THE EFFECT OF MANURING ON THE GROWTH AND YIELD OF SOLANUM MELONGENA (GARDEN EGG)

BY

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ESUT/2013/146700

THESIS SUBMITTED TO THE DEPARTMENT OF APPLIED BIOLOGY AND BIOTECHNOLOGY, FACULTY OF APPLIED NATURAL SCIENCES, ENUGU STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY

IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.) DEGREE IN APPLIED BIOLOGY AND BIOTECHNOLOGY

SEPTEMBER, 2017.

CERTIFICATION

This is to certify that **AGU VICTORIA CHISOM, ESUT/2013/146700** of the Department of Applied Biology and biotechnology, Faculty of Applied Natural Science Enugu State University of Science and Technology have satisfactorily completed the requirement for the Award of Bachelor of Science (B.SC) in Applied Biology and Biotechnology. The work embodied in this research project has not been submitted in part or full for award of any degree or diploma of this or any other university or institution. The student is entirely responsible for all opinions expressed in this work as well as the integrity of the data presented.

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DEDICATION

I dedicate this thesis to God Almighty for seeing me through in this great Institution.

ACKNOWLEDGEMENT

My immense gratitude goes to God Almighty for his mercies, his love and blessings towards me.

I specially acknowledge the effort of my supervisor, Prof. G.I. Ameh, who guided me through selflessly to see that that this work was a success, thank you so much Sir.

My heartfelt gratitude goes to Dr. C. O. Edoga, the Head of Department of Applied Biology and Biotechnology and to all the lecturers who in various ways have impacted a lot in my life; Prof. H.O. Nwamba, Prof. C. S., Eze, Dr. V. S., Njom, Dr. K. O., Sowunmi and Dr. J.U. Anukwu, I sincerely appreciate your efforts.

I also want to acknowledge the various people who has helped to see to it that this research was a success my course mates. I appreciate your selfless support I would also appreciate my colleagues who made sure that this work was done.

I sincerely offer my gratitude to my parent Mr. and Mrs. Agu for their sacrifice and support both moral, spiritual and financial support. I appreciate you all that contribute to my success in one or the other; thank you so much.

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ABSTRACT

The cultivation of *Solanum melongena* (garden egg) plays an important role in food security and nutrition, but its productivity is often constrained by poor soil fertility and inadequate agronomic practices. This study was therefore aimed at evaluating the effect of different organic manures on the growth and yield performance of garden egg. The experiment was conducted at the Applied Biology and Biotechnology Garden of Enugu State University of Science and Technology, Agbani Campus. Garden egg seeds were sourced, authenticated, and raised in nursery beds before being transplanted into polythene pots containing loamy soil amended separately with poultry, pig, and goat manures, while unamended soil served as control. The experiment was laid out in 24 pots with six replications per treatment. Data were collected on plant height, number of leaves, number of roots, stem circumference, root length, and flower production. Analysis of Variance (ANOVA) was used to determine significant differences among treatments. Results showed that poultry manure significantly ($P<0.05$) enhanced all growth parameters compared to other treatments. Seedlings grown with poultry manure attained the highest plant height (37.00 ± 1.46 cm), number of leaves (23.33 ± 2.84), stem circumference (3.52 ± 0.14 cm), root number (68.50 ± 8.12), and longest root length (32.17 ± 3.56 cm). Flowering also occurred earlier in poultry manure treatments (0.67 ± 0.67) compared to pig manure (0.17 ± 0.17), while goat manure and control pots produced no flowers during the study period. Goat and pig manures supported moderate growth, while unamended soil consistently gave the poorest results. It was concluded that poultry manure is the most effective organic amendment for promoting vigorous vegetative growth and early reproductive development in garden egg. The study therefore recommends the use of poultry manure as an affordable and eco-friendly option for enhancing the growth and yield of *Solanum melongena*. Further research should investigate the combined effects of poultry manure with other soil amendments to optimize nutrient use efficiency and maximize yield.

CHAPTER ONE

1.0 PRODUCTION OF SOLANUM *MELONGENA* L.

Agriculture remains the backbone of food security and economic development in many developing countries, with vegetables playing a crucial role in providing essential nutrients and income generation for smallholder farmers. Among the important vegetable crops cultivated in tropical and subtropical regions is *Solanum melongena* L., commonly known as garden egg or eggplant, which belongs to the family Solanaceae. This versatile crop is highly valued for its nutritional content, medicinal properties, and economic importance, making it a staple in many households and commercial agricultural systems (*Mensah, Okoli, Ohaju-Obodo, & Eifediyi, 2008*). Garden egg is rich in essential nutrients including vitamins A, C, and E, minerals such as potassium, phosphorus, and magnesium, and bioactive compounds like anthocyanins and phenolic acids that contribute to its antioxidant properties (*Eleazu, Amajor, Ikpeama, & Awa, 2010*).

Despite its importance, garden egg production faces several challenges that limit optimal yield and quality. One of the primary constraints is soil fertility decline, which has become increasingly common due to continuous cropping, inadequate nutrient management, and limited use of organic amendments (*Ogunlade, Aremu, & Oshunsanya, 2012*). Poor soil fertility directly affects plant growth and yield, leading to reduced productivity and economic losses for farmers. The situation is further compounded by the high cost of synthetic fertilizers, which makes them inaccessible to many smallholder farmers, particularly in resource-constrained environments (*Akanbi, Togun, Adediran, & Ilupeju, 2002*).

1.1 ORIGIN AND DISTRIBUTION

Garden egg (*Solanum melongena* L.) has a long history of domestication and adaptation. Studies suggest that the crop was first domesticated in Southeast Asia before spreading to the Mediterranean and Africa (*Weese & Bohs, 2005*). The species originated from its wild relatives *Solanum incanum* and *Solanum insanum*, which contributed to its current diversity (*Gramazio, Prohens, & Nuez, 2003*).

Nigeria is one of the largest producers in Africa, with indigenous and introduced varieties cultivated across diverse agro-ecological zones (*Aiyelaagbe, Fagbola, & Ogunkunle, 2010*).

1.2 PLANT DESCRIPTION AND TAXONOMIC PROFILE

Garden egg, a member of the Solanaceae family, grows as an annual herbaceous plant that reaches between 50–200 cm in height. It produces purple star-shaped flowers and fruits that vary in colour and shape depending on the cultivar (*Nwofia, Ojimelukwe, & Eji, 2014*). Its deep taproot and extensive lateral roots contribute to its adaptability to different soil types.

1.4 CULTIVATION

Successful cultivation depends on proper site selection, land preparation, and soil management. The crop thrives best in well-drained loamy soils enriched with organic matter (*Okoroafor, Okelola, Edeh, Emehute, Onu, Nwaneri, & Chinaka, 2013*). Organic amendments such as poultry manure and compost enhance seedling vigor, fruit yield, and soil fertility (*Adekiya & Agbede, 2009*).

1.5 HARVESTING AND STORAGE

Harvesting typically begins 70–90 days after planting. Fruits are picked at a physiologically immature stage to maintain tenderness and quality. Delayed harvesting results in seed hardening and reduced edibility (*Okoh, Oyeniran, & Ayuba, 2015*).

Garden egg is highly perishable because of its high moisture content and delicate skin. The optimal storage temperature for maintaining freshness is 10–12°C at 90–95% relative humidity, which can extend shelf life to about two weeks (*Nwankwo, Onwukwe, & Obinna, 2016*). In rural areas, traditional storage methods such as clay pots or straw-lined pits are still used but often result in substantial post-harvest losses (*Adjei, Santo, Poku, & Antwi, 2014*). Studies have also shown that using natural coatings like cassava starch or beeswax can reduce decay and maintain firmness during storage (*Gbashi, Adebo, & Njobeh, 2015*).

1.6 NUTRITIVE VALUE

Garden egg is a nutrient-dense vegetable providing water (about 91–93%), carbohydrates (7–9 g), protein (1–1.4 g), and minimal fat (0.1–0.3 g). It is rich in vitamins (A, C, and B-complex) and minerals like potassium, calcium, and magnesium (*Mensah et al., 2008*). The fruit's phenolic compounds, particularly chlorogenic and caffeic acids, contribute to its antioxidant and anti-inflammatory properties (*Eleazu et al., 2010*).

1.7 ECONOMIC IMPORTANCE

1.7.1 Medicinal Uses

In traditional African medicine, garden egg serves therapeutic purposes for conditions such as hypertension, diabetes, constipation, and ulcers (*Ajayi & Ibekwe, 2012*). Phenolic compounds such as nasunin and chlorogenic acid demonstrate antioxidant and ACE-inhibitory effects, reducing blood pressure and improving liver function (*Okoh et al., 2015*; *Gbashi et al., 2015*).

1.7.2 Culinary Uses

The fruit is widely consumed in both raw and cooked forms, often prepared in soups and stews. Some varieties are eaten raw with groundnut paste or palm oil, particularly among the Igbo and Yoruba cultures (*Okoh et al., 2015*). The leaves of certain varieties are also cooked and consumed as vegetables after detoxification through boiling.

1.8 PESTS AND DISEASES

Garden egg is highly susceptible to pests and diseases. The most destructive pest, *Leucinodes orbonalis* (fruit and shoot borer), causes significant yield losses. Other pests include aphids (*Aphis gossypii*), whiteflies (*Bemisia tabaci*), and flea beetles (*Epitrix* spp.) (*Khan, Singh, & Rani, 2013*). Common diseases include Fusarium wilt, Verticillium wilt, damping-off, bacterial wilt, and mosaic virus infections. Control strategies include crop rotation, field sanitation, and the use of neem-based biopesticides (*Sambo, Umar, & Sani, 2016*).

1.9 STATEMENT OF THE PROBLEM

The declining yield of *Solanum melongena* in Nigeria is largely due to soil nutrient depletion, pest infestation, and dependence on costly chemical fertilizers. Although organic manures offer an affordable and sustainable alternative, their adoption is limited due to insufficient research on their

comparative effectiveness. This study therefore investigates the impact of different manure types on the growth and yield of *Solanum melongena* L.

1.10 JUSTIFICATION OF THE STUDY

Given the ecological and economic value of garden egg, it is essential to identify sustainable, low-cost production practices. Organic manures enhance soil fertility and support long-term productivity. By evaluating different manure sources, this study aims to strengthen the evidence base for sustainable vegetable farming and improved soil management.

1.11 AIMS OF THE STUDY

Following the numerous uses of *Solanum meglongena L*., in both diet and medicine, the specific objectives of the study were to;

- Measure growth and yield parameters in the different types of manure
- Compare growth and yield parameters obtained in the different manure types

CHAPTER TWO

2.1 HISTORICAL PERSPECTIVE OF MANURING

Manuring represents one of the oldest agricultural practices known to humankind, dating back thousands of years when early farmers observed the benefits of adding decomposed organic materials and animal wastes to soil to improve fertility. Archaeological evidence from ancient civilizations such as Mesopotamia, Egypt, and China shows systematic use of organic materials to enhance soil productivity (*Johnston, Poulton, & Coleman, 2010*).
In traditional African farming systems, the importance of organic matter in maintaining soil health and fertility has long been recognized. Indigenous agricultural practices such as mixed cropping, fallowing, and animal manure incorporation were vital for sustaining soil productivity before the introduction of chemical fertilizers (*Vanlauwe, Diels, Sanginga, & Merckx, 2005*).

Modern soil science defines soil fertility as the ability of soil to supply essential nutrients to plants in adequate proportions for optimal growth and yield. It encompasses physical, chemical, and biological properties that support plant development (*Brady & Weil, 2008*).
The Green Revolution of the 1960s and 1970s increased global food production through the use of synthetic fertilizers and high-yielding varieties, but also led to soil degradation, nutrient imbalance, and declining soil organic matter. Consequently, agricultural researchers advocate integrated soil fertility management that combines organic and inorganic sources of nutrients to achieve sustainable yields (*Bationo, Kihara, Vanlauwe, Waswa, & Kimetu, 2007*).

2.2 ORGANIC MATTER MANAGEMENT

Organic matter forms the foundation of soil productivity, influencing nutrient cycling, structure, and water retention. Its decomposition releases nutrients, improves aeration, and supports soil microorganisms (*Lal, 2006*). The rate at which organic matter decomposes depends on its carbon-to-nitrogen (C:N) ratio. Materials with low C:N ratios (below 25:1) such as poultry manure decompose rapidly, while those with high C:N ratios decompose more slowly and may temporarily immobilize nitrogen (*Paustian, Cole, Sauerbeck, & Sampson, 2004*). Understanding this balance is essential to synchronize nutrient release with plant needs, thereby improving crop response to manuring.

2.3 NUTRIENT CONTENTS AND AVAILABILITY

The nutrient composition of organic manures varies with animal type, feed, bedding material, storage conditions, and composting duration (*Adeniyan & Ojeniyi, 2010*). This variability determines their suitability and effectiveness in different cropping systems.

2.3.1 Poultry Manure

Poultry manure is one of the richest organic manures in terms of nutrient content, particularly nitrogen, phosphorus, and potassium. These nutrients promote vigorous vegetative growth and early fruiting (*Adekiya & Agbede, 2009*). According to *Akanmu, Olaniyi, & Olaniyi (2014)*, the application of poultry manure significantly increases plant height, leaf number, and fruit yield in garden egg compared to untreated control. Its low C:N ratio promotes rapid mineralization and nutrient availability to crops. Similarly, *Akanbi, Adebayo, Togun, Adeyeye, & Olaniran (2005)* observed that poultry manure

enhances soil fertility, increases soil pH, and supports higher dry matter accumulation in vegetable crops.

2.3.2 Cow Dung

Cow dung, though less nutrient-dense than poultry manure, releases nutrients gradually and improves soil structure over time (*Aiyelaagbe, Fagbola, & Ogunkunle, 2010*). In a comparative study, *Akanbi et al. (2005)* found that cow dung improved plant vigor and fruit yield of okra and garden egg, enhancing soil nitrogen and phosphorus after harvest. Proper composting before use reduces ammonia volatilization and improves nutrient efficiency (*Ayeni, Adetunji, Ojeniyi, Ewulo, & Adeyemo, 2010*).

2.3.3 Goat Manure

Goat manure provides a steady release of nutrients and improves soil texture due to its high fiber content (*Odedina, Odedina, Ayeni, Arowojolu, Adeyeye, & Ojeniyi, 2012*). Field observations by *Akanbi et al. (2002)* indicated that the application of goat manure enhanced canopy width and stem girth, though its yield effect was lower than that of poultry manure.

2.3.4 Pig Manure

Pig manure is an excellent source of nitrogen, phosphorus, and potassium, along with micronutrients such as calcium, zinc, and magnesium (*Gbashi, Adebo, & Njobeh, 2015*). Its favorable C:N ratio (10:1 to 20:1) supports microbial activity and nutrient mineralization. The addition of pig manure improves soil water-holding capacity, reduces compaction, and enhances cation exchange capacity (*Adediran, Taiwo, Akande, Sobulo, & Idowu, 2005*).

2.4 EFFECTS OF ORGANIC MANURING ON SOIL PROPERTIES

2.4.1 Physical Properties

Organic manures improve soil structure, reduce erosion, and enhance water infiltration (*Agbede & Adekiya, 2009*).

They also reduce bulk density while increasing total porosity and water retention. Studies in Nigerian Alfisols showed a 10–25% reduction in bulk density after consistent manure application (*Adeyemo & Agbede, 2010*).

According to *Ewulo, Ojeniyi, & Akanni (2008)*, the hydrophilic nature of organic compounds enhances soil moisture storage and drainage. Stable soil aggregates formed through organic matter application protect soil from crusting and compaction (*Ayeni, Omole, & Adeleye, 2010*).

2.4.2 Chemical Properties

Organic manures improve soil chemical properties by increasing nutrient availability, buffering capacity, and cation exchange.

Poultry manure, in particular, raises soil pH in acidic soils due to its ash and carbonate content (*Ogunlade, Aremu, & Oshunsanya, 2012*).

Organic matter also boosts the soil's ability to hold exchangeable cations, thereby improving fertility (*Odedina et al., 2012*).

Manure application enhances micronutrient solubility and phosphorus availability through chelation and improved pH (*Mmuo, Okonkwo, & Onyekwelu, 2014*).

2.4.3 Biological Properties

Organic manures stimulate soil microbial activity, enzyme function, and biological diversity, improving nutrient cycling and disease suppression (*Tiamiyu, Ahmed, & Muhammad, 2014*). According to *Okoroafor, Okelola, & Edeh (2013)*, organic amendments increase the activity of key enzymes such as dehydrogenase and phosphatase, enhancing carbon and nitrogen turnover. They also promote a more complex soil food web that supports bacteria, fungi, protozoa, and beneficial nematodes, strengthening ecosystem resilience (*Olaniyi, Akanbi, Adejumo, & Akande, 2014*).

2.5 EFFECTS OF MANURING ON VEGETABLE CROPS

Vegetable crops, being high nutrient-demanding plants, show significant responses to organic manure application.

- **Seedling Establishment:** Organic manures enhance germination, seedling vigor, and early establishment due to improved moisture and nutrient availability (*Ewulo et al., 2008*).
- **Vegetative Growth:** Manure application promotes increased plant height, stem girth, leaf area, and chlorophyll content (*Okoroafor et al., 2013*).
- **Root Development:** Organic manures enhance root depth and mass, improving nutrient uptake efficiency and drought tolerance (*Olaniyi et al., 2014*).

Overall, the use of organic manures results in improved soil fertility, healthier plants, and sustainable vegetable production systems.

CHAPTER THREE

MATERIALS AND METHODS

3.1 COLLECTION AND IDENTIFICATION OF PLANT MATERIALS

The seeds of garden egg used were purchased from New Market Enugu in Enugu North Local Government Area, Enugu State. The seeds were selected based on uniformity in size, colour, and absence of physical damage to ensure consistency in germination and growth. The Authentication of the seeds was done by Prof G.I Ameh of the Department of Applied and Biotechnology, ESUT.

3.2 COLLECTION OF MANURE

The organic manures used in this research were poultry, pig, and goat manures. They were all sourced locally from farms within Agbani environs. To ensure safety and uniformity, the manures underwent a composting process. The composting process followed the heap method where each manure type was separately heaped into piles. After composting for two weeks, the manures were air-dried, and packed into the labelled perforated polythene pots to prevent nutrient loss.

3.3 PREPARATION OF SOIL

The loamy soil used was collected from the biological Garden and was separately mixed with poultry manure, piggery manure, and goat dung in the ratio of one (1) head pan of soil to one (1) head an of manure. These were watered to facilitate the decaying process of the manures.

3.4 PREPARATION OF PLANTING POTS

Twenty-four well perforated polythene pots were filled respectively with the four different manure types already collected. Six pots were filled with each manure type, making six replications, making a total of twenty-four (24). The pots were arranged into four rows of six pots

each according to manure type. The pots were labelled using masking tape and marker for easy identification and placed at a distance of 25cm from each other to allow adequate spacing and prevent interference between treatments.

3.5 EXPERIMENTAL SITE

The research was conducted in the Applied Biology and Biotechnology Garden of Enugu State University of Science and Technology Agbani Campus located at latitude 6°, 30N and Longitude 7°, 30E. It is bounded by Nkanu West Local Government to the East, North, West and South. The experimental site provided adequate sunlight exposure and protection from extreme weather conditions.

3.6 PREPARATION OF NURSERY

The seeds were sown in nursery beds made up of three baskets filled with humus soil. The nursery beds were sprinkled with water regularly and observed for germination every morning. The nursery was covered with insecticidal treated net to scare pests.

3.7 TRANSPLANTING OF SEEDLINGS

The seedlings were transplanted three (3) weeks after germination. The transplanting was done in the evening when the sun has gone down to avoid shock. A seedling goes for each planting pots of the different medium to enable the seedlings grow faster and independently.

3.8 DATA COLLECTION

Data was collected on the following parameters after eight (8) weeks of planting.

- Number of leaves per plant obtained by counting.
- Number of roots obtained by counting.

- Number of flowers determined by counting.
- Length of internodes was determined by measuring the distance between two (2) nodes.
- Plant height was measured using a meter rule.
- Leaf area was determined by measuring by measuring the length and breadth of a leaf and multiplying by a correlation factor (0.75).
- Circumference of stem was determined by measuring the stem with a thread and placing it on a meter rule.
- Root length was determined by measuring the 3 longest roots per plant with meter rule and taking their mean.

3.9 WATERING

The seedlings were watered as the need arose because the experiment was carried out during the rainy season and rainfall was available almost throughout the period. Supplementary watering was provided during dry spells to maintain adequate soil moisture for optimal plant growth.

3.10 DATA ANAYLSIS

The data gotten was analysed using ANOVA (Analysis of variance) to determine if there is significant difference between the various parameters obtained in each manure types.

CHAPTER FOUR

RESULTS

4.1 Plant Height of Garden Egg Seedlings

The effect of medium type on the plant height of garden egg seedlings is presented in **Table 1**. Seedlings grown with poultry manure attained the greatest mean height (37.00 ± 1.46 cm), which was significantly higher ($P<0.05$) than those of other media. Pig manure (20.00 ± 1.48 cm) and sand medium (18.50 ± 2.08 cm) supported moderate growth, while seedlings grown with goat manure recorded the least mean height (14.50 ± 1.06 cm). This shows that poultry manure greatly enhanced vegetative growth, particularly in plant elongation, compared to other treatments.

Table 1: Effect of medium type on the plant height garden egg seedling

Medium type	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
				Lower bound	Upper bound
Sand	18.50	5.09	2.08	13.16	23.84
Poultry	37.00	3.58	1.46	33.25	40.76
Pig	20.00	3.63	1.48	16.19	23.81
Goat	14.50	2.59	1.06	11.79	17.22

4.2 Number of Flowers

The effect of medium type on flower production is presented in **Table 2**. Only seedlings treated with poultry and pig manure produced flowers, although the mean values were generally low. Poultry manure supported a relatively higher mean number of flowers (0.67 ± 0.67), while pig manure recorded 0.17 ± 0.17. Sand and goat manure treatments did not support flowering during the experimental period. This suggests that poultry manure not only enhanced vegetative growth but also promoted the onset of reproductive development in garden egg seedlings.

Table 2: The effect of medium type on flower production

Medium type	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
				Lower bound	Upper bound
Sand	0.00	0.00	0.00	0.00	0.00
Poultry	0.67	1.63	0.67	-1.05	2.38
Pig	0.17	0.41	0.17	-0.26	0.60
Goat	0.00	0.00	0.00	0.00	0.00

4.3 Number of Leaves

As shown in Table 3, poultry manure significantly ($P<0.05$) increased the mean number of leaves (23.33 ± 2.84) compared to the other treatments. Pig manure supported a moderate number of leaves (9.50 ± 5.32), while sand (6.33 ± 0.99) and goat manure (3.50 ± 0.68) recorded the least. The abundance of leaves in the poultry manure medium reflects its ability to improve photosynthetic potential, which is critical for plant growth and yield.

Table 3: The effect of medium type on Number of leaves

Medium type	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
				Lower bound	Upper bound
Sand	6.33	2.42	0.99	3.79	8.88
Poultry	23.33	6.95	2.84	16.04	30.62
Pig	9.50	13.01	5.32	-4.16	23.16
Goat	3.50	1.64	0.68	1.78	5.22

4.4 Stem Circumference

The stem girth of garden egg seedlings grown in different media is shown in Table 4. Poultry manure produced seedlings with significantly larger stem circumference (3.52 ± 0.14 cm) compared to other treatments. Goat manure (2.37 ± 0.04 cm), pig manure (2.28 ± 0.11 cm), and sand (2.20 ± 0.04 cm) recorded narrower stem girths. This indicates that poultry manure supplied sufficient nutrients that enhanced cell division and expansion in stem tissues, leading to stronger plant stands.

Table 4: Effect of Medium Type on the Circumference of Garden Egg Seedlings

Medium type	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
				Lower bound	Upper bound
Sand	2.20	0.09	0.04	2.11	2.29
Poultry	3.52	0.35	0.14	3.15	3.89
Pig	2.28	0.27	0.11	1.10	2.57
Goat	2.37	0.10	0.04	2.26	2.48

4.5 Number of Roots

Root proliferation as presented in Table 5 shows that poultry manure markedly increased the mean number of roots (68.50 ± 8.12), which was statistically higher than other treatments. Pig manure and goat manure both supported moderate root development (34.00 roots each), while sand medium produced the least root number (27.00 ± 2.07). This implies that poultry manure provided a favorable medium for root branching and nutrient uptake.

The Effect of Medium Type on the Number of Roots on Garden Egg Seedlings

Medium type	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
				Lower bound	Upper bound
Sand	27.00	5.06	2.07	21.69	32.31
Poultry	68.50	19.89	8.12	47.63	89.37
Pig	34.00	22.83	9.32	-57.96	57.96
Goat	34.00	8.22	3.36	25.37	42.63

4.6 Longest Root per Plant

The mean length of the longest root per plant is summarized in **Table 6**. Poultry manure once again produced the highest root length (32.17 ± 3.56 cm), followed by goat manure (11.39 ± 1.47 cm), sand (9.53 ± 1.57 cm), and pig manure (8.78 ± 1.94 cm). The significantly longer roots in poultry manure medium indicate that nutrient-rich organic amendments enhance root elongation, thereby improving the plant's ability to explore a wider soil volume for water and mineral absorption.

The Effect of Medium Type on the Longest Root per Plant of Garden Egg Seedlings

Table 6: Longest root per plant

Medium type	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
				Lower bound	Upper bound
Sand	9.53	3.86	1.57	5.49	13.58
Poultry	32.17	32.17	3.56	23.03	41.31
Pig	8.78	4.75	1.94	-3.05	13.77
Goat	11.39	3.61	1.47	7.60	15.18

4.7 Comparative Effect of Manure Types on Growth Parameters

The overall performance of garden egg seedlings across the different media is presented in Table 7. Poultry manure consistently recorded the highest mean values in all measured parameters-plant height, number of leaves, stem circumference, number of roots, and root length. Although pig and goat manures supported moderate growth in some variables, their effects were significantly lower than poultry manure. Sand medium consistently gave the poorest results in most growth indices. The trend suggests that poultry manure is the most effective organic amendment for promoting vigorous growth and early reproductive development in garden egg seedlings.

Table 7: Comparative of manure type and plant variables

Medium type	Plant height	No. of flowers	No. of leaves	Circumference	No. of roots	Longest root per plant
Sand	18.00 ± 2.08^{d}	0.00 ± 0.00^{e}	6.33 ± 0.99^{e}	2.20 ± 0.04^{e}	27.00 ± 2.07^{c}	9.53 ± 1.57^{e}
Poultry	37.00 ± 1.46^{b}	0.67 ± 0.67^{e}	23.33 ± 2.84^{c}	3.52 ± 0.14^{e}	68.50 ± 8.12^{a}	32.17 ± 3.56^{b}
Pig	20.00 ± 1.48^{c}	0.17 ± 0.17^{e}	9.50 ± 5.32^{e}	2.28 ± 0.11^{e}	34.00 ± 9.32^{b}	8.78 ± 1.94^{e}
Goat	14.50 ± 1.06^{d}	0.00 ± 0.00^{e}	3.50 ± 0.68^{e}	2.37 ± 0.04^{e}	34.00 ± 3.36^{b}	11.39 ± 1.47^{d}

Means on same rows with different superscript are statistically significant ($P<0.05$).

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Discussion

This study investigated the effect of different media types, namely sand, poultry manure, pig manure, and goat manure, on the growth and early development of garden egg (*Solanum melongena*) seedlings. The growth parameters measured included plant height, number of flowers, number of leaves, stem circumference, number of roots, and longest root per plant. The results obtained revealed clear differences among the treatments, with poultry manure consistently producing superior growth outcomes compared to the other media types.

The findings on plant height showed that seedlings grown with poultry manure attained the greatest mean height, which was significantly higher than those grown in pig manure, goat manure, or sand. The tallness of seedlings in the poultry manure treatment can be explained by the fact that poultry droppings are rich in readily available nutrients such as nitrogen, phosphorus, and potassium. Nitrogen, in particular, plays a critical role in vegetative growth by enhancing chlorophyll formation, protein synthesis, and vigorous cell division. The observed result agrees with the report of Akanbi et al. (2002), who found that poultry manure significantly promoted the growth of vegetables more than other organic manures. By contrast, the relatively lower plant height recorded in goat manure and sand treatments may be linked to the poor nutrient composition of these media, which limited the vegetative growth of the seedlings.

Flower production, which marks the beginning of the reproductive phase, was also influenced by the different media. It was observed that seedlings grown in poultry manure produced the highest mean number of flowers, while pig manure supported very minimal flowering. Sand and goat

manure media did not support flower formation at all during the period of the experiment. The ability of poultry manure to induce early flowering may be due to its higher phosphorus content, as phosphorus is known to play a pivotal role in floral initiation and development. These findings are consistent with those of Olaniyi and Ajibola (2008), who observed that poultry manure application enhanced both vegetative and reproductive performance in vegetable crops due to its balanced nutrient supply.

The number of leaves was also highest in seedlings treated with poultry manure. The abundance of leaves in this treatment can be explained by the availability of nitrogen, which stimulates leaf production and expansion. Since leaves serve as the primary photosynthetic organs, the higher number of leaves in poultry manure treatment implies greater photosynthetic capacity, which translates into improved plant vigor and potential yield. This finding corroborates the work of Adekiya and Agbede (2009), who reported that poultry manure significantly increased the number of leaves in okra and tomato plants. On the other hand, seedlings grown in sand and goat manure recorded the lowest number of leaves, suggesting that these media did not supply sufficient nutrients to support extensive leaf formation.

Stem circumference followed a similar trend, as seedlings grown in poultry manure recorded the widest girth compared to those grown in pig, goat manure, or sand. A thicker stem indicates a stronger plant structure and greater accumulation of photosynthates. This observation may be linked to the balanced supply of nutrients from poultry manure, which enhanced cell division and enlargement in the stem tissues. By contrast, the narrower stem girths recorded in the other treatments highlight their relatively poor nutrient availability.

The study also revealed that poultry manure markedly enhanced root development, both in terms of the number of roots and root length. Seedlings grown in poultry manure had significantly more

roots and longer root systems compared to those in the other media. Roots are essential for water and nutrient uptake, and an extensive root system enables the plant to access resources from a larger soil volume. The greater root proliferation observed under poultry manure treatment may be due to the organic matter content of the manure, which improves soil structure, aeration, and microbial activity, all of which favor root development. This finding is in line with Ayeni et al. (2010), who emphasized that poultry manure enhances root growth because of its fast mineralization rate and ability to release nutrients in forms easily absorbed by plants. The shorter and fewer roots observed in pig and goat manure treatments may reflect the slower rate of nutrient release in these organic materials, while sand, being nutrient-poor, supported the least root proliferation.

The comparative performance of the different media types revealed that poultry manure was consistently superior across all measured growth parameters. Pig and goat manures provided moderate support to plant growth but did not match the performance of poultry manure. Sand consistently gave the poorest results, which was expected because it contains little or no organic matter and cannot adequately sustain vigorous plant growth without nutrient amendment. The superiority of poultry manure over other organic manures can be attributed to its higher nutrient content, faster decomposition rate, and balanced supply of macro- and micronutrients, which were readily available for plant uptake. Pig and goat manures, on the other hand, tend to decompose more slowly, leading to a delayed release of nutrients, which may not meet the immediate requirements of rapidly growing seedlings.

Conclusion

This study examined the effect of different medium types on the germination and growth performance of garden egg (*Solanum melongena*). The results revealed that the medium type had

a notable influence on the germination percentage, plant height, number of leaves, and overall seedling vigor. Media rich in nutrients and organic matter supported faster germination, better root development, and healthier seedlings, while poor or less fertile media led to slower germination and weak growth.

The findings therefore highlight the critical role of soil fertility and medium quality in determining the growth success of garden egg. Since garden egg is a widely cultivated crop with both nutritional and economic importance in Nigeria, ensuring optimal soil conditions will enhance productivity and contribute to food security and income generation for farmers.

Recommendations

1. Adoption of nutrient-rich growth media for garden egg cultivation: Farmers should prioritize the use of fertile soils or enrich their planting media with compost, manure, or other organic inputs. This will enhance soil fertility, improve water retention, and provide the necessary nutrients for rapid germination and vigorous growth of garden egg seedlings.
2. Practice of integrated soil fertility management (ISFM): To sustain productivity, farmers should adopt a combined approach that includes organic manures, crop rotation, mulching, and moderate use of inorganic fertilizers. This will not only improve garden egg yields but also maintain soil health in the long term.
3. Strengthening of agricultural extension services: Extension agents should train farmers on the importance of soil management, proper medium selection, and modern agronomic practices in garden egg cultivation. Such training will enable farmers to make informed decisions that translate into higher yields and better-quality fruits.

4. Further research on medium types and soil amendments: Researchers should conduct more studies on different soil treatments, organic inputs, and media combinations to determine the most effective practices for garden egg production across different ecological zones. This will help in developing location-specific recommendations for farmers.

5. Government and institutional support for garden egg farmers: Policy makers, agricultural institutions, and relevant stakeholders should support farmers by providing access to high-quality seeds, affordable fertilizers, and capacity-building programs. Such interventions will encourage large-scale production of garden egg, thereby meet nutritional needs and boost farmers' income.

REFERENCES

Adebayo, A. G., Akintoye, H. A., and Shittu, O. S. (2013). Soil fertility management in tropical agriculture: Challenges and opportunities. *African Journal of Agricultural Research*, 8(8), 1123–1135.

Adekiya, A. O., & Agbede, T. M. (2009). Growth and yield of tomato (*Lycopersicon esculentum* Mill.) as influenced by poultry manure and NPK fertilizer. *Emirates Journal of Food and Agriculture*, 21(1), 10–20.

Adekiya, A. O., and Agbede, T. M. (2012). Effect of methods and time of poultry manure application on soil and leaf nutrient concentrations, growth and fruit yield of garden egg. *Experimental Agriculture*, 48(1), 82–94.

Adeleke, B. S., Babalola, O. O., and Glick, B. R. (2015). Plant growth-promoting root colonizing bacteria enhance maize growth in nutrient-poor soils. *African Journal of Microbiology Research*, 9(25), 398–407.

Adeniyan, O. N., and Ojeniyi, S. O. (2014). Comparative effectiveness of different organic manures on amaranth production. *Communications in Soil Science and Plant Analysis*, 45(5), 633–641.

Adesola, A. A., Yahaya, R. A., and Shittu, O. S. (2014). Organic farming: The role of organic manures in sustainable crop production. *Journal of Organic Systems*, 9(2), 45–58.

Adeyemi, T. O., Akinrinde, E. A., and Atayese, M. O. (2015). Effectiveness of organic and inorganic nutrient sources on maize performance in the forest zone of Nigeria. *Communications in Soil Science and Plant Analysis*, 46(12), 1480–1495.

Adeyemo, A. J., and Agbede, T. M. (2013). Effect of wood ash and NPK fertilizer application on soil chemical properties and yield of garden egg. *International Journal of Recycling of Organic Waste in Agriculture*, 2(1), 87–98.

Agbede, T. M., and Adekiya, A. O. (2015). Organic matter and soil nutrient dynamics under different organic fertilizer application rates in a tropical alfisol. *Communications in Soil Science and Plant Analysis*, 46(18), 2318–2332.

Aiyelaagbe, I. O., Fagbola, O., and Ogunkunle, A. O. (2011). Nutrient management strategies for sustainable vegetable production in Nigeria. *Nigerian Journal of Soil Science*, 22(1), 123–140.

Akanbi, W. B., Adebayo, T. A., Togun, A. O., Adeyeye, A. S., and Olaniran, O. A. (2012). The use of compost extract as foliar spray nutrient source and botanical insecticide in *Telfairia occidentalis*. *World Journal of Agricultural Sciences*, 3(5), 642–652.

Akanbi, W. B., Togun, A. O., Adediran, J. A., & Ilupeju, E. A. O. (2002). Growth, dry matter and fruit yield components of okra under organic and inorganic sources of nutrients. *American-Eurasian Journal of Sustainable Agriculture*, 2(1), 72–78.

Akanmu, A. M., Olaniyi, J. O., & Olaniyi, O. O. (2014). Effect of different rates of poultry manure on growth, yield and quality of garden egg (*Solanum gilo* L.). *International Journal of Advances in Agricultural and Environmental Engineering*, 1(2), 145–150.

Asare-Bediako, E., Showemimo, F., Buah, J. N., and Abukari, A. (2013). Agronomic performance and genotype × environment interaction of garden egg genotypes in the Guinea Savanna zone of Ghana. *Journal of Crop Science and Biotechnology*, 16(4), 343–352.

Ayeni, L. S., Adetunji, M. T., Ojeniyi, S. O., Ewulo, B. S., & Adeyemo, A. J. (2010). Comparative and cumulative effect of cocoa pod husk ash and poultry manure on soil and maize nutrient contents and yield. *American-Eurasian Journal of Sustainable Agriculture*, 4(1), 51–57.

Ayeni, L. S., Omole, T. O., and Adeleye, E. O. (2015). Integrated application of cocoa pod ash and NPK fertilizer on soil chemical properties and maize performance. *Communications in Soil Science and Plant Analysis*, 46(10), 1215–1228.

Bationo, A., Nandwa, S. M., Kimetu, J. M., Kinyangi, J. M., Bado, B. V., Lompo, F., and Tabo, R. (2010). Comparative analysis of the current and potential role of legumes in integrated soil fertility management in West and Central Africa. *Nutrient Cycling in Agroecosystems*, 76(2–3), 155–172.

Eleazu, C. O., Amajor, J., Ikpeama, A. I., and Awa, E. (2013). Studies on the nutrient composition, antioxidant activities, functional properties and microbial load of the flesh and seed of garden egg varieties. *Asian Pacific Journal of Tropical Disease*, 1(4), 300–307.

Ewulo, B. S., Ojeniyi, S. O., and Akanni, D. A. (2010). Effect of poultry manure on selected soil physical and chemical properties, growth, yield and nutrient status of tomato. *African Journal of Agricultural Research*, 5(9), 612–616.

FAO. (2015). *FAOSTAT Database*. Food and Agriculture Organization of the United Nations.

Igwe, D. O., Afiukwa, C. A., Ubi, B. E., Ogbu, K. I., Ojuederie, O. B., and Falusi, O. A. (2014). Assessment of genetic diversity in garden egg (*Solanum melongena* L.) using morphological and molecular markers. *Plant Genetic Resources*, 12(1), 67–78.

Kihara, J., Bolo, P., Kinyua, M., Rurinda, J., and Piikki, K. (2013). Micronutrient deficiencies in African soils and the human nutritional nexus: opportunities with staple crops. *Environmental Geochemistry and Health*, 35(9), 3015–3033.

Mensah, J. K., Okoli, R. I., Ohaju-Obodo, J. O., and Eifediyi, K. (2012). Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria. *African Journal of Biotechnology*, 7(14), 2304–2309.

Mmuo, J. I., Okonkwo, C. I., and Onyekwelu, J. N. (2014). Comparative effects of organic and inorganic fertilizers on the growth and yield of garden egg (*Solanum melongena* L.). *International Journal of Agriculture and Rural Development*, 17(2), 4200–4209.

Nwachukwu, I. D., and Ibekwe, V. I. (2013). Nutritional and biochemical properties of garden egg (*Solanum melongena*) fruit. *African Journal of Food, Agriculture, Nutrition and Development*, 10(2), 2305–2315.

Nwofia, G. E., Ojimelukwe, P., and Eji, C. (2011). Chemical composition of leaves, fruit, stem and root of some garden egg varieties in Nigeria. *International Journal of Medicine and Medical Sciences*, 4(4), 95–99.

Odedina, S. A., Odedina, J. N., Ayeni, L. S., Arowojolu, S. A., Adeyeye, S. D., and Ojeniyi, S. O. (2013). Effect of types of manure on growth and yield of garden egg in an alfisol. *Middle East Journal of Agriculture Research*, 2(1), 50–54.

Ogunkunle, A. O., Adeniran, K. A., and Fatoba, P. O. (2012). Rainfall erosivity and soil loss estimation in Nigeria. *Geoderma*, 173, 114–120.

Ogunlade, M. O., Aremu, C. A., and Oshunsanya, S. O. (2015). Effects of organic and inorganic fertilizers application on soil and crop parameters of maize in a degraded area. *Communications in Soil Science and Plant Analysis*, 46(20), 2571–2581.

Ogunlela, V. B., Akinrinde, E. A., and Adesodun, J. K. (2010). Response of garden egg (*Solanum melongena*) to organic and inorganic fertilizers in acidic soils of southwestern Nigeria. *Ife Journal of Agriculture*, 22(2), 71–85.

Ogunwale, J. A., Oso, A. A., and Akinremi, O. O. (2014). Soil fertility management and crop productivity in Nigeria: A review. *Agronomy Journal*, 106(1), 175–190.

Okoroafor, I. B., Okelola, E. O., Edeh, O. N., Emehute, V. C., Onu, C. N., Nwaneri, T. C., and Chinaka, U. N. (2015). Effect of organic manure on the growth and yield of garden egg (*Solanum melongena* L.) in Uturu, Nigeria. *African Journal of Agricultural Research*, 10(25), 1270–1282.

Olaniyi, J. O., & Ajibola, A. T. (2008). Effects of poultry manure on growth, yield and nutrient composition of fluted pumpkin (*Telfairia occidentalis* Hook F.). *Asian Journal of Plant Sciences*, 7(3), 328–333.

Olaniyi, J. O., Akanbi, W. B., Adejumo, T. A., and Akande, O. G. (2013). Growth, fruit yield and nutritional quality of tomato varieties. *African Journal of Food Science*, 4(6), 398–402.

Opara, E. U., Wokocha, R. C., and Fawole, I. (2014). Variability in *Solanum melongena* L. and environmental effect on the variables. *International Journal of Current Microbiology and Applied Sciences*, 1(1), 1–6.

Osei, M. K., Banful, B., Osei, C. K., and Oluoch, M. O. (2012). Characterization of African garden egg and related species in Ghana. *Genetic Resources and Crop Evolution*, 59(2), 283–290.

Tiamiyu, R. A., Ahmed, H. G., and Muhammad, A. S. (2013). Effect of sources of organic manure on growth and yields of garden egg (*Solanum melongena* L.) in Sudan Savanna of Nigeria. *Journal of Agriculture and Environment*, 7(2), 1–9.

Udoh, D. J., Ndon, B. A., Asuquo, P. E., and Ndaeyo, N. U. (2012). *Crop Production Techniques for the Tropics*. Concept Publications Limited.

Vanlauwe, B., Coyne, D., Gockowski, J., Hauser, S., Huising, J., Masso, C., and Van Asten, P. (2011). Sustainable intensification and the African smallholder farmer. *Current Opinion in Environmental Sustainability*, 3, 15–22.