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DIFFERENT ORGANIC MANURES EFFECT ON THE YIELD OF TOMATO (MOGAL F1)

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ABSTRACT

The field experiment was conducted at Horticulture research center Yundum from 1st February to 13th July 2016.To investigates the effects of different organic manures (fertilizers) on the yield of tomato (mongal F1). The experiment involved five treatments which are as follows: NPK 15:15:15, fish waste, poultry manure, and a combination of NPK 15:15:15, fish waste, poultry manure, and control. The treatments were laid out in a Randomized Complete Block Designed (RCBD) and replicated four times. The parameters taken were soil organic matter, moisture content and soil pH, plant height at harvest, number of plants that survived at harvest, total fruits per fertilizer treatment, and yields per kilogram per fertilizer treatment. The results obtained show that tomato performs well and yields better ($p \leq 0.05$) if 15 kilograms of fish waste is applied on a $3m^2$ beds, while total number of fruits produced and plant height performed best ($p \leq 0.05$) if 15 kilogram of poultry manure is applied on a $3m^2$ beds. These results are similar to reports by Seran et al., (2010). Seran et al. (2010) reported that the use of organic and inorganic fertilizers had better effect on the growth and yield of tomato.

Keywords: Tomato, Fish-waste, Poultry-Manure, Yield

INTRODUCTION

Tomato (*Lycopersicon esculentum*, L.) is a popular vegetable crop grown in The Gambia. It is cultivated all over the country, mostly during cool dry season (October to April Tomatoes rank first, among the entire vegetable crops grown in The Gambia (FAO, 2002). Tomato has quite numbers of cultivars, that are grown but most common cultivars grown in The Gambia are: Cherry, roma VF, Heinz, Mongal, Xina, Local, Caribou, and Money Maker etc. These cultivars are widely grown in the Gambia on small scale particularly by women farmers and it can obtain average yields of 20-30 tons per hectare depending on type of soil and management (Jabang, 2000).Tomatoes play a vital role in human diet and are a good source of vitamins and minerals. The fruits are eaten raw or cooked and can be processed into soup, juice, sauce, ketchup, puree, paste and powder (Olaniyi and Ajibola, 2008). They also serve as an ingredient in stews and vegetable salads.

Tomato prefers deep fertile soil, rich in organic matter, well drained soil and with high water retaining capacity with pH ranging from 5.5 – 6.8, (NARI, 2001) High temperatures usually delay flowering and reduce the number and size of the flower (NARI, 2007). Fruit setting also is affected if the temperature is too low or high. Also, flower abortion occurs when the temperature is below 13^{O}C and above 38^{O}C. Therefore, tomato prefers an optimum temperature ranging from 25°C-30° C (Olaniyi and Ajibola, 2008).

Fertilizer is a critical input for improving production and increase crop yields. Compound fertilizer (NPK 15:15:15) works quickly and supplies needs for the crop (August, 2012) and added organic matter to the soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa *et al.*, 2008). Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients (Oyewole and Oyewole, 2011). Poultry

manure more readily supplies P to plants than other organic manure sources (Garg and Bahla, 2008).

Although, organic fertilizers exist in readily available forms, cheap and easy to assess, they need to be applied in large amounts to meet the nutrient requirements of crops (Prabu *et al.*, 2003). Where large hectares are involved, this single fact plays an important role in the cost of organic fertilizer application.

Fish wastes are excellent sources of nutrition for soils and plants, as fish wastes contain the full spectrum of nutrients found in waters. Fish waste fertilizers contain significant quantities of protein nitrogen as well as a healthy balance of all 18 essential nutrients known to be significant for crop growth. Nitrogen-phosphorous-Potassium ratio of fish fertilizer is 10-6-2 (Gaskell, 1999). Plants rapidly respond to and grow vigorously when regularly fertilized with fish waste fertilizers. Fish waste fertilizers are suitable for all fruits plants, flowers and vegetables. Farmers in peri-urban areas of The Gambia have been producing tomato (Mongal) for several years but they do seldom realize optimum yields in spite of application of chemical fertilizers and organic manure.

Given the fact that many farmers in The Gambia who grow tomatoes have not been able to increase and improve their yields after several years of production, there is the urgent need to help these farmers improve on their cultivation methods and consequently increase their current yield. The objective of the study is to establish the appropriate application rates of both inorganic fertilizer and organic manures in order to increase the fruit yield of tomato and evaluate the effects of different fertilizer application rates on the other growth parameters of the tomato plant. We have hypothesized that the use of different organic fertilizers has no positive effects on the yield of tomato.

LITERATURE REVIEW

Origin and Distribution of Tomato

Tomatoes (*Lycopersicon esculentum, L.*) originated from the area lying between Mexico and the west coast of South America. After its introduction into Spain in the 16th century, it was widely spread throughout Africa ((Obeng-Ofori *et al.*, 2007). In the Gambia, tomato is the most important vegetable crop in the most recently established dry season gardens in West Coast Region and the Greater Banjul Area and in some parts of North Bank Region (NARI, 2001). A flourishing tomato production also occurs in peri-urban areas (Banjulinding, Bakau, Lamin, Sukuta, and Brufut).

Botany of Tomato

An annual crop of up to 2 m tall, the stems are hairy with a strong odour. The terminal bud often becomes an inflorescence and growth is continued by an auxiliary bud. The flowers which are up to 2cm in diameter are borne in inflorescences of 4-12 flowers. The leaves are spirally arranged up to 3cm long and 10-15cm across. The leaf blade is lobed and divided. The calyx is short and remains green when the fruit ripens. The 6 petals are yellow and up to 1cm in height. The root is a tap root one with an extensive rooting system (NARI, 2011).

Agronomy of the Tomato Crop

In the Gambia, vegetables are grown on permanent sites on the upland and in hydro morphic ecologies to follow rice crops (Erestein et al, 2005).The crops are best when grown on a well drained, fertile soil with good moisture retaining capacities and relative high level of organic materials although many cultivars tolerate a range of soil conditions (Rice, 1991). Slightly acid soils with pH of 5.0-6.5 are suitable for growing tomato. Low soil temperatures retard the growth of seedlings and absorption of minerals (Peer, 2001). High air temperatures above 27^0C can cause pollen sterilization and high temperatures also adversely affect flower initiate on. Temperatures of about 19-30°C are considered ideal for most cultivars (Peer,

2001). Excessive rainfall can harm a tomato crop, particularly if it is unstaked due to spread of leaf diseases under humid conditions (Rice et al, (1991). Uneven levels of water application combined with lack of calcium or potassium in the soil water may lead to a physiological disorder of the fruit known as blossom end rot (Rice et al, 1991). Tomato seedlings require 3-4 weeks to be ready for transplanting to the field. The seedlings are spaced at 30cm-60cm between plants and 100cm-150cm between rows and this will depend on the vigor of the cultivars and level of pruning (Peer, 2001). High temperatures, combined with low relative humidity can seriously affect fruit setting. Both high and low temperatures can affect fruit quality particularly the color of the fruit (Peer, 2001).

Common Pests & Diseases of Tomato

Tomato is susceptible to infection by many pests and diseases, and pest infections occur right from the seedling stage to harvest. Several fungi, insects, viruses, bacteria, and nematodes frequently attack tomato and common diseases that they (these pests & diseases) cause are Ralsteria Solana caerum, fusarium solari, and verticillium dahilat. Tomato yellow leaf curl virus and tomato spotted wilt virus. These pathogens occur in complex forms leaving huge pre harvest losses (Youdeowei, 2002). Tomato leaf wilt (fulvia fulva, syn cladosporium fulluum) develops mainly when the temperature is close to 22°C and relative humidity (80-90%) is very high (Zhaoyong guan, 2008) .The symptoms are light green to yellowish spots in the upper surface of the leaves and a light olive green down on the undersides. As the lesions enlarge, the leaves turn to brown and dry out. Weekly application of maneb (Manebgan, Manesan) will control this disease, (Remain, 2001).

Damage caused by root knot nematodes (mloidogne spp) is often observed on tomato crops. Recommended methods to control this disease include the use of resistance cultivars, nematicides (DD, metum sodium or dazomet) and resorting to crop rotation (Remain

2001). Bronze acariosis is caused by the russet mite (Aculopo sycopersici, syn vasates lycoperci.) who feeds on the underside of the leaves resulting in premature, rapid desiccation of plants. This pest in controlled by an acaricide (dicotol) or by an insecticide with an acaricidal effect (dimethoate or endosultan) (Remain, 2001).

Effects of Fish Waste on Tomato Production

Fish fertilizer is a good soil conditioner and is good to use in vegetable plots because it helps in root development (Irshad and Javed, 2006). Fish fertilizers help to provide complex arrays of nutrients and minerals as proven by trials done in poor soils that were lacking many nutrients and minerals. Fish offal fertilizer provides plenty of phosphorous and organic nitrogen (Irshad and Javed, 2006). Studies done on peas, radishes, tomatoes, corn, straw berry, lettuce, soybeans, and peppers indicated that fish offal fertilizer promotes plant growth and retard senescence (Aung et al., 2011). The lowest amount of marketable yield was collected from plots treated with manure due to the slow availability of the nutrients from the manure and immobilization of nitrogen (Teklu et al., 2004). Manure has relatively little phosphate (Shankara et al., 2005). At first harvest, the numbers of marketable fruits collected from plots treated with fish offal fertilizer were small as compared to plots treated with chemical fertilizer. But, tomato treated with fish offal fertilizer at 7th harvesting was still green and others were completely dried at this stage.

This condition is complemented by fish fertilizer that promotes growth, retards senescence, delays flowering and fruiting in tomatoes (Aung et al., 2011). This could be a very important management tool to extend the time a single cultivar would be available for picking and marketing (Aung et al., 2011). Fish fertilizer is speculated to cause a reduction in the production of buds on fruit trees (Aung et al., 2011). At the early growth stages, yield of plots treated with fish offal fertilizer was lower but turned higher at

later growth stages, compared with the chemically fertilized tomato. This might be due to the low nutrient availability at the beginning, which limited the plant growth. Nutrients in chemical fertilizers are immediately available when applied to the soil but the sustainability is low (Seran et al., 2010). On the contrary, organic materials sustain the nutrients for longer time than chemical fertilizers. Specifically, nitrogen in the fish fertilizer encourages lots of leaves and branches, which helps support the tomato plant's large root system and bountiful crop (http://www.ehow.com/about_6327673_fish-emulsion-tomatoes.html, 26 August, 2012). The highest average tomato fruit weight was recorded at first harvest of plots treated with fish offal fertilizer which was 75.91 kilograms (Seran et al., 2010).

The minimum average fruit weight was 33.65 kilograms recorded from plots treated with chemical fertilizer, (Malka & Shoal, 2011). The average weight of fruit was decreased as harvesting stage proceeded for all other treatments. Even though the average weight of fruits was decreased as harvesting stage proceeded for all other treatments and the average weight of fruits treated with fish offal fertilizer showed slightly constant weight as compared to other treatments Malka & Shoal (2011). Malka & Shoal (2011) indicated that at first harvest, the highest plant height (80.333±3.97 cm) was obtained from tomato plots treated with fish offal fertilizer.

Effects of Poultry Manure and Compound Fertilizer on Tomato Production

Organic manure also helps to improve the physical condition of the soil and provides the required plant nutrients. It enhances cat-ion exchange capacity (CEC) and acts as a buffering agent against undesirable soil pH fluctuations (Ngeze, 2010; Giwa and Ojeniyi, 2004; Ojeniyi *etal*, 2007; Akanni and Ojeniyi, 2008). The application of organic manure has been found to have higher comparative economic advantage over the use of inorganic fertilizer. A study

conducted by Brown, (2010) and Akanbi *et al.*, (2005) showed that 9-18 tons/acre of manure appropriate for good tomato production, application of broiler liter at the rate of 15t/ha, N at 40kg/ha, P at 30kg/ha and K at 30kg/ha gave higher growth of fruit yield. Also, as a result of increased popularity of organic vegetable production, more information is needed comparing the growth and yield of vegetable crops produced organically or using inorganic fertilizer. Tomato crops require nutrients such as N, P, K, Mg, Ca, Na, and S for good production. These nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity for proper growth and reproduction (Adekiya and Ojeniyi, 2002).

However, there is renewed interest in proper and effective use of organic manure to maintain soil fertility (Olatunji and Oboh, 2012). Aside from being a source for plant nutrients, organic manure, e.g. poultry manure has improved agricultural productivity in West African countries Olatunji (2012). Organic manure helps to increase the population of soil micro-organisms which have some influence in protecting tomato plants against pathogens like nematodes and soil-borne insects and also provides plant growth hormones like auxins (Sanchez and Miller, 2013; Agbede and Ojeniyi, 2009). The result of the study on effects of different organic manures on the yield of tomato revealed that plant heights at harvest differed significantly among treatments with the highest recorded in plots fertilized with poultry manure (Usman 2015).

Poultry manure is known to supply adequate nutrients to the soil and precipitate rapid vegetative growth in crops (Agbede and Kalu, 1995; Aiyelaagbe *etal*, 2005; Katung *etal*, 2005). According to research conducted by Dantata et al (2011), poultry manure gave the highest fruit yields of 28.00 t ha^{-1}. A study conducted by Brown (2010) and Akanbi *etal*, (2005) showed that 9-18 tons/acre of manure appropriate for good tomato production, application of broiler liter

at the rate of 15t/ha, N at 40kg/ha, P at 30kg/ha and K at 30kg/ha gave higher growth of fruit yield. According to Akanbi and Togun (2002), the results of the study revealed that plant heights at harvest differed significantly among treatments with the highest recorded in plots fertilized with poultry manure. The control, which had no additional nutrients, had relatively shorter plants (62.0 cm) and this was significantly different from the plants that received chicken manure. This observation is in agreement with results of Oyewole et al. (2012) who reported that chicken manure applied at a rate of 150 kg/ha and 300 kg/ha produced taller plants compared to the control. The application of chicken manure produced the highest fruit yield (17.2 t/ha). The lowest fruit yield (11.5 t/ha) was obtained with the control (No fertilizer) treatment, (Oyewole et al. (2012) Chicken manure treatment yielded about 50% higher than the yield of the control. Results obtained showed the positive effect of poultry manure on tomato yield which compares well (in this case even slightly higher) with the yield obtained by chemical fertilizer (Ajibola, 2008).

This benefit of poultry manure has been reported by other researchers (Mehdizadeh, Darbandi, Naseri-Rad, & Tobeh, 2013; Oyewole *et al.*, 2012; Adekiya & Agbede, 2009; Olaniyi & Ajibola, 2008). This may be possibly explained by the fact that the poultry manure improved the soil physical and biological properties and provided the macro and micro nutrient requirements of the plants (Abou El-Magd et al., (2005) and Stephenson et al., (1990), thereby increasing yield.

Nutrient Contents of Organic and Inorganic Fertilizers

Fertilizers/manure Type	Nutrient Contents		
	N (%)	P (%)	K (%)
Compound Fertilizer	15	15	15
Fish Wastes	10	6	2
Poultry Manure (Dry)	4.5	2.7	1.4

Gaskell, (2010)

Fertilizer Nutrition of Tomato

Tomatoes are generally heavy feeders, requiring soils rich in organic matter and nutrients. Tomato planted in minimal fertile soils should be regularly fertilized to keep N-P-K levels consistent. Excessive nitrogen produces fast green growth and inhibits fruiting. Keeping this in mind, choose a fertilizer that's low in nitrogen levels and higher in phosphorus and potassium, Examples of suitable N-P-K ratios for tomatoes.

Nutrition of Tomato

CROP	Nutrients		
	N	P	K
TOMATO	8	32	16
	6	24	24

(Robert Lewis, 2000).

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at the National Agriculture Research Institute (NARI) Horticulture Center at Yundum, from March to April, 2016. The soil organic matter content of the area is 0.37 and pH of 5.4, respectively (NARI, 2016). The center is located at an altitude of 1636 mm and longitude of 7° 56' 0" North, 38° 43' 0" East. The average annual rainfall of the area is 1000 mm and the maximum and minimum temperatures are 27°C and 14°C, respectively according to weather forecast report on annual rain fall 2015

Planting material used

One sachet of tomato seed (mongal f1) was used in the experiment. Mongal f1(***Lycopersicon esculentum mill.***) is the popular tomato cultivar grown by most of the producers in The Gambia due to its high germination percentage (95%) and demand in consumer preference. If properly managed, it can grow to more than 1.5meter

in height and can produce 20-30 t h It is tolerant to Gambian weather condition i.e. can grow in all parts of the country.

Fertilization

Three (3) bags of 50kilograms of fish waste were used as a source of organic fertilizer. 500 grams of compound fertilizer (NPK 15:15:15) was used as a source of chemical fertilizer. A 50- kilogram bag of fresh poultry manure was also used as a source of organic fertilizer.

Treatments

Treatments	**Rates per bed**
T1- Compound fertilizer (npk 15:15:15)	300 grams
T2 -Fish waste	15kg
T3 -Poultry manure	15kg
T4- Combination (t1+t3+t2)	0.01kg +3kg +3kg
T5- control	no application

Experimental Design

The experimental design was Randomized Complete Block Designed (RCBD), with four replications and five treatments. The treatments comprised of compound fertilizer (NPK15:15:15) T1, Fish waste (T2), poultry manure (T3), fertilizer combination (T4) and control (T5). The experiment plots measured 3m x 1 m, 1 meter between the replications, and 0.5 meter as foot paths.

FIELD LAYOUT

----------17METERS----------

3-METERS BED

REP VI	T4	T5	T1	T2	T3

1-METER

REP III	T3	T4	T5 →	T1	T2

1-METER

REP II	T2	T3	T4 →	T5	T1

1-METER

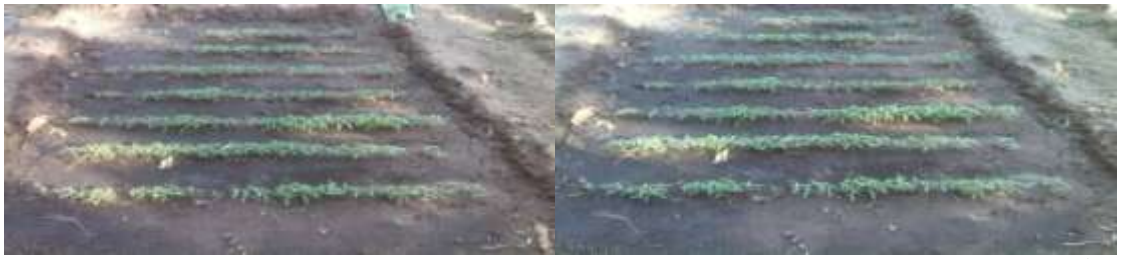
REP I	T1	T2	T3 →	T4	T5

Agronomic Practices

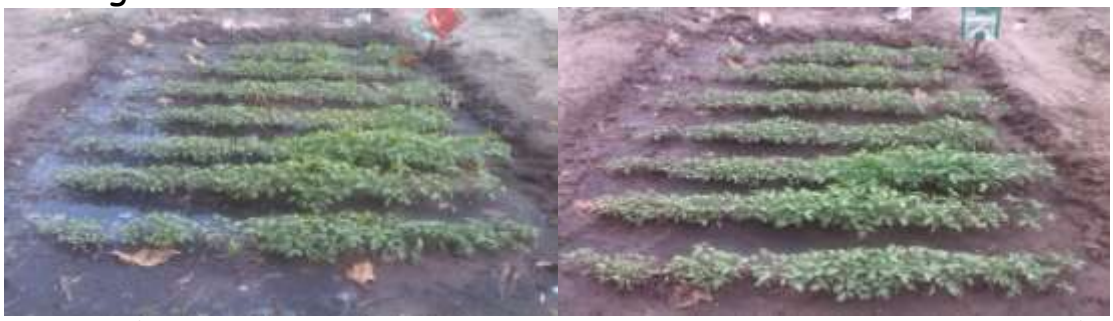
(I)Nursery Preparation

The seeds of Mongal F1 were raised in nursery trays on the 3rd February, 2016, where intensive care was provided for the optimum growth of the seedlings. There was one nursery bed of 1m x 2m and 5 liters of Water was applied both morning and evening, respectively. The seeds germinated 5 days after sowing and the seedlings were later transplanted at four (4) weeks after sowing; that is, when the seedlings reached 21 days old and 15-20cm tall.

Plate 1: Tomato seed development stages



1st week after emergence 2nd weeks after germination



3rd weeks after germination 4th weeks after germination

Plate1 Preparation of Manure/Fertilizers

The fish waste was put in a 50 cm deep hole for 2 weeks in order for it decompose before it was applied to the beds. Poultry manure was mixed thoroughly mixed with water to help break its hard particles and the mixed substance was placed into heap for 24 hours before application.

Plate 2: Prepared fertilizers

Land Preparation

Land preparation was done on 30th December, 2015. The research plot area was hand-cleared. Drip irrigation was used to moisten the area for easy ploughing. A power tiller was used to plough the area.

Plate 3: land preparation

Bed Demarcation

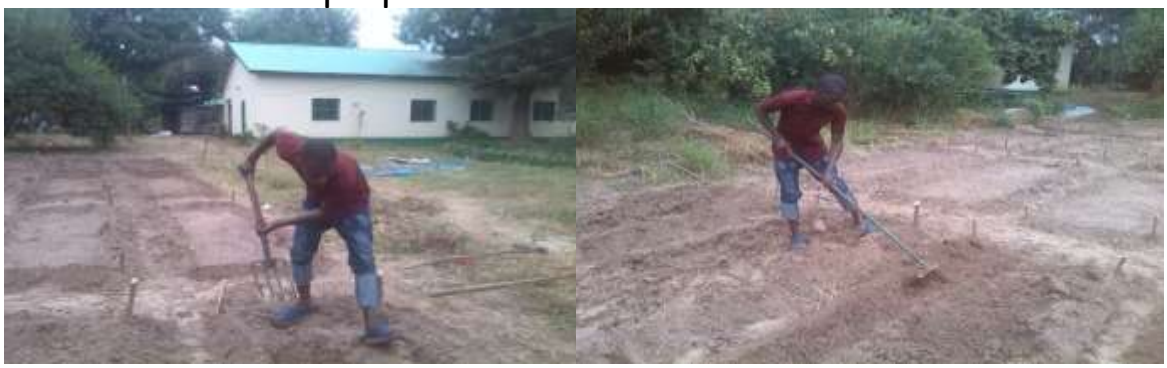
Bed demarcation was carried out on 31st December, 2015. Measurement tape was used to measure the lengths and breadths of each bed and was also used to construct the blocks in the plots.

Plate 4: seed bed demarcation

Seed bed preparation

The seed beds were prepared on 4th January, 2016. A hand fork was used to turn the soil in order to expose the previous crop roots underground. A twine was used to straighten the bed areas while preparing the edges. Seed bed leveling was done with the use of a rake.

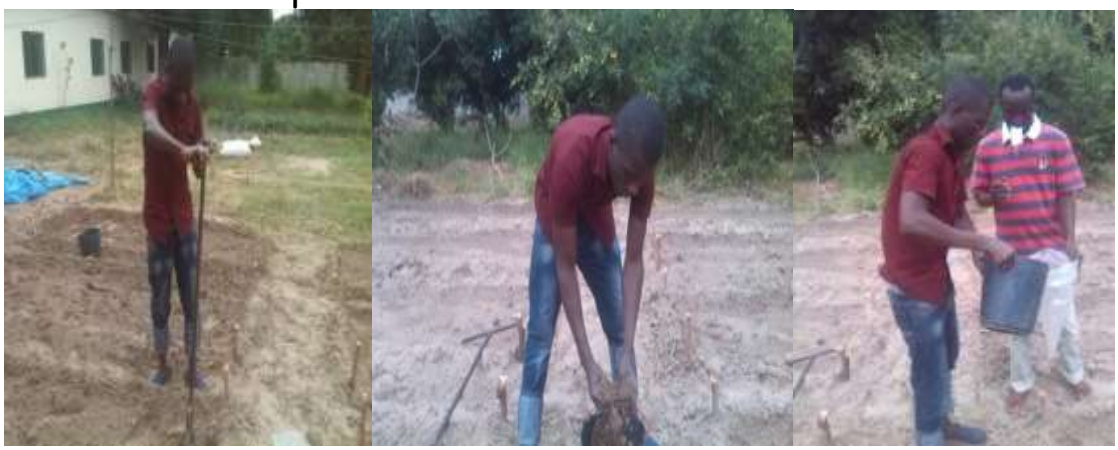
Plate 5: Seed bed preparation



Soil Sample Collection

Soil sample collection was done on 4th January, 2016. Before fertilizer treatment application was done, soil samples were randomly collected using a soil auger, at a depth of 0–30 cm and thoroughly mixed and put into plastic bags. The samples were air-dried for 5days and ground, and sieved to pass through a 2-mm sieve.

Plate 6: Soil sample collection



Fertilizer application

Poultry manure (PM) and fish waste were applied 4 weeks before transplanting of the seedlings. Fifteen (15) kilograms of poultry manure and 15 kilograms of fish waste were broadcast on the beds in order for decomposition to take place before transplanting of tomato seedlings. 300 grams of compound fertilizer (NPK 15:15:15) was applied at planting and 3 kilograms of poultry manure, 3kg fish waste, and 100 grams of compound fertilizer (NPK 15:15:15) were

applied as combination treatment. Manure (fish waste and poultry manure) was thoroughly mixed with soil and water was applied once every four days before seedlings were transplanted to provide moisture that helps manure decomposition.

Plate 7: Fertilizer measurement and application

Transplanting

Transplanting was done on 29th February, 2016. Twenty-one- day old tomato seedlings were transplanted in each bed at a spacing 50 cm between the plants and 70 cm between the rows. Each bed contained 12 tomato plants, which totaled to 240 seedlings for the whole experiment. Transplanting was carried out in the evening and watered immediately after transplanting.

Plate 8: Seedling transplanting

Watering

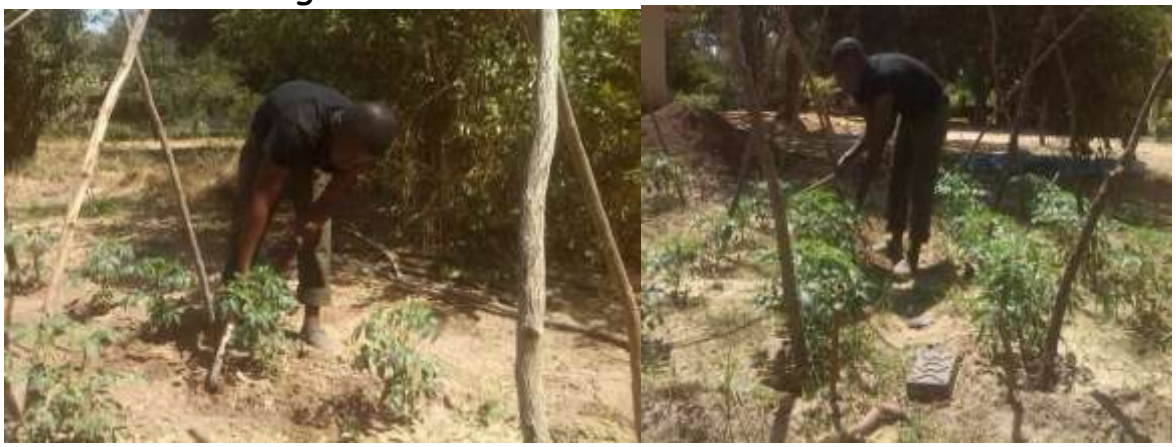
Transplanted seedlings were watered both morning and evening every day. Fifteen liters of water was applied in each bed per day.

Plate 9: Watering

Weeding

Weeding operation was carried out three times in 2 week intervals. First weeding was done two weeks after transplanting and the second weeding 2 weeks after the 1st weeding and third weeding 2 weeks after 2nd weeding.

Plate 10: Weeding



Staking

Staking and twining are important operations in tomato production. They help tomato plants from lodging. This operation was done three weeks after seedling were transplanted in their permanent beds. Each bed consisted of 6 staking, which gave a totaled of 120 staking for the whole experiment.

Plate 11: Staking

Pesticide Application

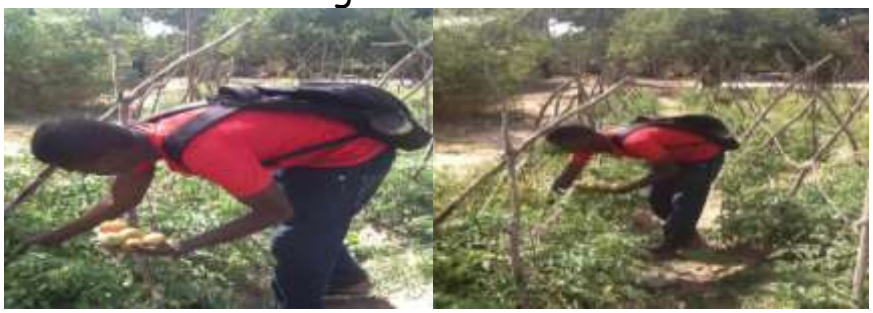
Application of pesticide was done 3 times at different intervals using neem solution. Leaves of neem were collected and fermented into a 60-liter pan of water with soap. First application was done at second week after transplanting (at the vegetative stage) and second application was carried out at flowering stage, the third application was done at fruiting stage, and the final application was done a week before harvest. 3 liters of neem solution was applied in each experiment bed. The same procedures were applied in all stages of application.

Plate 12: Pesticide application

Harvesting

Harvesting was started when 75% of the fruits show signed of physiological maturity that is half ripe at 4 weeks after transplanting in order to reduce post harvest losses. Harvesting was done by hand picking the tomato fruits from the mother plant. The fruits were harvested by hand picking.

Plate 13: Harvesting



Parameters Observed

1 Plant Heights: Plant height was collected with the use of a measuring tape. A sum of five plant heights were randomly measured in each bed and the averages of the five heights were recorded per bed. The data was analyzed to determine the effects of plant height on tomato yield.

2. Stand Counts: Stand count per bed was counted at harvest to determine the number of survived plant stands that have an effect on tomato yield per hectare.

3. Total number of fruits per plots: After harvest time, all the fruits were counted from each bed and the data was recorded to determine the number of fruits produced per treatment.

4. Total yield (kg) per Plot: Harvested tomato fruits per treatment were counted to determine total tomato yield per treatment.

DATA ANALYSIS

The data collected were analyzed using SPSS and determine the variance, treatment means, and keeping $p \leq 0.05$ and data presented in tables

RESULTS AND DISCUSSION

Soil chemical properties

Soil chemical properties of experimental site before planting shows that soil pH of the area is generally acid (5.4); the organic matter content (0.37%), calcium (cmol kg -1)) is moderate while the percentage of sand, clay and silt is high (52.4%, 12.68%, 64.9%) and varies within the different replications as in Table 1 below.

Table 1: chemical properties observed

Soil properties	Soil sample value per replication			
	1	2	3	4
Soil pH (water)	5.9	5.6	5.0	5.0
Soil PH (caC12)	3.6	3.8	4.0	3.7
EC (mmhos/cm)	0.08	0.04	0.03	0.03
Organic matter (%)	0.46	0.31	0.24	0.46
Sand (%)	22.4	42.4	40.4	52.4
Clay (%)	12.68	10.68	12.68	8.68
Silt (%)	64.9	46.9	46.9	38.9

Plant height (cm) at harvest as affected by different fertilizer rates

The highest plant height (85 cm) was recorded from plots treated with poultry manure followed by fish waste (82 cm) and finally NPK 15:15:15 recorded (75 cm). The shortest plant heights were recorded under the fertilizer combination (74 cm) and the control treatment (68 cm), respectively. However, there were statistical significant differences between plots treated with fish wastes, poultry manure, combination treatment, and the control at $p \leq 0.05$. The statistical difference (Table 2) below between these treatments was probably due to the ionization rates of the different fertilizer treatments. That means that when one fertilizer ionizes faster than the other, the faster ionized fertilizer would release plant nutrients faster for plant uptake leading to faster plant growth and development. This similar observation was made by Unman, (2015) who revealed that the highest plant height

was recorded from plots treated with poultry manure that ionized faster than other fertilizers during his experiment. However, there are significant different between NPK treatment and fish waste and it is also indicate statistical different between poultry manure treatment and combination. This trend may be due to nutrient available in plot treated with both fertilizers.

Table 2. Statistical significant differences in plant heights as per fertilizer treatment

Fertilizer Centimeters	Treatments
T1- Compound fertilizer (NPK (15:15:15)	75a
T2-Fish waste	82ab
T3-Poultrymanure	85b
T4-Combination	74bc
T5-Control	68c
Means	76.5000
LSD (0.05)	.033*

Means followed by the same Letter are not statistically different at $P \leq 0.05$

Number of plants that survived at harvest as per plot

Plants that survived per plot at harvest varied from 11 to 12 plants. The high number of plants that survived per plot was obtained from T2 (12) and T4 (12 plants).While T1, T2, and T3 both recorded 11 plants, respectively, per plot at harvest. There was no significance difference indicated among the treatments tested at $P \geq 0.05$ (see Table 3 below). But there is significant difference between treatment 1 and 2, 3 and 4. Plant counts of 11 and 12 should not be statistically significantly different because those two numbers have only 1 as a difference

Table 3. Number of plants that survived at harvest time as per fertilizer treatment

Fertilizer Treatments	Number of plants that survived per plot
T1- N.P.K 15:15:15	11a
T2- Fish wastes	12ab
T3- Poultry manure	11b
T4- Combination (T1+T2+T3)	12bc
T5- Control	11a
Means	11.8000
Lsd: 0.05	0.415

Means followed by the same latter are not statistically different at $P \leq 0.05$.

Total number of tomato fruits as affected by fertilizer treatment.

Fish waste and poultry manure treatments produced the highest number of fruits (268 fruits) followed by combination treatment of NPK 15:15:15 + Fish waste+ poultry manure (236 fruits), and finally NPK 15:15:15 (204). The lowest number of fruits was recorded from the control treatment (129 fruits). There was statistically significantly different among the treatments at $P \geq 0.05$. However, there was different between treatment 1 and the rest of the other treatments as seen in the table below. These is due to the shorter period of NPK nutrient available in the soil for plant uptake compared to the fish wastes, poultry manure and combination (NPK, Fish waste, poultry manure) does. There was no significantly different reveal in plot treated with fish waste and poultry manure at $P \geq 0.05$. Therefore, there was significant different reveal between control and all the treatment probably low organic matter content in the study area unable to provide adequate nutrient to plant to produced optimum fruits number in control treatment.

Table 5: Total number of tomato fruits produced as per fertilizer treatment

Fertilizer Treatments	Total number of fruits produced
T1-NPK 15:15:15	204a
T2- Fish waste	268b
T3-Poultry manure	268b
T4Combination(NPK,Fishwaste,Poultrymanure)	236c
T5-Control	129d
Means	220.9500
Lsd (0.05)	.000**

Means followed by the same letter are not statistically different at $P \leq 0.05$

Tomato yield (kg) as affected by fertilizer treatment

Kilograms (kg) of tomato fruits produced as affected by fertilizer treatment. The highest weight was obtained from plot treated with fish waste (17.25 kg) followed by poultry manure (13.20 kg), NPK 15:15:15 (8.71 kg) and the combination treatment (11.14 kg). The lowest fruit weight was recorded under the control treatment (4.88 kg). There was significantly different among the treatments tested at $P \geq 0.05$. Therefore, there was significant different between NPK fertilizer and fish waste, poultry manure and combination ((NPK, Fish waste, Poultry manure). These may be due to the efficiency of poultry manure and fish waste nutrient to carried tomato plant to the end of it life cycle. As NPK fertilizer can easily wash away from the soil and leave the plant with less nutrient to feed on. Similar results were reported by Seran et al., (2010).

Table 6 Tomato yield (kg) as affected by fertilizer treatment

Fertilizer Treatments	Yield (kg)
T1-NPK 15:15:15	8.71a
T2-Fish waste	17.25b
T3-Poultrymanure	13.20c
T4-Combination (NPK, Fish waste, Poultry manure)	11.14c
T5-Control	4.88a
Means	11.0345
Lsd 0.05	0.00**

Means followed by the same Letter not statistically different at P≤ 0.05.

CONCLUSION AND RECOMMENDATIONS

Conclusion

From the experiment it is clearly shown that used of organic manure and inorganic fertilizer can increase the yield of tomato (mongal f1). The soil chemical analysis reveals that the area was moderately acid pH 5.4 and (0.37%), of organic matter respectively. Therefore, the highest plant height was observed from plot treated with poultry manure and lowest was recorded in control and there was significant different exist among the treatments. Plant height had more effect on plant yield. The taller tomato plant produced many fruits than shorter plant due to number of branches. However, Plants that survived at harvest show no significant different among the treatments tested. Number of plant that survived had an effect on yield of tomato.

The result obtained from the total number of fruits per plots reveal that poultry manure and fish waste fertilizer produced the high fruits number followed by combination of NPK 15:15:15, fish waste and poultry manure. However, Yield kilograms (kg) per plot show variation among the treatments. Fish waste record the high yield followed by poultry manure and control treatment obtained the lowest yield in all parameter due to low organic matter 0.37% in the study area. In conclusion, used of organic manure and inorganic fertilizer had better effect on the yield of tomato. Also

combination of 0.01kilogram and 3kilogram of both poultry manure and fish wastes also performed best on tomato.

RECOMMENDATION

For good yield and better productivity of the tomato plant, use of 15 kilograms of fish wastes per $3m^2$ plots is recommended. The same experiment should be replicated in different locations within The Gambia in order to have a broader perspective on the effects of the different fertilizers on tomato production.

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