EFFECT OF DURATION OF FRUIT STORAGE, POULTRY MANURE AND SPACING ON THE GROWTH AND YIELD OF *Solanum anguivi*

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A DISSERTATION SUBMITTED TO THE POSTGRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) IN CROP SCIENCE, DELTA STATE UNIVERSITY, ABRAKA

DEPARTMENT OF AGRONOMY

DELTA STATE UNIVERSITY, ASABA CAMPUS

AUGUST, 2016

DECLARATION

I declare that this work is an original research work carried out by me in the Department of Agronomy

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UWABOR, Omoghene Godson

Research Student

CERTIFICATION

This is to certify that this research work was carried out by UWABOR, Omoghene Godson under my supervision in the Department of Agronomy, Delta State University, Asaba Campus, Asaba.

…….. ……

Prof. F. N. Emuh **Date**

Project Supervisor

…… ……..

Prof. S. O. Akparobi

Head of Department **Date**

DEDICATION

This research work is dedicated to Almighty God for his love, glory, grace, protection, kindness and blessing he has lavished on me.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

ABSTRACT

This study was carried out in the Teaching and Research Farm of Delta State University, Asaba Campus during the 2013 cropping season to assess the effect of duration of storage, spacing and poultry manure on growth and yield of *Solanum anguivi* in Asaba area of Delta State. Two experiments were conducted: (1) Effect of duration of storage on germination of *Solanum anguivi* seed. This was a completely Randomized Design with four replicates, *Solanum anguivi* seeds were sown at intervals of 2 weeks, 4weeks, 6weeks and 8weeks. The results obtained indicated that seeds sown at 2weeks had 66% emergence, followed by 4weeks which had 45% emergence followed by 6weeks which had 29% emergence. (2) Effect of spacing and poultry manure on the growth and yield of *Solanum anguivi.* It was a factorial experiment carried out in RCBD with three replicates. Four rates of poultry manure (0ton/ha, 15ton/ha, 30ton/ha and 45ton/ha) were applied to four spacing (50cm x 10cm, 50cm x 20cm, 50cm x 30cm and 50cm x 40cm) and the growth and yield indices were evaluated. Results obtained indicated that plants that received 45ton/ha had the highest yield mean values of 34.9, 81.8, 107.1 and 203.5 at 10, 12, 14 and 16 weeks respectively. Plants spaced 50cmx40cm also had the highest yield mean values of 24.6, 59.0, 82.8 and 134.8 at 10, 12, 14 and 16 weeks respectively. Results of interaction of spacing x poultry manure showed that there was significant difference ($p<0.05$). Based on this study, it is recommended (i) seedling of *Solanum anguivi* should not be stored for more than two weeks (ii) spacing of 50cm x 40cm be used (iii) application rate of 45ton/ha of poultry manure be applied as amendments.

CHAPTER ONE

Introduction

Solanum anguivi lam belongs to the family Solanaceae. It is believed to have originated from Africa (Elekofehinti, Adanlawo, Saliu, Fakoya and Sodehinde, 2012). *Solanum anguivi* is widely distributed in non arid areas of Africa notably West Africa, central Africa, East Africa and Southern Africa (Denton and Nwangburuka, 2011). It is highly polymorphic (having different forms) and variable in its plant structure, fruit and leaf characters. *S. anguivi* is regarded as the most likely wild progenitor of the egg plant *Solanum aethiopicum* (Schippers, 2000).

Solanum anguivi is a medicinal plant that improved health both in the ancient times and the Modern age of today. Its fruit is eaten in south western region of Nigeria where it is called "Igba yirin" because it is believed to reduce hypertension (Elekotehinti *et al.,* 2012). The roots which are crimson in colour, have expectorant quality useful for coughs, catarrhal, colic, nasal disorder, ulcers, asthma, tooth ache, nervous disorder and fever (Zhu, Honbu and Ikeda, 2000).

Solanum species fruit consists of 89% water, 8% carbohydrate, 1.4% protein and 1.5% fibre while the leaves contains 86% water, 6% carbohydrate, 4.6% protein, 1.6% fibre and 1% fat. The leaves are rich in calcium (Schippers, 2000; Adeyemi and Olaniyi, 2008).

In Nigeria, its leaf is consumed as vegetable, while in Ghana, the fruits is used as an appetizer (Bukenya, 1980), Similarly in Cameroon, the bitter fruits are an important ingredient of a dish called 'nkwi' used both in fresh or dried state and even grounded form and are used as a seasoning to add taste to soup (Schippers, 2000). The seed of S. *anguivi* is dispersed with the help of birds which drops the seeds after eating the berries (Zhu *et al.,* 2000).

In Nigeria especially Delta State *Solanum anguivi also called "enunu" by the Ukwanis* is found in the wild. This highly important vegetable with its medicinal properties and nutritive value is going into extinction. There is a need to domesticate this crop found in the wild.

1.2 Justification of the Study

Very little or nothing is known about *Solanum anguivi* in south-south region of Nigeria or even Nigeria at large.

Solanum anguivi is an important medicinal plant that should not be allowed to go into extinction especially with its increasing rate of medicinal or medical benefits for anti-hypertension, asthma, nasal disorder, ulcers, tooth ache, nervous disorder, fever to mention a few (Zhu *et al.,* 2000).

1.3 Objectives of the Study

i. To assess the effect of duration of seed storage on the germination of *S. anguivi*.
ii. To identify the best spacing for optimum growth and yield of *S. anguivi*
iii. To determine the best level of poultry manure application for optimum growth and yield of *S. anguivi*

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin and Distribution of *Solanum anguivi*

S. *anguivi* is a native to Africa, widely distributed in the continent (Bukenya, 2004). It is found in West Africa, as well as central Africa, East Africa, Southern Africa, Madagasca and neighboring African Islands and Arabia. S. *anguivi* also occurs in all non-arid regions of the tropical Africa. It grows in the wild save in Uganda and Cote d'Ivoive where it is semi cultivated (Bukenya, 2004).

2.2 Botany of *Solanum anguivi*

S. *anguivi* is an annual or bi-annual plant, grows up to 3m tall with spreading branches. Stem are often prickly, bearing small star like hairs with 4-8 arms (USDA, 2001).

Leaves are alternate, simple without stipules and has petiole of 2-6cm long with densely stellate hairy, elliptical-ovate 10-20cm x 5-10cm, sinuate to distinctly lobed, with 2-4 pairs of lobes 2-3cm long base without symmetrical sides. Apex has blunt tipped leaves on both surfaces with more or less sessile stellate hairs having 6-10 more or less equal arms (USDA, 2001).

The inflorescence is a receme-like cyme, extra-axillary with 5-15 flowers. Flowers are bisexual and regular. Pedicel are 4-15mm long, calyx densely hairly, lobes 0.3mm long, corolla 6-12mm in diameter having white or pale purple veins (Lester and Niakan, 1986).

Stamens are alternate with corolla lobes, filaments short and thick. Anthers Connivent, yellow and opening by terminal pores. Ovary is superior, 2-6 celled, style is as long as Stamens or slightly longer than stamens with small stigma (Lester and Niakan, 1986).

The fruits are globe shaped berry, 7-18mm in diameter smooth, green or white when immature, red in colouration when ripe and in dusters of up to 20 fruits, stem 8-15mm long, usually erect, sometimes curved (Bukenya 2004).

2.3 Climatic and Soil Requirements

Solanum anguivi does well in relatively humid localities. *S. anguivi* shares same soil and climatic requirements with *S. aethiopicum* since *S.anguivi* is its wild progenitor.

S. anguivi requires fairly deep and well drain sandy loam soils with pH of 5.5 – 6.8 and temperature of 25-45^{o}C during the day and 20-27^{o}C at night. It does not survive frost or very wet and water logging conditions (Nabakooza, 2003).

2.4 Importance of *Solanum anguivi*

S. anguivi is a medicinal plant that has improved health both in the ancient and the modern age of today. Its fruit is eaten in south western region of Nigeria because it is believed to reduce/cure hypertension (Elekofehinti *et al.,* 2012).

The roots which are Crimson in colour, have expectorant quality useful for coughs, catarrhal, colic, nasal ulcers, asthma, tooth ache, nervous disorder and fever (Zhu *et. al.,* 2000).

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In Nigeria, its leaf is consumed as vegetable while in Ghana, its fruits is used as an appetizer (Bukenya, 1980). In Cameroon, the bitter fruits are an important ingredient of a dish called ‘nkwi’ used both in fresh or dried state and even grounded form and are used as a seasoning to add taste to soup (Schippers, 2000).

2.5 Cultivation of *Solanum anguivi*

Emergence of the seedling starts about a week after sowing, with epigeal germination, after which the cotyledons expand and the first true leaves form a rosette (Bukenya, 2004). Heat treatment (dry heat and hot water) are alternative physical techniques for the use of chemicals to reduce seed borne fungi and therefore increase in percentage germination of *Solanum gilo* seed (Umechuruba, Bassey and Herold, 2013). Heat treatment of *S. gilo* seeds at temperature if 90^{o}C for 20, 40 and 60 minutes will eliminate seed borne fungi but will affect seed viability (Umechuruba *et al.,* 2013. Heat treatment of *S. gilo* should be given dry heat or hot water treatment at 30^{o}C for 60 minutes because this treatment reduces seed borne fungi significantly ($p<0.05$) and enhance optimum seed germination (Umechuruba *et al.,* 2013).

Seeds of *S. anguivi* can be sown in nursery beds, polytene bags or boxes. The seeds be may broadcasted or sown in lines 10 – 20cm spacing and covered with little soil. The nursery requirement is manuring for good emergence of seedlings (Bukenya, 2004).The soil for the nursery should be loosened to facilitate rooting and transplanting in 4-6 weeks after emergence, when the seedlings are at least 6-8cm tall and have 5-6 true leaves, but are not more than 15cm tall to avoid weak and thin plants (Bukenya, 2004). The seedlings selection based on strength and freedom from disease ensures adequate stands (Zhu *et al.,* 2000). Adequate water is needed just before and immediately after transplanting since roots are sensitive to drought (Lester and Seck, 2004)

Flowering starts 2-3 months after germination flowers open early in the morning when it is still dark. It is mainly self pollinated, but crossing by bees may take place. The stigma is receptive some hours before the flowers are open and remains receptive for about two days (Ripperger and Himmelreich, 1994).

The harvest of the fruits starts 2.5 – 3months after planting establishment. Fruits are ready for picking 2 -3 weeks after fruits set (when fruit have reached a reasonable size but are still immature and green). Only the quantity needed for immediate consumption is harvested (picked). It keeps producing for up to a year or more. When seeds are required, fruits are allowed to reach full maturity turning orange –red in colour (Bukenya, 2004).

Fresh fruits are easily transported and can be stored under shade or in cool place. Sun drying of fruits after cooking is practiced to preserve them (Bukenya, 1980). The fresh fruits when stored under shade or in a cool place has a shelf life of about 3-6 days while when refrigerated has a shelf life of about one month or more (Nabakooza, 2003).

2.6 Effect of Duration of Storage on Germination

Seed quality and viability of S. *anguivi* is affected by seed extraction method, duration of storage, temperature and fruit maturity. Duration of storage of the seed of S. anguivi is not known yet (Denton and Nwangburuka, 2011).

Givelberg, Horowitz and Poljakoff (2002) reported high levels of germination at constant temperature of 25-30^{o}C for seeds of *Solanum nigrum* stored at room temperature for 2 months after collection or stored at 50^{o}C for 6 months.

Roberts and Boddrell (2002) reported 80%germination at 20-30^{o}c for seeds of *Solanum sarrachoid* stored for 3 months.

In a work done by Nona (2009) where he investigated the timing of seed germination in the weedy species of *solanum nigrum* L., as affected by the level of dormancy and temperature conditions. Germination requirements of non stratified seeds and seeds stratified at 5^{0}C and 15^{0}C were investigated. Germination was tested at (i) constant temperatures ranging from 6 to 38^{0}C (ii) alternating temperatures with 15^{0}C constant amplitude and increasing mean

temperatures from 16 to 33.5^{0}C and (iii) alternating temperatures with constant mean temperature of 25^{0}C and increasing amplitude from 0 to 20^{0}C. He concluded that seed germination of *S. nigrum* depends on the level of dormancy and to a large extent on the current temperature. Seeds with lower level of dormancy germinated at constant temperatures and alternating temperatures resulting in a high percentage of germination in seeds with different levels of dormancy.

Suthar, Naik and Mulani (2009) reported that mature freshly collected air dried seeds showed 52% germination while maximum percentage of seed germination(*Solanum nigrum*) showed at room temperature.

Nemati, Nazdar, Azizi and Arouiee (2010) reported that effect of cultivar on traits was significant, also the effect of temperature of fermentation, duration of fermentation and interaction effects of them(25^{0}C and 350c at 24h, 48h, 72h, 96h, 120h and 144h) on seed germination was significant. They further reported that total seed quality decreased with increasing temperature and duration of fermentation and the fermentation duration from 24 to 48 hours at temperature 25^{0}C is recommended.

2.7 Effect of Spacing and Poultry Manure on Growth and Yield of S. *anguivi*

Malik, Nehra and Singh (1999) reported that the closest spacing had the highest plant height while number of branches per plant were highest in the widest spacing in radish.

Decreasing plant density significantly increased number of branches in soybeans but increasing plant density increased significantly plant height (El Badawy and Mehasen, 2012).

Aniefiok, Idorenyin and John (2013) reported that poultry manure increases the yields of pastures and crops including vegetables. The positive yield response from poultry manure is

attributed to increased nitrogen nutrition (Hochmuth, Donleye and Hochmuth, 1993; Opera and Asiegbu, 1996).

In addition to its value as an organic nitrogen source, poultry manure has also been shown to increase soil organic matter content and to effectively reduce root knot nematode populations and root galling in vegetables (Cheung and Wong, 1983; Babatola, 1989; Chindo and Khan, 1990).

The superiority and richness of poultry manure over other manures has been confirmed in many experiments (Asiegbu, 1987, De lannoy and Romain, 2001). Asiegbu (1987) reported that the application of 10 tonnes per hectare of poultry manure gave a significantly greater number of fresh pods and fresh pod weight in okra when compared with 50kg N + 22kgP + 60kg k ha^{-1}.

Christo, Okorie and Chikere (2011) also reported that poultry manure is essential for establishment and maintaining optimum soil physical condition and important plant growth, also that the application of nitrogen a major component of poultry manure improves the yield of eggplant as reported by DIPA (2006) is 1.0- 1.8% N, 0.4-0.8% and 0.5-1.9% k.

Mbagwu (1992) and Nnaji, Mbagwu and Asadu (2004) reported that organic manures have high agricultural value as soil amendment materials. Girma and Emdale (1995) indicated that application of organic manure increases the water holding capacity and soil structure. In many tropical soils, organic manure has been reported to be major source of nitrogen, phosphorus, potassium and sulphur (Olanikan, 2006).

Application of poultry manure increases carbon content, water holding capacity, aggregation of soil and decreases bulk density (Egerszegi, 1990).

2.8 Pests and Diseases of *S. anguivi*

It is susceptible to the rust (*Puccina substriate* var. indica) but it is very resilient and resistant to diseases and pests that affects many other *solanum* species.

Spider mites (*Hemitar sonemus* and *Tetran cychus*) are serious problem in drier regions, acaricides sprays can control them. Birds, fruit and flower borers (*Leucinodes* and *scrobipalpa*) Bukenya, 2004).

Anjorin, Salako and Usman (2010) reported that *Solanum melongena* are affected by *Aspergillus flavus, A. miger, A. tamari* and Penicillium oxalicum, he further reported that seed should be treated with Albit biosubstance before planting for optimum yield.

Onekutu, Omoloye and Odeniyi (2010a) reported the infestation of *Solanum gilo* by *L. orbonalis*. He went further to recommend that 200mls/ha of karate (R) 5EC as an effective insecticide for the control of *L. orbonalis.*

Onekutu *et al*. (2010b) also reported that the infestation of *Leucinodes orbonalis Guenea* attack on *Solanum gilo* both vegetative and reproductive stages at 56.51% and 56.61% of shoot and fruit infestation respectively. Eggplant farmers should adopt wider spacings so as to minimize egg plant infestation by shoot and fruit borer (Degri, 2014).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Site Description

The experiments were carried out during 2013 cropping season at the Teaching and Research Farm of Delta State University, Asaba Campus, Asaba. Asaba is located on latitude $06^{o}14$ N and longitude $06^{o}49$ E. Asaba lies in the tropical rain forest zone and is characterized by rainfall between April and October, with a dry spell in August. The mean annual rainfall ranges from 1500mm to 2000mm, with its rainfall peak in July and September. The mean temperature is 23.8^{o}c with 37.3^{o}c maximum and relative humidity is between 79-80% while mean sunshine stands at 4.8 bars (Meteorological Office Asaba, 2003).

3.2 Pre Planting Soil Analysis

Representative surface soils (0-20cm) were sampled with a tubular sampling soil auger. These soil samples were air dried at room temperature and crushed to pass through 2mm sieve Mesh, sub-samples from the bulked soil sample were further grounded to pieces to pass through 100mm-mesh sieve for the determination of organic matter. The samples were than analysed to determine the physical and chemical properties of the soil. The analysis was done at Delta State University Asaba Campus Asaba soil/crop science standard laboratory.

Analytical procedure

Physical properties

Particle size distribution: Particle size distribution was analysed using the Bouyoucos hydrometer method in which 0.5 N sodium hexameta-phosphate was used as dispersant (Landor, 1991). The texture was evaluated using the USDA soil textural triangle.

Chemical Properties

Soil pH: This was determined in water suspension (1:1) using glass electrode p^H-meter as described by Mclean, (1982).

Organic carbon: This was determined using the wet oxidation method of Walkley and Black (Walkley and Black, 1945).

Organic Matter : This was determined using the wet oxidation method of Walkley and Black (Walkley and Black,1945).

Total nitrogen: This was determined using the modified KJeldah wet distillation method as described by landor,(1991). Available phosphorus: This was determined by Bray No. 1 method as described by Landor, (1991).

Exchangeable cations were determined by extracting the cations with IN ammonium acetake (IN NH_4OAC) as displacing solution, buffered at pH 7 as described by Thomas (1986). The extract was then determined using atomic absorption spectrophometry for Mg and Ca while Na and K were determined by EDTA titration method. The exchangeable acidity was determined by titration with KCL as described by Juo, (1981) and expressed in $Cmolkg^{-1}$. Cation exchange capacity (CEC) was determined by neutral Ammonium – solution as modified by Anderson and Ingram (1996).

3.3 Seed Procurement and Storage

Seeds used for this experiment was sourced locally from Delta State.

The ripe fresh fruit pods were dried under room temperature and also stored under room temperature in paper bag.

3.4 Experiment 1: Effect of duration of storage on germination of *S. anguivi*

3.4.1 Aim of Experiment: The aim of the experiment was to asses the effect of duration of storage on germination of *Solanum anguivi.*

3.4.2 Experimental Design

The experiment was a completely randomized design (CRD) with four replicates. The treatments were the various intervals which the seeds was planted (2 weeks, 4 weeks, 6 weeks and 8 weeks).

3.4.3 Land Preparation and Plot Layout

Soil packed into polythene bags, 2 polythene bags represented a plot, replicated four times. Hundred (100) seeds were planted in each polythene bag. The total number of polythene bags (plots) laid out in the entire experiment was 16.

3.4.4 Data Collection and Statistical Analysis

Data collected were total number of seeds germinated 14 days after sowing. Data collected were subjected to analysis of variance (ANOVA).

3.5 Experiment 2

Effect of Spacing and poultry manure on the growth and yield of *S. anguivi*

3.5.1 Aim of Experiment

The aim was to identity the best spacing and the best rate of application of poultry manure for optimum growth and yield of S. *anguivi*

3.5.2 Experimental Design

The experiment was a 4x4 factoral experiment carried out in a Randomized Complete Block Design (RCBD) field layout with three replicates. The treatments were four different

plant spacing and four different rates of poultry manure. The spacings are 50cmx10cm, 50cmx20cm, 50cmx30cm and 50cmx40cm while the rates of poultry manure are: 0t/ha, 15t/ha, 30t/ha and 45t/ha.

3.5.3 Agronomy Practices

Among the agronomic practices were land preparation/plot layout, transplanting, application of treatments various spacings and various rates of poultry manure and weeding.

3.5.4 Land Preparation and Plot Layout

The land was ploughed and harrowed using a tractor. Four blocks consisting of 16 plots each were laid out, with three (3) replicates. Each plot measuring 2mx2m and separated from each other with a space of 1m. Pathways of 1m also separated each replicate and a total of forty-eight (48) plots was laid out in the entire experiment.

3.5.5 Transplanting and Manure Application

Well decomposed poultry droppings was obtained from deep litter system of poultry management within the study area, poultry manure was incorporated into the plot two weeks before transplanting.

S. anguivi stands was transplanted to the plots at the rate of one plant per stand, using 50cmx10cm, 50cmx20cm, 50cmx30cm, 50cmx40cm as indicated by the second experiment.

3.5.6 Data Collection and Statistical Analysis

Six (6) middle stands were used as sample population for data collection. Data collect were plant height (cm), number of leaves, leaf area (cm^2), stem girth (cm), 1000 seed weight (g) and the total number of fruit. Plant height was measured with tape from the base of the plant

to the tip of the plant. Leaf area was measured using graphical method. Number of leaves of plant was obtained by counting, stem girth was measured using vernal caliper and total number of fruit was also obtained by counting.

Data collected were subjected to analysis of variance (ANOVA) and means separated ($p>0.05$) using Duncan Multiple Range Test (DMRT).

CHAPTER FOUR

RESULTS

4.1.0 Soil Physico-Chemical Properties of the Experimental Site

The pre-physico-chemical properties of the experimental site is shown in Table I. The result showed predominantly sand at the surface and this tends to decrease with depth of profile. Texturally, the soil of the experimental site is classified as sandy clay loam. The soil is slightly acidic with a pH in water of 6.2

The organic matter content and total nitrogen were low with value of 1.23 gkg^{-1} and 0.113gkg^{-1}. The available P was high with value of 25.4$mgkg^{-1}$. The exchangeable cations (Ca, Mg, K and Na) were equally low with values of 2.60 $cmolkg^{-1}$ for Ca^{++} and 0.90 $cmolkg^{-1}$ for Mg^{++}. The value obtained for Na^{+} was 0.03 $cmolkg^{-1}$ which was low while that for k^{+} was 0.08$cmolkg^{-1}$, which was low. The CEC was 8.75cmol, this was rated low. The exchangeable acidity was low to moderate depicting the slightly acidic nature of the soil.

4.1.1 Chemical Properties of Poultry Manure Used For The Experiment.

The nutrient content of organic manure (poultry Manure) used in the study is shown in Table 2. The results showed that the poultry droppings were moderately acidic with a Ph value of 5.8, Organic Carbon content was high with a value of 17.7gkg^{-1}, Total N with a value of 19.3$gkg^{-1,}$ Available P with a value of 28.9$mgkg^{-1}$, The values for Ca (21.1$gkg^{-1)}$,Mg (3.50$gkg^{-1)}$, K (14.7gkg^{-1}) clearly showed that the poultry manure was rich in nutrient reserve. The micronutrients of Zn(1.10gkg^{-1}), Mn (0.64gkg^{-1}) were low and considerably enough for the study.

Table 1: **Soil Physico-Chemical Properties of Experimental Site**

SOIL PROPERTY		VALUE
Particle size distribution (%)		
	Sand	79
	Silt	9
	Clay	12
	Texture	Sandy clay loam
Soil pH	**H_20**	6.2
	Organic matter (gkg^{-1})	1.23
	Total Nitrogen (gkg^{-1})	0.113
	Available P ($Mgkg^{-1}$)	25.4
	Exchangeable bases ($cmolkg^{-1}$)	
	Ca^{++}	2.60
	Mg^{++}	0.90
	k^{+}	0.08
	Na^{+}	0.03
		3.61
	Exchangeable acidity ($cmolkg^{-1}$)	
	Al^{3+}	0.25
	H^{+}	1.5
	Cation exchangeable capacity ($cmolkg^{-1}$)	8.75

Table 2: Chemical Properties of the Poultry Manure Used for the Experiment

Parameters	Value
pH	**5.8**
OC (gkg^{-1})	**17.7**
Total N(gkg^{-1})	**19.3**
Available P($mgkg^{-1}$)	**28.9**
Ca(gkg^{-1})	**21.1**
Mg(gkg^{-1})	**3.50**
K($gkg^{-1)}$	**14.7**
Zn(gkg^{-1})	**1.10**
Mn(gkg^{-1})	**0.64**

4.2 Effect of Duration of Seed Storage on Germination of S. *anguivi*

The response of Seedling emergence of S. *anguivi* to duration of storage is shown in Table 3. There were significant differences in duration of storage as it affects germination. The first planting had the highest percentage emergence values 66%, 45%, 29% and 18% at 2, 4, 6 and 8 weeks respectively.

Table 3: Effect of Duration of fruit Storage on % Seedling Emergence of *S. anguivi*

Duration Of Storage (Weeks)	Percentage (%) Emergence
2	66^{d}
4	45^{c}
6	29^{b}
8	18^{a}

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan multiple range test (DMRT)

4.3.0 Effect of Spacing on Number of Leaves of S. *anguivi*

The effect of spacing on number of leaves gradually increased from 2 – 16 weeks after transplanting. There were significant differences ($p<0.05$) in the number of leaves among various spacing's. Plants with the spacing of 50cmx40cm had the highest number of leaves with mean values of 20.2, 32.5, 52.5, 67.0, 75.8, 93.9, 111.4 and 112.0 at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively while plants with the spacing of 50cmx10cm had the least number of leaves with mean values of 6.7, 8.7, 13.4, 16.6, 20.0, 26.5, 33.0 and 34.0 at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively.

Table 4: Effect of Spacing on Number of Leaves of S. *anguivi*

Spacing (cm x cm)	Weeks After Transplanting(WAT) 2	4	6	8	10	12	14	16
50 x 10	6.7[d]	8.7[d]	13.4[d]	16.6[d]	20.0[d]	26.5[d]	33.0[d]	34.0[d]
50 x 20	15.9[c]	20.5[c]	29.2[c]	33.3[c]	40.1[c]	44.5[c]	47.5[c]	48.0[c]
50 x 30	18.7[b]	25.9[b]	37.1[b]	42.8[b]	50.0[b]	54.7[b]	54.7[b]	60.0[b]
50 x 40	20.2[a]	32.5[a]	52.5[a]	67.0[a]	75.8[a]	93.9[a]	111.4[a]	112.0[a]

Means with the same letter under the same column are not significantly different (p<0.05) using Duncan multiple range test (DMRT)

4.3.1 Effect of Poultry Manure on Number of Leaves of S. *anguivi*

The response of number of leaves of S. *anguivi* to poultry manure are shown in Table 5. The number of leaves of S. *anguivi* gradually increased from 2-16 weeks after transplanting. There were significant differences in the number of leaves with respect to the rates applied. Plants that received 45ton/ha had the highest number of leaves with mean values of 18.6, 27.7, 49.0, 58.2, 68.8, 81.1, 96.1 and 96.3 at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively. while the plants that received 0ton/ha had the lowest number of leaves with mean values of 11.4, 14.8, 19.3, 24.0, 27.1, 29.5, 33.5 and 34.0 at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively

Table 5: Effect of Poultry Manure on Number of Leaves of *S. anguivi*

Rates of poultry manure (ton/ha)	Weeks After Transplanting 2	4	6	8	10	12	14	16
0	11.4[d]	14.8[d]	19.3[d]	24.0[d]	27.1[d]	29.5[d]	33.5[d]	34.0[d]
15	14.6[c]	20.8[c]	27.6[c]	33.1[c]	39.2[c]	49.0[c]	55.5[c]	55.8[c]
30	16.9[b]	24.0[b]	36.5[b]	44.1[b]	50.7[b]	60.0[b]	69.3[b]	70.0[b]
45	18.6[a]	27.7[a]	49.0[a]	58.2[a]	68.8[a]	81.1[a]	96.1[a]	96.3[a]

Means with the same letter under the same column are not significantly different (p<0.05) using Duncan Multiple Range Test (DMRT).

Table 6: Effect of Interaction of Spacing and Poultry Manure on Number of Leaves of S. *anguivi*

Spacing (cm x cm)	Poultry manure (ton/ha)	Weeks After Transplanting 2	4	6	8	10	12	14	16
50 x 10	0	5.3	7.6	10.3	13.3	14.6	17.3	18.6	20.0
	15	6.0	7.3	12.0	14.6	17.3	25.0	32.0	30.0
	30	7.6	9.0	13.6	18.0	21.3	30.6	37.3	40.0
	45	8.0	11.0	17.6	20.6	26.6	33.3	44.0	45.0
50 x 20	0	8.0	10.0	11.6	12.3	17.3	20.0	21.3	25.0
	15	16.3	20.6	22.0	24.0	30.6	35.0	37.6	36.0
	30	18.0	23.3	31.3	39.6	48.0	51.3	55.3	59.0
	45	21.3	27.3	52.0	57.3	64.6	72.0	76.0	84.0
50 x 30	0	15.0	18.3	24.6	30.6	34.0	36.6	43.3	40.0
	15	18.3	25.3	32.6	36.6	47.6	57.0	59.3	58.2
	30	19.6	28.6	40.0	49.3	55.6	58.3	63.3	80.0
	45	22.0	31.3	51.3	54.6	62.6	67.0	82.6	105.0
50 x 40	0	17.3	23.3	30.6	40.0	42.6	44.0	50.6	51.1
	15	18.0	30.0	44.0	57.3	61.3	79.3	91.6	99.0
	30	22.3	35.3	61.3	70.6	78.0	100.0	121.3	101.
	45	23.3	41.3	75.3	100.3	121.0	152.3	182.0	150
SP		*	*	*	*	*	*	*	*	*
PM		*	*	*	*	*	*	*	*	*
SP x PM		*	*	*	*	*	*	*	*	*

Where: ** = significant at 1% *= significant at 5% Ns = not significant SP= spacing PM= Poultry manure

4.4.0 Effect of Spacing on Plant Height (cm) of *S. anguivi*

Table 7 shows the effect of spacing on plant height of *S. anguivi.* There were gradual increases in plant height from the 2–16 weeks after transplanting. At each of the weeks plants with the spacing 50cm x 10cm grew taller with mean values of 14.3cm, 25.2cm, 37.0cm, 45.1cm, 50.4cm, 62.6cm, 74.1cm and 75.0cm at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively) than

the other spacings (50cmx20cm, 50cmx30cm and 50cmx40cm). There were significant differences among the various spacings.

Table 7: Effect of Spacing on Plant Height (cm) of *S. anguivi.*

	Weeks After Transplanting							
Spacing (cm x cm)	2	4	6	8	10	12	14	16
50 x 10	14.3[a]	25.2[a]	37.0[a]	45.1[a]	50.4[a]	62.6[a]	74.1[a]	75.0[a]
50 x 20	10.3[b]	18.2[b]	26.9[b]	36.1[b]	40.5[b]	50.5[b]	51.3[b]	51.5[b]
50 x 30	8.2[c]	13.3[c]	18.8[c]	30.8[c]	33.9[c]	48.8[c]	54.7[c]	54.8[c]
50 x 40	6.7[d]	12.4[d]	18.1[d]	24.6[d]	30.3[d]	36.7[d]	39.3[d]	41.1[d]

Means with the same letter under the same column are not significantly different (p<0.05) using Duncan Multiple Range Test (DMRT).

4.4.1 Effect of Poultry Manure on Plant Height (cm) *S. anguivi*

The response of plant height to poultry manure were significantly different at various rates of application because higher rate of application of poultry manure resulted in higher plant height(45ton/ha with mean values of 12.6cm, 30.7cm, 43.2cm, 55.8cm, 64.2cm, 75.6cm, 79.2cm and 80.1cm at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively)

Table 8: Effect of Poultry Manure on Plant Height of *S. anguivi*

	Weeks After Transplanting							
Rates of Poultry Manure (ton/ha)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
0	7.2[d]	8.1[d]	9.9[d]	14.5[d]	13.3[d]	18.0[d]	28.7[d]	28.7[d]
15	9.1[c]	12.8[c]	17.2[c]	21.2[c]	28.1[c]	43.6[c]	53.4[c]	54.0[c]
30	10.7[b]	17.5[b]	30.6[b]	45.2[b]	49.4[b]	60.6[b]	68.2[b]	69.0[b]
45	12.6[a]	30.7[a]	43.2[a]	55.8[a]	64.2[a]	75.6[a]	79.2[a]	80.1[a]

Means with the same letter under the same column are not significantly different (p>0.05) using Duncan Multiple Range Test (DMRT).

Table 9: Effect of interaction of spacing and poultry manure on plant height (cm) of *S. anguivi.*

		Weeks After Transplanting							
Spacing (cm x cm)	**Poultry manure (ton/ha)**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
50 x 10	0	10.0	10.0	12.5	18.2	21.0	30.0	39.7	42.5
	15	12.1	20.2	28.2	31.0	38.0	54.4	72.6	74.0
	30	15.0	28.4	49.3	60.2	62.6	71.4	84.1	85.0
	45	20.2	42.3	58.1	71.1	80.0	94.6	100.0	101.2
50 x 20	0	6.6	8.2	10.4	16.1	12.0	12.6	34.3	32.3
	15	11.0	14.0	18.2	22.6	30.3	48.0	60.0	60.0
	30	11.7	20.0	31.1	44.5	48.6	62.5	69.8	71.0
	45	1.0	30.5	48.1	61.3	71.1	78.8	81.4	85.5
50 x 30	0	6.2	7.8	9.0	15.0	11.3	19.3	30.1	28.4
	15	6.5	9.1	12.3	20.0	24.0	44.0	50.1	50.0
	30	9.0	10.3	20.5	38.0	44.3	60.6	68.2	70.0
	45	11.2	26.1	33.3	50.2	56.0	68.3	70.4	70.5
50 x 40	0	6.1	6.6	7.6	8.6	9.3	9.9	10.6	11.6
	15	6.7	8.0	10.1	11.1	20.0	28.2	31.0	32.0
	30	6.9	11.1	21.5	38.0	42.1	48.0	50.8	50.0
	45	7.1	23.8	33.2	40.6	50.0	60.6	65.0	63.2
SP	*	*	*	*	*	*	*	*	*
PM	*	*	*	*	*	*	*	*	*
SP x PM	*	*	*	*	*	*	*	*	*

Where: ** = significant at 1% *= significant at 5% Ns = not significant SP= spacing PM= Poultry manure

4.5.0 Effect of Spacing on Stem Girth (cm) of *S. anguivi*

The effect of spacing on stem girth of S. anguivi is presented on Table 10. Stem girth gradually increased from the 2-16 weeks after transplanting. There were significant differences in the stem girth. The spacing 50cmx40cm had the highest stem grith with mean values of 1.51cm, 1.88cm, 2.19cm, 2.47cm, 2.83cm, 3.22cm, 3.50cm and 3.50cm at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively followed by 50cm x 30cm while spacing 50cm x 10cm had the least stem girth with mean values of 0.73cm, 0.85cm,0.99cm, 1.15cm, 1.29cm, 1.42cm, 1.55cm and 1.55cm at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively.

Table 10: Effect of Spacing on Stem Girth (cm) of *S. anguivi.*

	Weeks After Transplanting							
Spacing (cm x cm)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
50 x 10	0.73[d]	0.85[d]	0.99[d]	1.15[d]	1.29[d]	1.42[d]	1.55[d]	1.55[d]
50 x 20	0.94[c]	1.10[c]	1.35[c]	1.55[c]	1.83[c]	2.10[c]	2.33[c]	2.34[c]
50 x 30	1.13[b]	1.32[b]	1.76[b]	1.99[b]	2.33[b]	2.70[b]	3.03[b]	3.04[b]
50 x 40	1.15[a]	1.88[a]	2.19[a]	2.47[a]	2.83[a]	3.22[a]	3.50[a]	3.50[a]

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan Multiple Range Test (DMRT).

4.5.1 Effect of Poultry Manure on Stem Girth (cm) of *S. anguivi*

The response of stem girth of *S. anguivi* to poultry manure is shown in Table 11. The stem girth of *S. anguivi* consistently increased from 2nd -16th weeks after transplanting. There were significant differences in stem girth on the different application rates. Higher rates of application resulted in higher stem girth(45ton/ha with mean values of 1.67cm, 1.92cm, 2.46cm, 2.68cm, 3.02cm, 3.30cm, 3.46cm and 3.47cm at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively).

Table 11: Effect of Poultry Manure Stem Girth(cm) of *S. anguivi*

	Weeks After Transplanting							
Rate of poultry manure (ton/ha)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
0	0.58^{d}	0.72^{d}	0.83^{d}	0.93^{d}	1.20^{d}	1.43^{d}	1.68^{d}	1.70^{d}
15	0.90^{c}	1.09^{c}	1.30^{c}	1.54^{c}	1.77^{c}	2.10^{c}	2.40^{c}	2.40^{c}
30	1.13^{b}	1.40^{b}	1.65^{b}	1.95^{b}	2.23^{b}	2.56^{b}	2.83^{b}	2.84^{b}
45	1.67^{a}	1.92^{a}	2.46^{a}	2.68^{a}	3.02^{a}	3.30^{a}	3.46^{a}	3.47^{a}

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan Multiple Range Test (DMRT).

Table 12: Effect of interaction of spacing and poultry manure on stem girth (cm) of *S. anguivi.*

Spacing (cm x cm)	Rate of poultry manure (ton/ha)	Weeks After Transplanting 2	4	6	8	10	12	14	16
50 x 10	0	0.40	0.50	0.60	0.60	0.63	0.70	0.86	1.00
	15	0.76	0.83	0.90	1.03	1.13	1.30	1.46	1.20
	30	0.86	1.00	1.13	1.40	1.63	1.73	1.80	2.00
	45	0.90	1.10	1.33	1.56	1.76	1.96	2.10	2.36
50 x 20	0	0.50	0.60	0.85	0.90	1.05	1.35	1.65	1.20
	15	0.90	1.00	1.03	1.23	1.63	1.93	2.10	2.00
	30	1.00	1.20	1.53	1.80	1.93	2.13	2.43	2.20
	45	1.23	1.46	1.83	2.06	2.46	2.76	2.93	3.23
50 x 30	0	0.60	0.60	0.90	1.00	1.43	1.83	2.16	2.40
	15	0.96	1.10	1.46	1.86	2.06	2.53	2.93	3.20
	30	1.13	1.56	1.86	2.06	2.53	2.73	3.06	3.10
	45	1.83	2.03	2.83	3.03	3.03	3.73	3.96	3.23
50 x 40	0	0.80	1.16	1.00	1.23	1.63	1.83	2.03	2.20
	15	1.00	1.43	1.83	2.03	2.26	2.66	3.10	3.20
	30	1.53	1.83	2.06	2.56	2.83	3.66	4.03	4.06
	45	2.73	3.10	3.86	4.06	4.56	4.73	4.86	5.06
SP	*	*	*	*	*	*	*	*	*
PM	*	*	*	*	*	*	*	*	*
SPXPM	*	*	*	*	*	*	*	*	*

Where: ** = significant at 1% *= significant at 5% Ns = not significant SP= spacing PM= Poultry manure

4.6.0 Effect of Spacing on Leaf Area (cm^2) of *S. anguivi*

Leaf area of S. anguivi as affected by spacing as presented on Table 13. Leaf area gradually increased from 2-16 weeks after transplanting. There were significant differences in leaf area of *S. anguivi* in each of the spacings. The wider spaced plants had higher leaf area than narrower spaced plants. The order of performance with respect to higher leaf area for plant based on spacing was 50cmx40cm > 50cmx30cm > 50cmx20cm > 50cmx10cm.

Table 13: Effect of Spacing on Leaf Area (cm^2) of *S. anguivi*

	Weeks After Transplanting							
Spacing (cm x cm)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
50 x 10	8.50^{d}	14.6^{d}	19.2^{d}	24.0^{d}	31.8^{d}	38.4^{d}	42.8^{d}	43.4^{d}
50 x 20	10.0^{c}	25.2^{c}	29.0^{c}	30.8^{c}	34.6^{c}	41.2^{c}	49.4^{c}	50.0^{c}
50 x 30	11.4^{b}	28.0^{b}	32.8^{b}	42.5^{b}	50.2^{b}	60.0^{b}	72.0^{b}	72.2^{b}
50 x 40	12.0^{a}	33.4^{a}	42.4^{a}	49.0^{a}	52.4^{a}	64.8^{a}	77.0^{a}	78.0^{a}

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan Multiple Range Test (DMRT).

4.6.1 Effect of Poultry Manure on Leaf Area (cm^2) of *S. anguivi*.

The response of leaf area of *S. anguivi* to poultry manure is presented in Table 14. The leaf area gradually increased from 2– 16 weeks after transplanting. There were significant differences in leaf area of *S. anguivi* in relation to different rate of application. Plants that received the highest rate of poultry manure had the highest leaf area (45ton/ha with mean values of 12.8, 34.4, 56.2, 70.5, 82.3, 83.5, 84.0 and 84.0 at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively) while plants that received 0ton/ha had the least leaf area with mean values of 9.00, 16.2, 28.6, 31.0, 35.4, 48.0, 51.9 and 52.1 at 2, 4, 6, 8, 10, 12, 14 and 16 weeks respectively).

Table 14: Effect of Poultry Manure on Leaf Area(cm^2) of *S. anguivi.*

	Weeks After Transplanting							
Rate of poultry manure (ton/ha)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
0	9.00^{d}	16.2^{d}	28.6^{d}	31.0^{d}	35.4^{d}	48.0^{d}	51.9^{d}	52.1^{d}
15	9.80^{c}	18.0^{c}	32.8^{c}	40.9^{c}	45.3^{c}	51.6^{c}	60.0^{c}	60.0^{c}
30	10.0^{b}	21.4^{b}	44.0^{b}	49.0^{b}	56.2^{b}	64.8^{b}	73.4^{b}	73.8^{b}
45	12.8^{a}	34.4^{a}	56.2^{a}	70.5^{a}	82.3^{a}	83.5^{a}	84.0^{a}	84.0^{a}

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan Multiple Range Test (DMRT).

Table 15: Effect of Interaction of Spacing and Poultry Manure on Leaf Area cm^2 on *S. anguivi*

Spacing (cm x cm)	Rate of poultry manure (ton/ha)	Weeks After Transplanting 2	4	6	8	10	12	14	16
50 x 10	0	6.00	14.8	19.9	20.2	20.2	25.5	28.1	28.4
	15	6.20	15.2	21.6	30.5	25.6	26.6	30.0	30.0
	30	10.0	18.0	25.2	28.0	30.1	34.7	44.7	44.7
	45	10.5	25.9	30.1	35.0	56.0	56.2	59.5	59.5
50 x 20	0	8.00	15.0	23.5	25.8	26.6	50.3	40.0	40.0
	15	9.00	16.8	24.3	33.1	35.2	43.2	54.0	54.4
	30	10.0	20.0	30.1	33.0	35.4	55.9	64.8	65.8
	45	12.7	28.2	36.1	70.0	85.8	86.8	76.5	76.5
50 x 30	0	10.0	15.0	31.0	33.0	41.8	56.2	60.1	60.0
	15	11.0	18.0	35.1	41.0	50.8	60.7	72.0	72.0
	30	10.0	22.0	55.4	59.3	60.0	78.7	83.4	83.4
	45	13.5	37.4	69.2	80.1	85.9	86.5	87.2	87.2
50 x 40	0	12.0	20.0	40.0	45.0	53.0	60.0	79.4	80.0
	15	10.0	22.0	50.1	57.0	71.4	75.9	84.0	84.0
	30	13.0	26.0	65.3	75.0	100.0	100.4	100.6	101.6
	45	14.5	46.1	89.0	99.9	101.9	102.5	112.8	112.8
SP		*	*	*	*	*	*	*	*	*
PM		*	*	*	*	*	*	*	*	*
SPXPM		*	*	*	*	*	*	*	*	*

Where: ** = significant at 1% *= significant at 5% Ns = not significant SP= spacing PM= Poultry manure

4.7.0 Effect of Spacing on Total Number of Fruit of *S. anguivi*

Table 16: shows the effect of spacing on the number of fruits of *S. anguivi*. There were no significant difference between 50cmx20cm and 50cmx30cm at early fruiting stage (10 WAT) but there were significance differences in subsequent weeks (12, 14, and 16).

Table 16: Effect of Spacing on Total Number of fruit of *S. anguivi*

	Weeks After Transplanting			
Spacing (cm x cm)	**10**	**12**	**14**	**16**
50 x 10	9.8^{c}	22.8^{d}	32.8^{d}	48.6^{d}
50 x 20	14.2^{b}	37.0^{c}	49.6^{c}	77.0^{c}
50 x 30	15.3^{b}	14.9^{b}	56.4^{b}	116.2^{b}
50 x 40	24.6^{a}	59.0^{a}	82.8^{a}	134.8^{a}

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan Multiple Range Test (DMRT).

4.7.1 Effect of Poultry Manure on Total Number of Fruit of *S. anguivi*

The response of the fruit of *S. anguivi* to poultry manure is presented in Table 17. The total number of fruit increased gradually from 10-16 weeks after transplanting with significant differences in each week except week 10 were 0ton/ha and 15ton/ha were not significantly different ($p<0.05$).

Table 17: Effect of Poultry Manure on Total Number of Fruit of *S. anguivi*

	Weeks After Transplanting			
Rate of poultry manure (ton/ha)	**10**	**12**	**14**	**16**
0	5.3^{c}	14.3^{d}	21.5^{d}	32.2^{d}
15	8.5^{c}	19.6^{c}	30.5^{c}	50.5^{c}
30	15.3^{b}	44.9^{b}	62.5^{b}	90.5^{b}
45	34.9^{a}	81.8^{a}	107.1^{a}	203.5^{a}

Means with the same letter under the same column are not significantly different ($p<0.05$) using Duncan Multiple Range Test (DMRT).

Table 18: Effect of Interaction of Spacing and Poultry Manure on Total Number of Fruit of *S. anguivi*

		Weeks After Transplanting			
Spacing (cm x cm)	**Rate of p.m.(ton/ha)**	**10**	**12**	**14**	**16**
50 x 10	0	2.33	3.66	8.33	13.00
	15	4.66	8.33	17.66	26.00
	30	10.66	32.00	45.00	58.00
	45	21.66	47.33	60.33	97.66
50 x 20	0	5.33	16.33	62.00	87.33
	15	8.33	21.00	30.00	36.66
	30	17.00	51.33	62.00	87.33
	45	26.00	59.33	85.00	115.00
50 x 30	0	7.33	20.66	27.66	36.66
	15	10.00	26.00	33.00	60.00
	30	12.33	38.33	55.00	100.00
	45	31.66	82.66	110.00	268.33
50 x 40	0	6.33	16.66	28.33	50.00
	15	11.00	23.33	41.66	79.33
	30	21.33	58.00	88.00	116.66
	45	60.00	138.00	173.33	293.33
SP	*	*	*	*	*
PM	*	*	*	*	*
SP x PM	*	*	*	*	*

Where: ** = significant at 1% *= significant at 5% Ns = not significant SP= spacing PM= Poultry manure

CHAPTER FIVE

DISCUSSION

5.1 Effect of Duration of Storage on Germination of *S. anguivi*

Duration of storage attributed to the differences observed in percentage seedling emergent of *S. anguivi* This is similar with the findings of Givelberg *et al*., (2002) who reported that high levels of germination at constant temperature of 25 – 30^0C for seeds of *Solanum nigrum* stored at room temperature for 2 months. It is also consistent with the findings of Roberts and Boddrell (2002) who reported 80% germination at 20 – 30^0C for seeds of *Solanum sarrachoid* stored for 3 months.

5.2 Effect of Spacing on Number of Leaves of *S. anguivi*

The differences observed in the number of leaves of ***S. anguivi*** may be attributed to increased growth rate in search for sunlight, nutrient and water because ***S. anguivi*** sown on 50cmx10cm spacing had higher number of leaves than the others which were sown on 50cm x 20cm, 50cmx30cm and 50 cm x 40cm spacing. This is consistent with the Malik *et al.,* (1999) who reported that closer spacing had the highest plant height and number of leaves.

5.3 Effect of Poultry Manure on Number of Leaves of *S. anguivi*

The variation in the number of leaves of *S. anguivi* could be traced to the difference in rates of application. Plants that received 45ton/ha of poultry manure had more leaves than plants that received 0ton/ha, 15ton/ha and 30ton/ha. Higher rate of manure enhances microbial activities as well increase soil organic matter leading to improved crop development. This is similar to the finding of Gopnaith, Supradip, Mina, Pamde, Kundu and Gupta (2008) who reported that higher rates of manure to maize crops enhanced microbial activities better than

those that received lower rates. Similarly Rose *et al.,* (1996) reported that higher rates of manure increased the amount of plant nutrients and organic matter in the soil.

The result also showed that there was significant difference in interaction between spacing and poultry manure on number of leaves

5.4 Effect of Spacing on Plant Height of *S. anguivi*

The differential growth rate observed among the different spacing may be attributed to increased competition for sunlight, water and available nutrients. 50cm x 10cm spacing had the highest plant height. This is consistent with the findings of Malik *et al.,* (1999) who reported that closer spacing leads to increased plant height and number of leaves.

5.5 Effect of Poultry Manure on Plant Height of *S. anguivi*

Plants that received higher rates of poultry manure grew taller than plants that received lower rates, possibly because of increase build up of organic matter in the soil which improves the physical structure. This supports the findings of Girma and Emdele, (1995) who reported that the application of large amount of organic manure increased the amount of plant nutrients and organic matter in the soil which generally improves the water holding capacity, structure as well as other physical properties of the soil. The result also showed that there was significant difference in interaction between spacing and poultry manure on Plant height.

5.6 Effect of Spacing on Stem Girth of *S. anguivi*

Plants with 50cm x 40cm spacing had the highest stem girth while plants with 50cm x 10cm spacing had the lowest stem girth, possibly because the plant had more soil moisture, sunlight and nutrients than closely spaced plants. This agreed with the findings of Azam *et al.,*

(2007) who reported that wider spaced plants obtained more soil moisture and nutrients than closely spaced plants.

5.7 Effect of Poultry Manure on Stem Girth of *S. anguivi*

Plants that received higher rate of poultry manure had the highest stem girth possibly because increase build up of organic matter in the soil which improves physical soil properties. This is consistent with the findings of Girma and Emdele, (1995) who reported that the application of large amount of organic manure increased the amount of plant nutrients and organic matter in the soil which generally improves the water holding capacity, structure as well as other physical properties of the soil. The result also showed that there was significant difference in interaction between spacing and poultry manure on Stem girth.

5.8 Effect of Spacing on Leaf Area of *S. anguivi*

Increased spacing resulted in larger leaf area which could be attributed to reduction in competition for water, sunlight and nutrient. This is similar to the findings of Morison (1990) that well spaced plants received more nutrient, water and sunlight and are therefore more photosynthetically efficient than closely spaced ones.

5.9 Effect of Poultry Manure on Leaf Area of *S. anguivi*

Plants that received higher rates of poultry manure had higher leaf area possibly because of increased availability of nutrient elements within the root zone. This is consistent with the findings of Christo *et al.,* (2011) which reported that higher rates if manure significantly influenced the performance of egg plant. The result also showed that there was significant difference in interaction between spacing and poultry manure on leaf area.

5.10 Effect of Spacing on Total Number of Fruit

Plants with 50cm x 40cm spacing had the highest total number of fruits which can be attributed to reduction in competition for space, water, sunlight and nutrient. This is similar to the findings of Aniefiok *et al.,* (2013) which reported that plants with ample space will compete less for environmental factors.

5.11 Effect of Poultry Manure on Total Number of Fruit

The plants that received the highest rate of poultry manure had the highest total number of fruits which can be attributed to increased availability of nutrient elements within the root zone. This is consistent with the findings of Christo *et al.,* (2011) which reported that higher rates of manure significantly influenced the performance of egg plant. The result also showed that there was significant difference in interaction between spacing and poultry manure on total number of fruit.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

The result of the research showed that S. *anguivi* seeds stored above two weeks had less percentage seedling emergence, wider spaced plants (50cm x 40cm) and higher rates of poultry manure (45ton/ha) resulted in a significantly ($p<0.05$) higher performance of growth and yield parameters.

6.2 Recommendations

In view of the results and findings in the study, it is recommended that:

i. Seedling of *S. anguivi* should not be stored for more than two weeks for optimum germination, as *S. anguivi* seed loses viability easily.
ii. Spacing of 50cm x 40cm performed better in terms of stem girth, leaf area and total number of fruit. Therefore this, spacing 50cm x 40cm should be adopted for *S. anguivi* cultivation
iii. Farmers who practice organic agriculture in Asaba agro-ecological zone should apply 45ton/ha of poultry manure to enhance *S. anguivi* yield.

6.3 Contribution to Knowledge

The study provided unique and specific contribution towards the advancement of knowledge in the area of crop production this can be itemized as follows:

i. The study has shown that storing *S. anguivi* seed above two weeks greatly affects germination.

ii. The study has shown that there is response to variation of spacing in growth and yield of *S. anguivi.*

iii. The study has also shown that there is response to variation of poultry manure application on growth and yield of *S. anguivi.*

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APPENDIX

Solanum anguivi at early stage of growth

Solanum anguivi leaf

Solanum anguivi at early flowering stage

Solanum anguivi at early flowering stage

Solanum anguivi at flowering stage

Solanum anguivi at early fruiting stage

Solanum anguivi at early fruiting

Solanum anguivi at early fruiting

Fruits of *Solanum anguivi*

Fruits of *Solanum anguivi*

Harvested fruits of *Solanum anguivi*