend on the manure source and soil characteristics.

2.10 Physical Properties

Manure not only affects the chemical properties of soils but also the physical properties for example, Campbell et al. (1986) reported that soils that received repeated applications of cattle manure were more friable to the feed and less compact under the foot than those of the unmanured plots. Barnyard manure when applied to farmland, could improve soil structure. Stewart (1982) has shown that cattle manure increased soil porosity. Meek et al. (1982) had also shown that manure increased water-holding capacity and decreased evaporation rate with increased applications.

Cattle feedlot manure applications to solids increased water infiltration into the soils. Mathers and sterwart (1980) observed a decreased in soil bulk density and an increase in the saturated hydraulic conductivity of the soil following repeated cattle manure applications over an eleven-year period. Nuttall (1970) found from a pot experiment that additions of manure decreased crust strength and increased the emergence of rapeseed.

2.11 Microbial Activity

Microbial activity and its associated factors are important in systems where organic materials are used as sources of fertilizer nutrients because it is the microbial turnover of soil organic matter that determines nutrient flow to crops (Cooper and Warman. 1997) soil organic matter that determines nutrient flow to crops (Cooper and Warman. 1997). Manure additions to soils also affect microbial activities in the soil. For example, increases in microbial activity following farmyard manure and pig slurry additions to acidic silt loam soil. They observed that the farmyard manure had a larger effect in increasing the microbial activity than the pig slurry, which was attributed to the higher level of organic carbon in the farmyard manure than that in the pig slurry. (Charless et al 1999) found more rapid initial decomposition of hog manure C than the cattle manure C per unit C but cattle manure sustained the increase in microbial activity over a longer time period. In general, larger pools of microbial biomass are associated with soils of higher levels of organic C and this, in turn, influences the size of the plant nutrient pool as well as the flux of nutrients into plants (Goyal et al., 1993).

2.12 Crop Growth and Production

Manure has been recognized throughout recorded history as an excellent soil amendment that can be used as an organic fertilizer, providing plant macro and micronutrients to improve crop production (Dormaar and Chang, 1995). Major fertilizer and trace nutrients contained in manure as well as the benefits to the soil as a conditioner, by raising the organic matter content of the soil, comprise the main value of manure for crop production. However, there is a major difference between animal manure and commercial fertilizers in terms of nutrient availability, in that some of the nutrients in animal manure exist in the organic form and need to be converted to inorganic forms through mineralization before being available for plant use. Hence animal manure, particularly cattle manure, is a slowly available source of plant nutrients as compared to inorganic fertilizers. Nonetheless, manure has the advantage over inorganic fertilizers of adding organic matter and multiple nutrients to the soils (Schoenau et al., 2000).

2.13 Manure Management Practices to Reduce Water Pollution

If you allow manure to flow into surface waters, you cause pollution. It's that simple and you have an obligation to take steps to remedy the situation

Pollution exists when water quality is reduced and becomes unacceptable for designated (beneficial) uses. The Oregon department of environmental quality has defined beneficial uses and the minimum water quality standards needed to protect them.

Federal pollution control regulations, contained in public laws 92-500 and 95-217, refer to these as "best management practices." Operations differ, so what is "best" for one may not be "best" for another. Apply practices only when they are best for your confined animals operation. If evaluation shown that no water pollution potential exists, no changes are necessary.

Most pollution results when manure comes in contact with runoff or surface water.

2.14 Basic Practices That Keep Manure Away From Runoff and Surface Water

Don't deposit manure into surface waters! There are several steps you can take when animals can get to a natural water way or ditch . Move the lot fence to keep animals from surface waters except at watering points. Move the lot fence to keep animals from surface waters except at watering point. Move the waterway or ditch outside the lot. Pipe the open waterway or ditch underneath the lot

Keep wastewater (from your milking parlor, for example) away from surface waters collect it and spread a on cropland or evaporate from a collection basin

2.14.1 Reduce Polluted Runoff Volume.

There are a number of ways you can do this. They simply apply the general principle of keeping clean water clean.

Use curbs, dikes, ditches, or channels to intercept and reroute upslope runoff around the lot rain and snow can still fall on animal lots and become polluted. You must collect store (usually) and apply this water to your land properly. Use water bars to divert runoff flowing down a road way toward the lot. Intercept roof drain age with gutters that empty into clean water outlets.

Reduce the amount of cleaning, cooling, and other water (high-pressure system will reduce cleaning water). Reuse water for flushing manure. Maintain waters and water system to avoid overflows, lakes, and water wastage by animals.

Roof and/or reduce lots and manure storage areas. Many open animals lots or stockpiled manure can be reduced in size. This reduces the volume of polluted runoff to be collected and managed.

Practice include roofing a greater portion or all of the manure storage and/or grading, firming the lots surface with concrete, hog fuel, or other material to support equipment to reduce the size of the manure storage area.

2.14.2 Reduce Movement of Land-Applied Manure.

A number of commonly used practices will reduce the movement of manure with runoff. Consider those that reduce the volume of land runoff. You can use all soil-erosion control practices. Incorporating manure during or immediately following land application is beneficial. It reduces the loss of (a) manure with runoff, (b) volatilized nitrogen, and (c) odor. Use practices that encourage the movement of surface-applied liquids into the soil. Do not apply liquid faster than they can infiltrate into the soil. Apply liquids to match the infiltration rate and capacity of the soil. Adopt practices that improve soil structure. Install drain tile to lower the water table, which increases the frequency with which you can apply manure.

This will also improve the ability of the land to support manure- spreading equipment. Distribute manure on land as uniformly as possible, in amount that match the needs of the crops and at times and rate when the soil will absorb all of the liquids.

Apply manure on grassed waterways and next to surface waters during drier season, when rain and runoff are not likely to occur. However, if there is a ditch in a field where you want to apply manure during the winter, consider converting the ditch to buried pipe to stop runoff-transported pollutants from entering the water.

Maintain a separating distance between the stream and the location where you apply the manure. A vegetated buffer strip between the manured area and the stream will filter soil and manure particles from the runoff before it enters the water. When you spread liquid manure on your land though a surface irrigation system, install a tail water pump-back system. This will save water and nutrients in the manure and reduce the chance that surface water pollution will occur downstream.

2.15 Facilities to Manage Lot Runoff, Manure, and Associated Wastes

A number of factors affect the selection of equipment and facilities used to manage wastes. Some of these are; location, size and type of operation; amount and availability of land to receive manure; climate, soils, and crops; existing equipment and facilities; and distance to surface waters. In many operations, commonly available equipment and simple earthen facilities are used to collect and manage runoff and manure.

When you plan, ask about the availability and use of various kinds of equipment and facilities. The extension service, soil conservation service, private consultants, equipment suppliers and construction contractors are possible sources of information.

In summary, as animal owner you responsible for taking those steps that are reasonable and practical to keep manure out of surface waters.

CHAPTER THREE

3.0 MATERIALS & METHOD

3.1 Methodology

The methodology involved in this project involves the selection of a site where the plantation took place and the collection of poultry and cattle manure from local herdsmen and poultry farmer for the purpose of application and the subsequent processes of site visitation, application method, time of application and the type of crops to be grown i.e. cowpea [*Vigna unguiculata*] and sorghum [*Sorghum bicolor]*

3.2 Site Selection and Visitation

The site for this experiment is located at London street Minna Niger State (latitude $09^{o}\ 30^{1}$ and longitude $06^{o}\ 32^{1}$E with average annual rainfall of 1287.4mm)

The field was cleared and prepared for the preparation of ridges, and eight ridges were prepared for the plantation proper. The project site was cleared of weeds and other debris on the farm; this was done on 04-07-08. After the site has been prepared for plantation (plate 1) soil samples were taken for the following tests: Textural classification and Bulk density which is the mass per unit volume of soil. The samples were taken to The Soil Science Department of The Federal University of Technology Minna.

Plate1: The Layout of the Experimental Plot

Plate 2: Identification of each portion on the plot

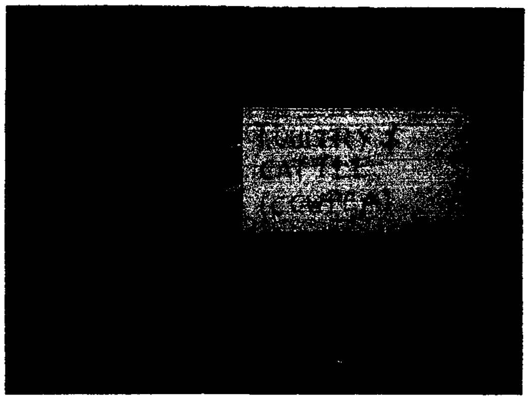

Plate 3: poultry & cattle (cowpea) at 3 weeks old

Plate 4: poultry (cowpea) at 3 weeks old

Plate 5: Cattle (cowpea) at 3 weeks old

Plate 6: Cattle (cowpea) at 3 weeks old

te 7: Cattle (Sorghum) at 3 weeks old

Plate 8: Cattle (Cowpea) at 3 weeks old

3.2.2 Application of Manure

The study is aimed at investigating the effect of cattle and poultry was test [manure] either used alone or combined together on its soil amendment effect and possible the yield of cowpea and sorghum using the same application ratio. The study should provide information on the best application rate of either poultry or cattle manure or both manure for proper yield as application of manure above agronomic rate depressed growth yield [Dewi et al 1994].

Cattle manure was obtained from local herdsmen that allow the cattle to go on extensive grazing method. The animals had been evacuated from their block and the manure was left to dry. Poultry manure was collected from the rearing section of a local poultry farm where the birds were under 16 weeks old and kept under deep liter system on floors with sawdust. The manures were weighed and measured according to the rate of application.

spacing of 30cm apart. This follows the same method for other portions of the field. The field was weeded at one week interval and thinning was done when the plantation was 4 weeks old and 7 weeks old

3.3 Experimentation

Plants were sampled on each bed or ridges by picking at random three (3) stands per row. These samples were marked for the purpose of identification for the observations as well as subsequent measurements. The heights (H), stem diameter (SD), leaf area (LA) were measured. Plant height (cm) was measured using a meter rule while the leaf area (cm^2) was assessed as the product of the total length and breadth (at the broadest point) of the longest leaf on the plant. Stem diameter (cm) was determined using vernier caliper. The average of these values for the 3 plants on the whole of rows was taken

3.3 Determination of Physical Properties of Cowpea and Sorghum

The physical properties of the crops that were determined are stem diameter, stem height and leave area.

The leaf area = Laminal length x maximum width x 0.75

The leave area index of the crops is leaf area index = LAI

$\therefore$ LAI = LA x n

Where LA = Leaf area selected plant

n = number of ridges

in addition, the area of each plant was obtained using a tape and ruler and the vernier caliper was used to obtain the stem diameter

The laminal length of the each plant was obtained by measuring the leaf length of the plant from the point where it terminates, the width is obtained by measuring the widest print of the leaf area.

3.4 Method of Analysis

The method of analysis chosen is by the nature and type of data or results required to achieve the objective of the study. The results are in general term bits of information and facts which entails the needed materials for the subject they relate. Tabular representations were used to summaries the information obtained and in addition, pictures were used to show the kind of crops grown and the formations of ridges to further authenticate the study and all the results, data and information obtained will be presented in the next chapter for full discussion and analysis.

3.5 Problems Encountered

The difficulties associated with the project or the method of analysis is that there is difficulty in the application of manure to the field, the workability is very high i.e it is difficult to work on poultry and cattle manure and also there is the issue of contention with odour from manures and the fear of not contacting disease from the waste if not properly treated from the source of collection.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

Table 4.1 Bulk Density

Sample	Wt of clod in air (g)	Wt of waxed clod /g	Vol of waxed clod cm^3	Vol of waxedcm^3	Bulk density gcm^3
1	2.44	2.95	2.5	0.638	1.310
2	3.14	3.96	3.0	1.025	1.590
3	6.59	7.68	5.5	1.363	1.593
4	5.51	6.58	5.0	1.338	1.505

Table 4.2: Particle Size Analysis of Samples before Planting and Application of Manure

Sample	% sand	% clay	% silt	Textural classification
1	66.40	27.04	6.56	Sandy clay loam
2	66.40	27.04	6.56	Sandy clay loam
3	66.40	27.04	6.56	Sandy clay loam
4	64.40	27.04	8.56	Sandy clay loam

From the above table one can obtained that the textural classification of the plot for the study is sandy clay loam.

Table 4.3: Plant Parameters Three Weeks after Manure Application

Treatment	Height H[cm]	Leaf area LA[cm^2]	Stem diameter SP[cm]
Poultry + cattle [sorghum]	36.5 35.5 34.9	5.807 6.697 7.249	0.101 6.126 0.115
Poultry + cattle [cowpea]	26.5 29.5 28.5	1.130 1.215 0.850	0.096 0.095 0.079
Poultry [sorghum]	34.5 37.4 38.4	5.313 5.159 0.459	0.211 0.199 0.115
Poultry [cowpea]	31.4 30.5 32.5	1.191 0.880 1.219	0.076 0.122 0.095
Cattle [sorghum]	37.5 39.5 34.4	4.420 5.239 4.411	0.115 0.119 0.105
Cattle [cowpea]	30.4 29.5 31.2	1.352 1.445 1.201	0.108 0.098 0.105
Control [sorghum]	29.9 28.5 30.5	2.796 3.275 3.139	0.087 0.092 0.091
Control [cowpea]	26.5 28.5 27.9	1.309 1.125 1.412	0.045 0.052 0.072

4.3.1: Effect on Growth

There was remarkable increase in all the growth parameters for all the manure sources at all the application rates over the control. However this study showed that potential values of the organic manures for cowpea and sorghum production varied according to organic manure sources and rate of application with sorghum and cowpea under [poultry application alone] is doing well and apparently better, and sorghum under cattle doing well as at 12-08-08.

Table 4.4 Physico – Chemical Results of the Soil before Application of Manure

S/no	Parameter	Samples			
		1	2	3	4
1	Conductivity [microhoms /cm	66.7	66.7	66.7	66.4
2	pH	6.4	6.4	6.4	6.5
3	Total alkalinity [$CaCo_3$ mg/l	253	253	254	253
4	Total hardress [$CaCo_3$ mg/l	405	404	405	405
5	Ca^{2+}[mg/1]	55	55	55	55
6	Mg^{2+}[mg/l]	330	330	331	329
7	cl^{-1}[mg/l]	301	300	301	301.5
8	Sulphate So_4^{2+}mg	126	126	125.7	127
9	Nitrate NO_3^{-1}	270	270	270	271
10	Fe^{2+}[mg/l]	0.26	0.26	0.26	0.26
11	K^{1+}[mg/l]	0.331	0.332	0.330	0.331
12	Pb^{2+}[mg/l]	0.250	0.252	0.253	0.250
13	Po_4[mg/l]	363	363	362	353.4
14	SAR	0.112	0.112	0.112	0.112
15	Mn^{2+}[mg/l]	0.40	0.40	0.39	0.41
16	Na^{1+}[mg/l]	0.34	0.34	0.34	0.34
17	Soil redox potential (Eh/mv)	427	427	427	427
18	Soil organic matter (g/kg)	436	434	436	436
19	Porosity (m^3 /m^3)	0.58	0.58	0.57	0.56

Table 4.5: Physico /Chemical Results of the Soil after First Application of Manure

S/no	Parameter	Samples			
		Co	Ca	Po	P+c
1	Conductivity	66.7	66.9	67	67.4
2	pH	6.4	6.9	6.8	7.1
3	Total alkalinity	253	464	207	295
4	Total hardress	405	391	589	394
5	Ca^{2+}[mg/1]	55	67	94	78
6	Mg^{2+}[mg/l]	330	201	393	187
7	cl^{-1}[mg/l]	301	298	301	394
8	Sulphate So_4^{2+}	125	497	607	541
9	Nitrate NO_3^{-1}	267	304	427	307
10	Fe^{2+}[mg/l]	0.25	0.45	0.70	0.74
11	K^{+1}[mg/l]	0.331	0.290	0.202	0.214
12	Na^{+1}[mg/l]	0.350	0.601	0.527	0.744
13	Mn^{2+}[mg/l]	0.43	0.29	0.271	0.297
14	Pb^{2+}[mg/l]	0.252	0.197	0.191	0.201
15	Po_4[mg/l]	2362	671	957	894
16	SAR	0.112	0.201	0.572	0.191
17	Soil redox potential (Eh/mv)	427	594	756	372
18	Soil organic matter (g/kg)	436	701	634	852
19	Porosity (m^3/m^3)	0.58	0.68	0.72	0.77

KEY: Co- control Ca- cattle, Po= poultry, P+c – poultry + cattle

Table 4.6: Physico-Chemical Results of the Soil after the Final Application of Manure

S/no	Parameter	Samples			
		Co	Ca	Po	P+c
1	Conductivity	68	86	90	73
2	pH	6.6	7.9	7.7	8.2
3	Total alkalinity	255	480	223	354
4	Total hardness	407	434	695	445
5	Ca^{2+}[mg/1]	56	79	101	88
6	Mg^{2+} mg/1]	332	329	431	202
7	cl^{-1}[mg/1]	302	328	337	439
8	Sulphate So_4^{2+} mg/1	126	563	765	820
9	Nitrate NO_3^{-1} mg/1	255	382	497	356
10	Fe^{2+} mg/1]	0.26	0.47	0.79	0.88
11	K^{+1}[mg/1]	0.332	0.302	0.224	0.232
12	Na^{+1}[mg/l]	0.35	0.625	0.569	0.765
13	Mn^{2+}[mg/l]	0.41	0.33	0.30	0.344
14	Pb $^{2+}$[mg/l]	0.221	0.204	0.204	0.210
15	Po_4[mg/l]	354	766	1029	958
16	SAR	0.112	0.221	0.241	0.241
17	Soil redox potential (Eh/mv)	430	641	756	398
18	Soil organic matter (g/kg)	438	733	653	865
19	Porosity (m^3 /m^3)	0.47	0.79	0.81	0.88

4.7 Discussions

4.7.1 Effect on Growth

Table 4.3 gives values of the growth parameters as affected by manure application and indicated that cattle manure [ca] alone led to remarkable difference in height, leaf and stem diameter for sorghum and poultry manure alone (PA) also showed vivid difference in height and stem diameter compared to other two treatments while combination of poultry and cattle manures (p+c) gave better leaf area compared to the use of either of the manures alone. The addition of organic manures enhanced growth in the treatments plots far above the control this observation is supported by the findings of Dewi et al. [1994] and Obi and Ebo [1994] that the benefits of organic manures are due to their ability to improve soil physical characteristics and to supply micro and trace elements needed by plants. The improvement in plant growth due to nutrient supplemented soil is associated with increase N, P and K levels in the soil while the high growth rate in the poultry manure alone [PA] supplemented soil is as a result of the enhanced nutrient status and their slow rate of release in the soil [Cook and Westlake 1973]

4.7.2 Soil Chemical Properties

Application of organic manures significantly improved soil chemical characteristics. Total porosity improved for cattle manure a lone [CA] from 0.68m^3lm^3 to 6.79 [m3lm3, and poultry alone from 0.72 to 0.81m^3lm^3 and that poultry and cattle treatment increase from 0.77 m^3lm^3 to 0.88m3lm3 which might be partly due to noted appreciable promotion of biological activity [Obi and Ebo, 1994]. The pH also improved for all the three treatment with poultry and cattle manure increasing from 7.1 to 8.2 due to the increase in availability of P and K in the soil [Moore1994]. Ca^{2+} contents of the soil significantly increase over the control value, this can be due to the findings of Dewi et al., [1994] that treated plots of farmyard manure do have increase in the uptake of nutrients.

Meanwhile poultry manure [PA] contributed to the highest number of ca^{2+} while highest number of pH came from poultry + cattle alone [PAC]

4.8 Health Impacts and Problem Encountered.

The health impacts associated with the used of animal manure is that there is contention with the smell coming from the manure especially poultry manure. Others include the fear of contacting skin rashes or diseases if the person applying is not properly protected. Other problems encountered in the course of the study is the difficulty in the application of manure to the experimental field and also it very difficult to work on, and the difficulty of not been able to apply poultry manure when collected from source due to the fact that some of the nutrients are not readily available so the manure have to dry and decompose before it application to avoid damage of the crops and considering the fact that crops may suffer deficiency and injury as a result of over and under application of manure.

4.8.1 Suggestions

The protection of skin and other part of the body for the person applying the manure can be achieved by using hand gloves and other protective cloth and using of nose guard for contention with the smell and reducing the impact while working on the farm.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The result of this study has buttressed earlier findings that farmyard manure and organic manure in general can provide the necessary nutrients needed by plants for growth. The study also showed that both poultry and cattle manure can provide the fertilizer requirements of cowpea and sorghum either when applied alone or combined together.

Mean while the physical parameters of the sorghum of cattle manure showed the most pronounced characteristics of the parameters and that of cowpea of poultry plus cattle manure. This result did not give progressive increment in parameters with respect to increasing application rate as some findings have shown, this might be due to slight errors in manure application and seed planting. This finding indicated that animal manure irrespective of application sate and method, significantly increase the growth performance, the chemical and biological activities of the soil increased in other to give good result of the plantation when compared to the control treatment of field.

5.2 Recommendations

The project work presented by this report can still be worked upon again and improved or so as to make the project more efficient, effective and compatible with modern trends.

I therefore make the following recommendations that the use of mechanical device in the application of both manure and seed in further studies. Also that cattle manure will yield good result in terms of growth performance for the production of sorghum on a sandy clay loam soil and farmers should return back to the use of animal manure for their plantation, since is readily available and cheep and also been generated as waste for their farm activities.

Lastly government should reduce the importation of N.P.K fertilizer better know as inorganic fertilizer which have adverse effect on soil activities e.g affecting the nutrient level and availability so that the farmers will be encourage to use organic manure for their farming activities and a proper method of analyzing the amount of animal manure needed for a particular plot to avoid under or over application problem.

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