EVALUATION OF DIFFERENT CROPS GROWN IN A SNAIL SCREEN HOUSE AND THEIR RESPONSE TO ENVIRONMENTAL VARIABLES

BY

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BENIN CITY.

NOVEMBER, 2025

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE BACHELOR OF AGRICULTURE HONORS, DEGREE IN ANIMAL SCIENCE OF THE UNIVERSITY OF BENIN, BENIN CITY, NIGERIA.

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CERTIFICATION

This is to certify that this project work was carried out by Kemi Benita ADEJUMOBI with the Matriculation Number AGR2004291 of the Department of Animal Science, Faculty of Agriculture, University of Benin, Benin City, Nigeria.

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Prof J.M. OMOYAKHI **Date**

(Project Supervisor)

______________________ ______________________

Dr. N.C. AKAEZE **Date**

(Head of Department)

DEDICATION

This research work is dedicated to God Almighty, for guidance, direction and strength.

God has been so good and as well as to my precious family for their consistent support.

ACKNOWLEDGEMENTS

I would like to acknowledge a few people for helping me in this journey, I could not have done it alone without the help, support and guidance of these people.

I want to appreciate God almighty for provision, protection, strength, wisdom and more in this journey.

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To my fellow project colleagues, Cephas, Victoria, Debby, Chisom, Fredrick, Freda and my amiable classmates, thank you for all everything. Let's move on to greater heights.

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ABSTRACT

Snail farming also knows as Heliciculture excels under specific micro environment which include appropriate ranges for humidity, temperature, light intensity and CO2 levels. Environmental fluctuations in open fields has been seen to reduce yield and productivity and the need to be able to control environmental conditions brought about the use of screenhouse. This study is based on the evaluation of growth performance and response to environmental variables of crops in which some selected crops; Banana (*Musa spp*), Cocoyam (C*olocasia esculenta*), Sweet potato (*Ipomoea batatas*), Water leaf (*Talinum triangulare*) and Pawpaw (*Carica papaya*) were used. The goal was to determine how crops response to controlled environment conditions and determine their suitability for snails. Environmental variables was duly observed, data collections was carried on morphological yield and quality in which results obtained showed positive development in all crops and determined that the screenhouse is effective for both crops and snails under controlled environmental conditions.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Heliciculture or snail farming involves the domestication of snails in controlled environments that closely replicate their natural habitats (Munywoki, 2022). Despite its notable profitability, snail farming remains underutilized within the agro-industry, primarily due to limited awareness of its economic value (Munywoki, 2022). Despite increasing interest, much of the snail meat sold in Nigerian markets still originates from wild harvests by local inhabitants (Adewale and Belewu, 2022).

The growing demand for snail meat, coupled with the diminishing availability of wild snails and the recognized benefits of heliculture, has fueled a renewed interest in domesticated snail farming as a sustainable agricultural venture (Adewale and Belewu, 2022). Snail farming entails raising snails in enclosed, controlled environments where essential resources such as food, water, and lime are provided to promote healthy growth (Etukudo, 2017). While snail farming is gradually gaining global recognition, its growth in parts of Nigeria remains sluggish. Many farmers still depend on harvesting snails from the wild, a practice largely attributed to inadequate entrepreneurial competence (Odo, 2016).

The use of screenhouse has emerged as a productive way to raise and meet snail meat demand. The screenhouse presents an integrated cropping system where plants which are beneficial for snails can be planted, leading to less cost on feeding materials for snails as the crops grown provide natural and nutritious fresh feed for snails. Critical to raising snails are environmental variables and plants grown for feeding. Climatic influence and its effects on snails have an associative effect on temperature, humidity, wind/air movement, light intensity and water logged soil (Ebenso, 2002). This study aims to observe crop responses in which different crops species selected were used to monitor environmental variables for optimal growth and wellbeing of both plant and snail. Proper and optimum environmental condition required for growth and reproductive performance of snail must be met for successful snail farming industry (Ezemonye *et al*., 2018).

1.2 JUSTIFICATION OF THE STUDY

The giant African land snails are a wildlife dietary protein source in Nigeria and some other parts of Africa (Alikwe *et al*., 2014). Nutritious benefits of snail meat include being particularly rich in protein, iron, calcium and phosphorous and low in fat, saturated fatty acids and cholesterol when compared with beef, goat meat, mutton, pork, broiler meat and fish (Babalola, 2015).

In spite of the stated nutritional value of snail meat, snail production has not reached large-scale production and commercialization as compared with other livestock like cattle, goat, sheep and poultry. Its demand is met by hunting the animals from their habitat in the wild. In recent years, wild snail populations have declined considerably, primarily because of the impact of human activities such as deforestation, pesticide use, slash-and-burn agriculture, spontaneous bushfire, and the collection of immature snails (Oyeagu *et al*.,2018).

Graamans *et al.* (2018) Compared protected cultivation systems and found that screenhouses and greenhouses improve resource-use efficiency, particularly water and microclimate control, resulting in higher biological productivity. Plants modify the internal microclimate by generating shade, cooling the air, and maintaining high humidity through transpiration, which is essential for snail activity (Omole *et al*., 2014; Omoyakhi and Osinowo, 2021). Integrating leafy vegetables within a snail screenhouse improves microclimate stability, enhances humidity through transpiration, and significantly increases snail growth and survival rates. Crop canopy reduced snail aestivation and improved feeding activity. (Omoyakhi and Osinowo 2021)

While research on open-field crop performance is abundant, empirical studies on the growth of root, tuber, and leafy vegetables within the specific, semi-controlled microclimate of a tropical snail screenhouse are notably lacking (Eze *et al.,* 2017). Addressing this gap is the focus of the present study. The outcomes will contribute to the science of protected cultivation in humid tropics and provide evidence-based protocols for crop selection and microclimate management, thereby enhancing the resilience and productivity of integrated snail farming.

1.3 OBJECTIVES OF THE STUDY

General Objective:

The general objective of this research is to evaluate how different selected crops respond to environmental variables under screen house conditions which can be suitable for snail production.

Specific Objectives are to;

i. Evaluate the performance (height, leaf area, stem diameter, quality parameters) of different crops grown in a snail screen house;

ii. Examine how the different crops grown in a snail screen house can respond to environmental variables like temperature, humidity, light intensity and soil quality in the screen house;

iii Assessment of how suitable these crops can be used for snail production based on micro climatic and foliage production.

iv. Identify the crops with the best performance that enhance snail growth and productivity and as well recommend the best crop combinations and management strategies for improved productivity.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 CONCEPT OF SCREEN HOUSE CULTIVATION

Screen houses/Net houses are basically naturally ventilated climate controlled structures and are the simplest and most affordable type of protected structure. Net houses are built of a pre-galvanized channel cum tubular structure/ tubular structure, wooden or bamboo structures mainly used in regions with less rainfall (Jayasurya et al, 2021). Agricultural production under covered structures is considered a form of agricultural production where the microclimate factors affecting plant growth and development are totally or partially controlled (Graamans, L.; Baeza, E.; van den Dobbelsteen, A.; Tsafaras, I.; Stanghellini, 2018).

A primary benefit of this system is the stabilization of the internal microclimate. Compared to external conditions, screenhouses typically exhibit reduced temperature fluctuations, sustained higher relative humidity, and lower evapotranspiration rates (Adeniran *et al*., 2020). This regulated environment is conducive not only to crop production but also to integrated farming practices. For instance, species such as the African giant snail (Archachatina marginata), which require stable humid conditions, can be co-cultivated, aligning with bio-integrated models that enhance resource efficiency and farm productivity (Omoyakhi and Osinowo, 2021).

2.2. ADVANTAGES OF GREENHOUSE CULTIVATION

Extended Growing Seasons : One of the primary advantages of greenhouse cultivation is the ability to extend growing seasons beyond the limits imposed by natural outdoor conditions. Greenhouses create a controlled environment that allows for year-round crop production, regardless of external weather patterns (Ghoulem M, El Moueddeb K, Nehdi E, Boukhanouf R, Calautit JK. 2019). It also offers other advantages;

i. Increased Crop Yields: Year-round production allows for multiple crop cycles, resulting in higher overall yields compared to traditional outdoor cultivation methods. (Ahamed MS, Guo H, Tanino K. 2019).

ii. Consistent Supply: Greenhouse cultivation ensures a steady supply of fresh produce throughout the year, meeting consumer demand and reducing reliance on imports.(Shamshiri RR, Jones JW, Thorp KR, Ahmad D, Man HC, Taheri S. 2018).

iii.Market Advantages: Off-season production enables growers to capitalize on higher market prices when supply from outdoor sources is limited (Sethi VP, Sharma SK. 2007).

iv. Protection from Adverse Weather Conditions: Greenhouses provide a protective environment that shields crops from adverse weather conditions such as extreme temperatures, heavy rainfall, hail, and strong winds. This protection is particularly important in regions prone to climatic extremes or unpredictable weather patterns (Ahmad D, Man HC, Taheri S. 2018).

2.1.2 Integrated Crop Snail Screen-House System

This co-cultivation system facilitates efficient resource recycling, forming a semi-closed nutrient loop. Irrigation water sustains both crops and the humid atmosphere required by snails. In return, snail depositions (faeces and mucoid secretions) mineralize into a rich organic fertilizer, enhancing soil nutrient availability and structure for the plants (Eze *et al*., 2017). For instance, the vegetation canopy helps buffer temperature extremes and maintains higher relative humidity through transpiration, conditions that are crucial for preventing snail aestivation and promoting consistent feeding and growth (Omoyakhi and Osinowo, 2021).

2.2 FOUNDATIONS OF SNAIL FEED

A critical aspect of snail farming is about understanding snail feed requirements and their diet. From natural feed to compound and supplementary feed, snails behaviours and preferences, nutritional content of the feed and essential nutrients for optimal production

As poikilothermic (cold-blooded) herbivores, the metabolic and nutritional demands of snails are influenced by factors including species, life stage (juvenile vs. adult), and prevailing environmental conditions like temperature and humidity. Contemporary advances in snail nutrition therefore focus on formulating diets that enhance the bio-availability and digestibility of key nutrients to optimize physiological outcomes, including growth rates, shell calcification, and reproductive fitness (Ademolu *et al*., 2005; Akinnusi, 2018).

2.2.1 DIETARY AND NUTRITIONAL REQUIREMENTS FOR SNAIL

Snails nutritional requirements involves high nutritious feeds and essential nutrients needed for the snail growth and development. The use of natural feed which includes leaf meals (fluted pumpkin, water leaf, sweet potato leaves e.t.c), tubers and root crops(Sweet potato, cocoyam e.t.c) and fruits(Pawpaw, banana e.t.c) have shown to be snails preference compound and supplementary feed can be used to boost and promote growth. Snails, like other animals, need basic nutrients (energy, protein, fats, amino acids, vitamins and minerals) for optimal metabolism and growth, shell formation and reproduction (Eze et al., 2010).

i. Calcium (Critical for Shell Strength); Calcium is the most important nutrient for snails. Lack of calcium leads to weak, thin, or cracked shells and increased susceptibility to disease. Good calcium sources include: Crushed eggshells, limestone powder, bone meal, oyster shells. Thus, farmers should actively supplement calcium in snail diets to ensure strong shells and healthy development.

ii. Protein (Needed for Growth & Reproduction); Protein supports tissue development and egg production. Without sufficient protein, snails grow slowly and reproduce less. Adewumi and Ogunjinmi (2011) evaluated the growth performance of Archachatina marginata fed diets with varying protein sources and found that snails receiving higher-quality protein diets exhibited significantly improved weight gain, shell development, and feed utilization efficiency. Protein deficiency resulted in slow growth and poor shell formation. Recommended protein sources include: Legumes (soybeans, groundnuts, beans), fish meal, poultry waste meal, earthworms or insects (e.g., mealworms)

iii. Carbohydrates (Provide Energy); Carbohydrates fuel snail activity, movement, and reproduction. Sources include: Fruits (pawpaw, banana, mango), vegetables (cabbage, lettuce, pumpkin leaves), tubers (sweet potatoes, cassava, yam peels). Omole, Kehinde & Ajayi (2014) demonstrated that leafy vegetables used as snail feed significantly improved growth performance, moisture intake, and survivability of African giant land snails. Leaves with high moisture and mineral content promoted faster growth.

iv. Water (Hydration & Life Support); Snails need constant moisture for survival and to support digestion. They absorb water through their skin, so a damp environment or source of water is essential.

Also essential are lipids(fats and oil) to help absorb fat soluble vitamins). Vitamins and trace minerals (vital for immunity and reproduction, minerals required in trace amount for various metabolic pathways). Crude fiber (for gut health and motility).

2.3 GROWTH CHARACTERISTICS OF EACH CROP IN THE SCREENHOUSE

2.3.1 Growth Characteristics of Banana Plant (*Musa spp.*)

Banana plants are fast-growing, giant herbaceous plants (not true trees) with a central pseudostem (tightly packed leaf sheaths) that supports huge leaves and eventually a fruit bunch, growing from an underground corm (rhizome) and producing new shoots (suckers) for continuous fruiting, requiring warm, moist soil with good drainage. They grow rapidly (up to 5 ft/day), have large leaves that tear easily, and fruit develops from a central flower stalk that emerges after many leaves form.

When bananas are being grown in a screenhous, it significantly alters the microclimate, leading to several positive effects on plant growth, yield, and resource efficiency, particularly in hot, arid, or windy climates.

2.3.2 Growth Characteristics of Cocoyam (*Colocasia esculenta*)

Cocoyam are herbaceous perennial plants belonging to the family Araceae and are grown primarily for their edible roots, although all parts of the plant are edible. Cocoyam that are cultivated as food crops belong to either the genus Colocasia or the genus Xanthosoma and are generally comprised of a large spherical corm (swollen underground storage stem), from which a few large leaves emerge. The petioles of the leaves stand erect and can reach lengths in excess of 1 m (3.3 ft). The leaf blades are large and heart-shaped and can reach 50 cm (15.8 in) in length. The corm produces lateral buds which give rise to tubers or cormel and suckers or stolons. Cocoyams commonly reach in excess of 1 m (3.3 ft) in height and although they are perennials, they are often grown as annuals, harvested after one season.

Cocoyam grown in a controlled environment reduces pest and disease incidence and allows for the management of environmental factors such as light exposure and humidity. The specific effects are related to growth, disease resistance, and yield.

2.3.3 Growth Characteristics of Sweet Potato (*Ipomoea batatas*)

Sweet potatoes are fast-growing, vining tropical plants (annuals in cultivation) that produce edible, starchy tubers, thriving in warm, sunny conditions with well-drained soil (pH 6.0-6.5) and needing 4-5 months of warm weather for good yield. Key growth features include long, trailing vines (up to 4m), heart-shaped leaves, funnel-shaped flowers, and adventitious roots that swell into diverse tuber shapes and colors (white, orange, purple). They're propagated by slips (sprouts) and require high daylight but tuber formation is favored by cooler nights, with high daytime temps promoting leaf growth, and pruning shoots redirects energy to tubers.

Sweet potatoes in a screenhouse produces healthier, disease-free planting material by protecting the crops from pests and viruses, which in turn leads to a significantly higher yield of storage roots when the material is used for field planting.

2.3.4 Growth Characteristics of Water Leaf (*Talinum triangulare*)

Waterleaf (*Talinum triangulare*) is a fast-growing, erect, succulent herb with swollen roots, thriving in warm climates, easily propagated by seeds or cuttings, featuring spoon-shaped leaves clustered at branch tops, and producing small pink flowers with quick-maturing capsules, harvested within weeks for its nutritious greens, needing minimal fertilizer but good water. It's highly adaptable, growing year-round in the tropics but prefers warm, moist, well-drained soils, and is a short-duration crop valuable for quick returns.

Water leaf growing in a screenhouse environment's microclimate (light, temperature, and humidity) provides protection from pests, which influences the plant's growth, yield, and possibly its nutritional composition.

2.3.5 Growth Characteristics of Pawpaw Plant (*Carica papaya*)

Pawpaw (Carica papaya) is a fast-growing, short-lived, large herbaceous plant with a single, unbranched stem topped by large, deeply lobed leaves and melon like fruit, growing quickly (flowering in 4-8 months) to 5-10m tall in full sun, needing well-drained soil and warmth, and forming an umbrella-like crown with large, often scarred trunk base from fallen leaves/fruit.

The planting of pawpaw in a screenhouse primarily helps by modifying its microclimate, leading to enhanced seedling growth, increased leaf size, and protection from pests and diseases. The controlled environment helps optimize conditions that can be inconsistent outdoors.

2.4 IMPORTANCE OF ENVIRONMENTAL VARIABLES IN CROP PERFORMANCE

Crop growth and yield are fundamentally governed by key environmental variables, including temperature, relative humidity, light intensity, and carbon dioxide (CO_2) concentration. These factors directly regulate core physiological processes such as photosynthesis, respiration, and transpiration, ultimately determining plant vigor and productivity (Nwosu *et al., 2*020).

Influence of Key Variables:

Temperature governs enzymatic activity and metabolic rates. Most tropical crops exhibit optimal growth within a range of 25–32°C, with deviations potentially inducing stress that reduces growth efficiency (Adeniran *et al.*, 2020).

Relative Humidity (RH) critically affects plant-water relations. High RH supports stomatal opening and leaf turgor, promoting expansion in succulent vegetables like water leaf, while low RH can trigger water stress and wilting (Omoyakhi and Osinowo, 2021).

Light Intensity drives photosynthesis and influences plant morphology. Moderated light conditions under screenhouse netting are particularly beneficial for shade-tolerant crops such as cocoyam and water leaf (Oladimeji *et al*., 2021).

Carbon Dioxide (CO_2) is the primary substrate for photosynthesis. The semi enclosed nature of screenhouses can lead to temporarily elevated CO_2 concentrations during daylight hours, potentially enhancing photosynthetic rates and biomass accumulation in C3 plants like sweet potato and banana (Nwosu *et al*., 2020).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 SITE OF EXPERIMENT

The experiment was carried out in the University of Benin Teaching and Research Farm, Snail screenhouse unit. This environment created the perfect opportunity to establish a natural habitat for snails were environmental management can be observed and controlled, environmental conditions such as temperature, humidity, CO2 levels and light intensity can be monitored and observed for effective results.

3.2 EXPERIMENTAL PERIOD

The experiment spanned out for 18 weeks in which data collection was carried out on a weekly basis after crop development for 15 weeks

3.3. SCREEN HOUSE PREPARATION:

The screen house was constructed in an East west direction which is conducive for raising snails. It was seen to have dwarf walls which acted as fence to provide protection against external preditors and factors. An entry was provided to which access into the screenhouse is possible, while walk ways were also designed in the screenhouse to avoid stepping on small growing plants and also helped in organizing the screenhouse for better management. The internal part of the screen house was sectioned into four and separated by the walk ways designed for easy access with an extra space for raising young snails. The screen house was maintained on a weekly basis at the start of the project work before crop establishment.

The house was constructed East-west direction, dwarf wall was laid in place to provide a fence to keep away external factors. An entry way was provided to be able to access the screen house. The interior of the screen house was further sectioned into four with an extra area for the raising of young snails. The screen house was maintained by regular weeding on a weekly basis before crop establishment.

3.4 MATERIALS USED FOR THE EXPERIMENT

The material which were used for this study were selected to ensure that data collection was collected correctly, better management of plants and observation of environmental conditions in the screen house. The materials used were selected on experimental requirements and needs of the different crops grown. Each material used was appropriately sorted out for uniformity and accurate data collections.

3.4.1 Materials

1. Banana (*Musa spp*) suckers

2. Cocoyam (*Colocasia esculenta*) cormels

3. Sweet potato (*Ipomoea batata*) vine cuttings

4. Water leaf (*Talinum triangulare*) stem cuttings

5. Pawpaw (*Carica papaya*) seedlings

6. Organic compost

7. Weeding tools (use of cutlass and hoes)

8. Mulching materials (use of dried leaves and mucuna plants)

9. Use of measuring tape

10. Data collections notes

3.5 CROP ESTABLISHMENT

Mucuna plant was widely spread in the screenhouse as at the first week of which the project commenced and was used as a cover crop to improve soil fertility for which the selected crops will be sowed or transplanted on. Manual weeding and trimming of banana leaves was done on a weekly basis (every Friday) to avoid overcrowding of screenhouse and competition.

The experiment spanned for a period of 18 weeks in which plants transplanted or sowed were allowed to develop before data collection was carried out for 15 weeks. At start of the experiment it was observed that Banana and water leaf plants were already established within the screen house though not at maturity stage. Cocoyam plant was transplanted into the screen house at the end of week one and week two in every corner of the screenhouse. Pawpaw was brought from the nursery as seedlings and transplanted on the 2nd of July into the screen house, sweet potato was the last plant introduced into the screenhouse on the 23rd of July as seedlings, the late introduction was due to the ongoing modelling of the screenhouse. Although not planted at the same time, it gave a natural intercropping system which was considered good for a more realistic planting pattern.

Plant spacing was maintained as follows:

Banana: 90 cm × 90 cm

Cocoyam: 50 cm × 50 cm

Sweet potato: 30 cm × 30 cm

Water leaf: 25 cm × 25 cm

3.6 EXPERIMENTAL DESIGN

A Randomized Complete Block Design (RCBD) was used for the experiment. Each section of the screenhouse was ensured to have the different five crops selected for uniformity and canopy. Five crop reps each was selected for Banana, cocoyam and water leaf while three crop reps each for sweet potato and pawpaw due to the late introduction into the screen house. These crops selected were picked randomly for weekly measurements and data collection to observe changes and record how they respond to environmental conditions.

3.7 DATA COLLECTION PROCEDURES

Data collection was carried out after crops transplanted were recovered n developing im the screenhouse. The data collection was taken on growth parameters and environmental conditions of the screen house.

3.7.1 Growth Parameters

Plant Height (cm): Plant height was taken on a weekly basis

Number of Leaves: Counted manually for each plant.

Leaf Area (cm^2): Estimated using the formula: $LA= L \times W \times CF$

Stem Girth (cm): Measured at 2 cm above the soil level using a Vernier caliper.

3.7.2 Environmental Variables

Environmental Variables were observed, monitored and noted down.

3.8 STATISTICAL ANALYSIS

Data collected from the experiment which was noted down, recorded for the 15 weeks of the experiment and was calculated to give the Mean weekly growth of each crop species which was placed in a tabular form for easy understanding.

CHAPTER FOUR

4.0 RESULTS

4.1 GROWTH PARAMETERS

The following tables below show the progressive Mean weekly growth for the five crops which were selected and averaged.

MEAN WEEKLY GROWTH FOR BANANA PLANT

The banana plant, with its perennial nature, demonstrated remarkably steady growth week after week over the 15-week period. Instead of fluctuating wildly, it channeled its energy into building a strong framework, producing abundant, lush leaves with high moisture content. This consistent performance establishes banana as the most dependable and resilient backbone of the entire forage system, providing reliable structure and biomass.

The weekly growth measurements for banana are summarized in Table 4.1. To help visualize this steady progress, the data is also presented in a bar chart, which clearly illustrates how the plant grew taller, expanded its large leaves, and steadily thickened its pseudostem throughout the study.

Table 4.1 showing plant progressive growth of banana highlighting growth parameters; plant height, leaf area and stem diameter.

Table 4.1; Weekly mean growth for Banana plant

Week	Plant height(cm)	Leaf area(m^2)	Stem diameter (cm)
1	183.50	42.02	1.70
2	189.20	42.85	2.15
3	195.90	43.80	2.70
4	203.00	44.88	3.35
5	210.80	45.92	4.05
6	218.00	46.80	4.68
7	225.80	47.95	5.39
8	233.10	48.99	6.05
9	240.80	50.15	6.78
10	248.50	51.30	7.50
11	255.40	52.32	8.18
12	262.90	53.48	8.85
13	271.00	54.75	9.62
14	279.10	55.99	10.45
15	287.50	57.35	11.30

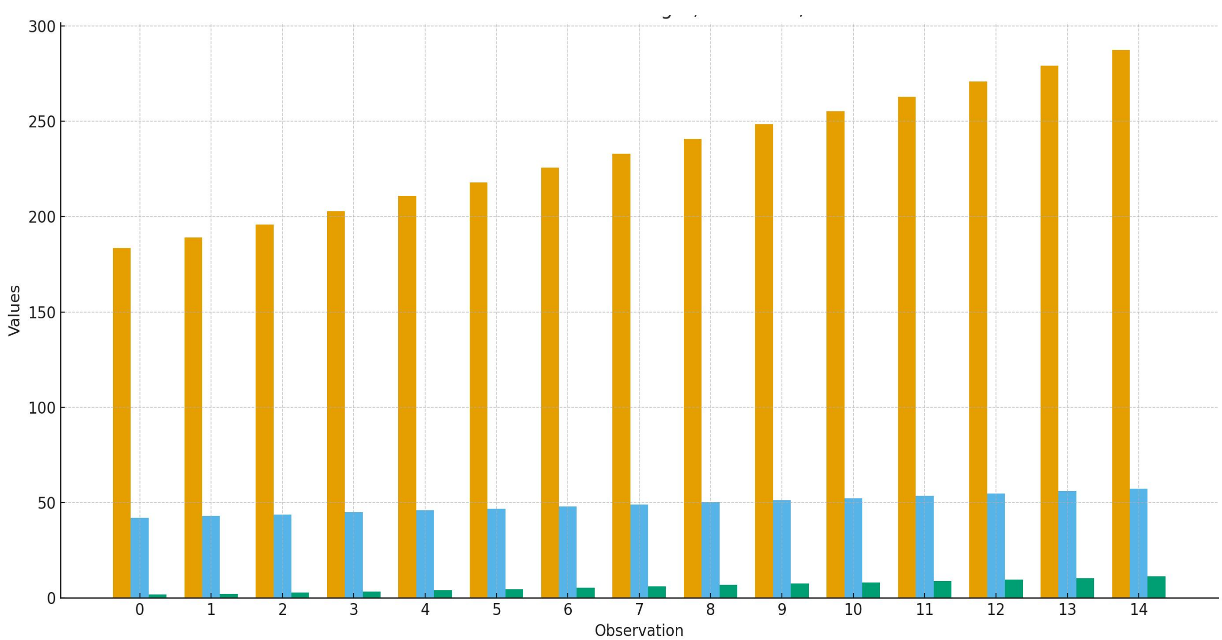

Figure 4.1: Growth Parameters of Banana Plant with Plant

Bar chart representing Table 4.1 above giving clear information on the growth parameters of banana plant with plant height dominating over leaf area and stem diameter

4. 2 MEAN WEEKLY GROWTH FOR COCOYAM PLANT

The cocoyam plants showed a strong, resilient growth pattern over the 15 weeks. After an initial adjustment period (weeks 1–4), during which the plants acclimated to their new environment, they entered a phase of rapid, vigorous growth. This quick recovery and sustained development highlight the plant's suitability as a reliable producer of substantial leafy biomass.

The weekly growth measurements for cocoyam are detailed in Table 4.2. This data is visualized in the accompanying bar chart, which clearly illustrates the plant's progressive increase in leaf area, stem diameter, and height.

The chart reveals that leaf area was the dominant growth metric. This makes biological sense, as the leaves are the plant's primary photosynthetic engines. A larger leaf area allows the cocoyam to capture more sunlight and carbon dioxide, which directly fuels growth and the development of its valuable storage corms. While increases in stem thickness and plant height are important indicators of overall health, the expansion of the leaf canopy is the fundamental driver of final yield in this crop.

Table 4.2 showing plant progressive growth of cocoyam highlighting growth parameters; plant height, leaf area and stem diameter.

Table 4.2; Weekly mean growth of Cocoyam plant

Week	Plant height (cm)	Leaf area(cm^2)	Stem diameter(cm)
1	95.00	19,700	15.68
2	100.20	24,500	16.45
3	106.10	30,100	17.28
4	113.30	36,500	18.20
5	121.50	43,800	19.25
6	130.80	52,000	20.35
7	141.20	61,400	21.55
8	152.90	72,000	22.80
9	165.80	83,800	24.18
10	179.80	96,900	25.65
11	194.50	110,500	27.20
12	209.60	124,900	28.85
13	225.10	140,200	30.65
14	241.00	156,500	32.50
15	257.50	174,000	34.50

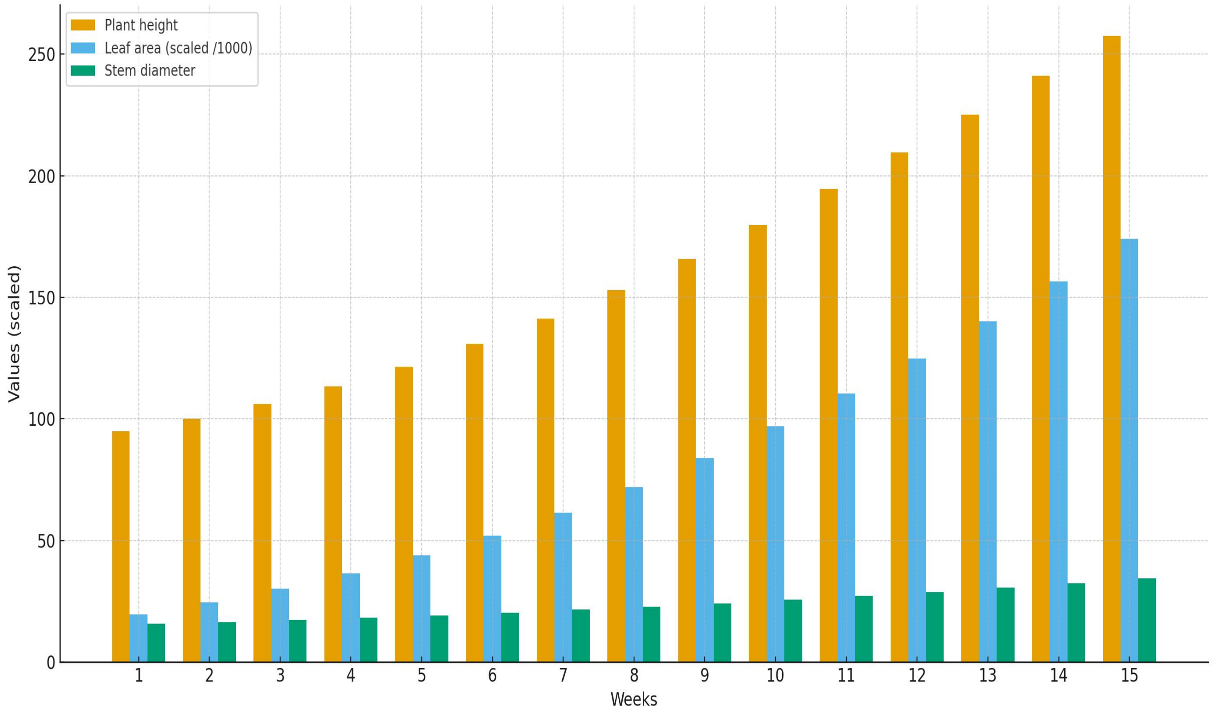

Figure 4.2: Growth Parameters of Cocoyam Plant with Plant

Bar chart representing Table 4.2 above giving clear information on the growth parameters of cocoyam plant with plant height dominating over leaf area and stem diameter

4.3 MEAN WEEKLY GROWTH FOR SWEET POTATO PLANT

Sweet potato, introduced into the study at week 5, quickly established itself as a vigorous and fast-growing forage producer. Its growth was characterized by aggressive vine elongation and rapid leaf expansion, a pattern that prioritized the production of above-ground biomass over the development of its storage roots. This makes it particularly valuable as a leafy forage crop within the system. The weekly growth measurements are summarized in Table 4.3.

The accompanying bar chart visualizes this growth strategy. Similar to cocoyam, sweet potato invested significantly in leaf area, which was consistently its most dominant growth parameter. This emphasis is strategic: a large, sprawling canopy of leaves maximizes photosynthesis, generating the energy needed to support its rapid vegetative spread. This growth habit results in extensive vine coverage with abundant foliage, explaining why increases in leaf area far outpaced gains in plant height or stem diameter during the observation period.

Table 4.3 showing plant progressive growth of sweet potato plant highlighting growth parameters; plant height, leaf area and stem diameter.

Table 4.3; Weekly mean growth of sweet potato

Week	**Plant height(cm)**	**Leaf area(cm^2)**	**Stem diameter(cm)**
1	N/A	N/A	N/A
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	N/A	N/A	N/A
5	60.00	450	0.50
6	89.50	820	0.59
7	125.80	1250	0.67
8	165.20	1780	0.74
9	207.50	2410	0.81
10	249.90	3100	0.88
11	290.50	3820	0.95
12	329.80	4580	1.02
13	365.10,	5350	1.09
14	398.50	6100	1.16
15	430.20	6820	1.23

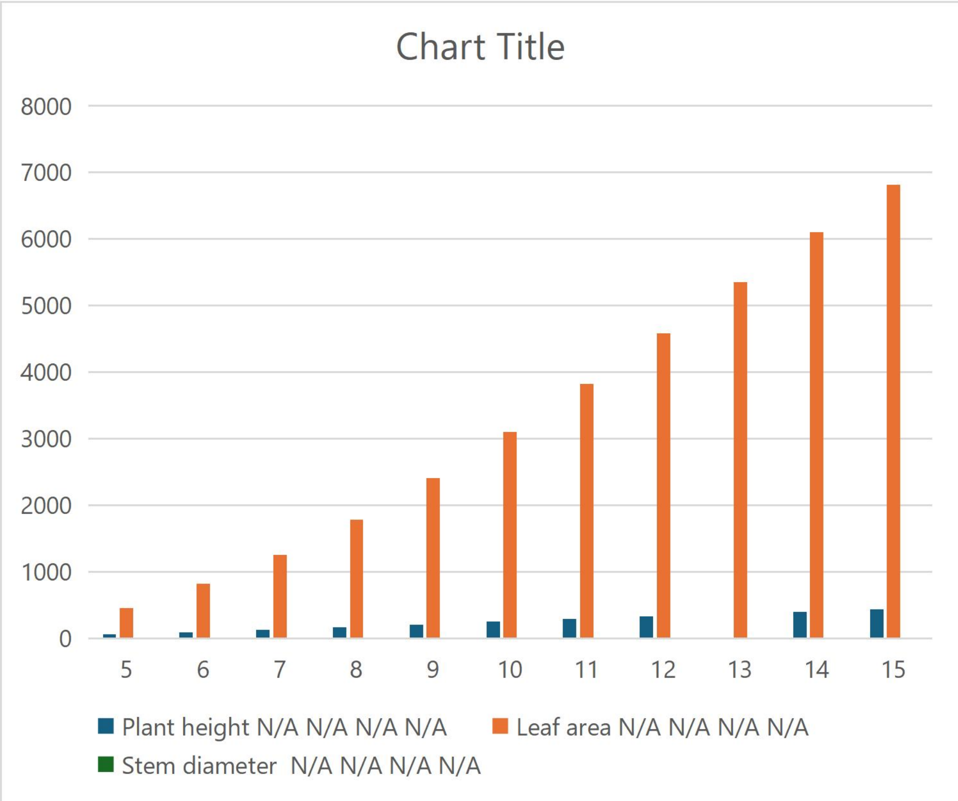

Figure 4.3: Weekly mean growth of sweet potato

Bar chart representing Table 4.3 above giving clear information on the growth parameters of sweet potato plant with leaf area dominating over plant height and stem diameter

4.4 MEAN WEEKLY GROWTH OF WATER LEAF PLANT

Water leaf thrived in the screenhouse environment, demonstrating the rapid growth typical of this succulent vegetable. Its fast life cycle allowed it to reach harvestable size twice during the observation period. Growth data, detailed in Table 4.4, shows it consistently produced a high leaf area with more moderate gains in plant height and stem diameter.

This pattern is clearly visualized in the accompanying bar chart. As a soft-stemmed leafy crop, water leaf's primary growth strategy is to maximize its leafy canopy. It invests resources into producing broad, abundant leaves to capture as much light as possible for photosynthesis, rather than into building tall, woody stems for long-term height competition. This efficient strategy makes it an excellent producer of high-moisture forage in a short timeframe.

Table 4.4 showing plant progressive growth of water leaf highlighting growth parameters; plant height, leaf area and stem diameter.

Table 4.4; Weekly mean growth of waterleaf plant

Week	Plant height(cm)	Leaf area(cm^2)	Stem diameter(cm)
1	30.80	275	1.80
2	35.05	322	1.83
3	39.01	371	1.88
4	43.20	418	1.92
5	47.66	477	1.97
6	51.59	527	2.01
7	55.52	571	2.05
8	59.99	626	2.11
9	64.22	669	2.16
10	68.08	720	2.21
11	72.24	761	2.25
12	76.11	804	2.29
13	79.97	855	2.34
14	84.04	909	2.38
15	87.46	960	2 .43

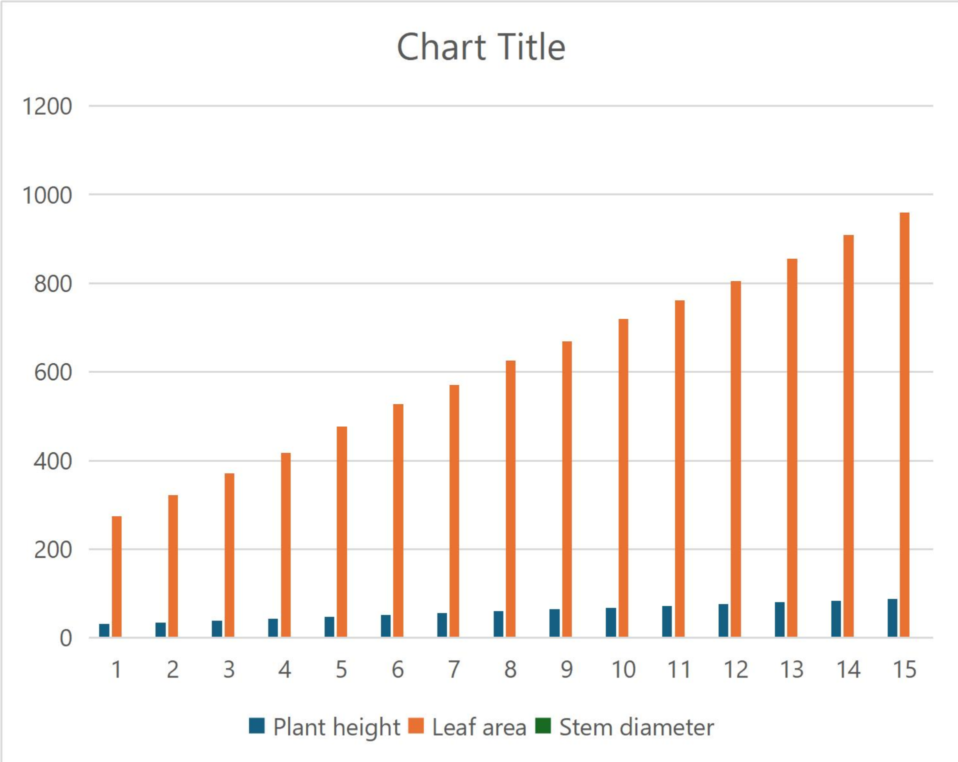

Figure 4.4: Growth Parameters of Water Leaf Plant

Bar chart representing Table 4.4 above giving clear information on the growth parameters of water leaf plant with leaf area dominating over plant height and stem diameter

4.5 MEAN WEEKLY GROWTH FOR PAWPAW PLANT

Pawpaw plants showed very slow growth during the initial eight weeks of the observation period, with only marginal increases in height and stem diameter. This stunted growth is characteristic of pawpaw's sensitivity to root disturbance; after transplanting, the plants dedicated their energy to regenerating their root systems rather than expanding above ground. This recovery phase is essential for re-establishing a strong foundation in the soil.

The weekly growth measurements are summarized in Table 4.5, with the accompanying bar chart clearly illustrating this slow initial progress. While height and stem diameter remained limited, the plants steadily increased their leaf area. This is a telling sign of recovery, as expanding the leaf canopy directly boosts the plant's ability to photosynthesize and generate energy for future growth and fruiting. In this context, leaf area serves as a more meaningful indicator of pawpaw's health and recovery potential than physical stature alone.

Table 4.5 showing plant progressive growth of pawpaw highlighting growth parameters; plant height, leaf area and stem diameter

Table 4.5; Weekly mean growth of pawpaw plant

Week	Plant height(cm)	Stem diameter(cm^2)	Leaf area(cm)
1	32.67	0.28	125
2	36.10	0.33	240
3	40.50	0..39	385
4	45.40	0.46	570
5	50.85	0.54	790
6	56.80	0.63	1055
7	62.95	0.73	1370
8	69.30	0.84	1740
9	75.85	0.96	2165
10	82.50	1.09	2650
11	89.25	1.23	3190
12	96.10	1.38	3795
13	102.95	1.54	5200
14	113.00	1.71	5200
15	117.20	1.90	6000

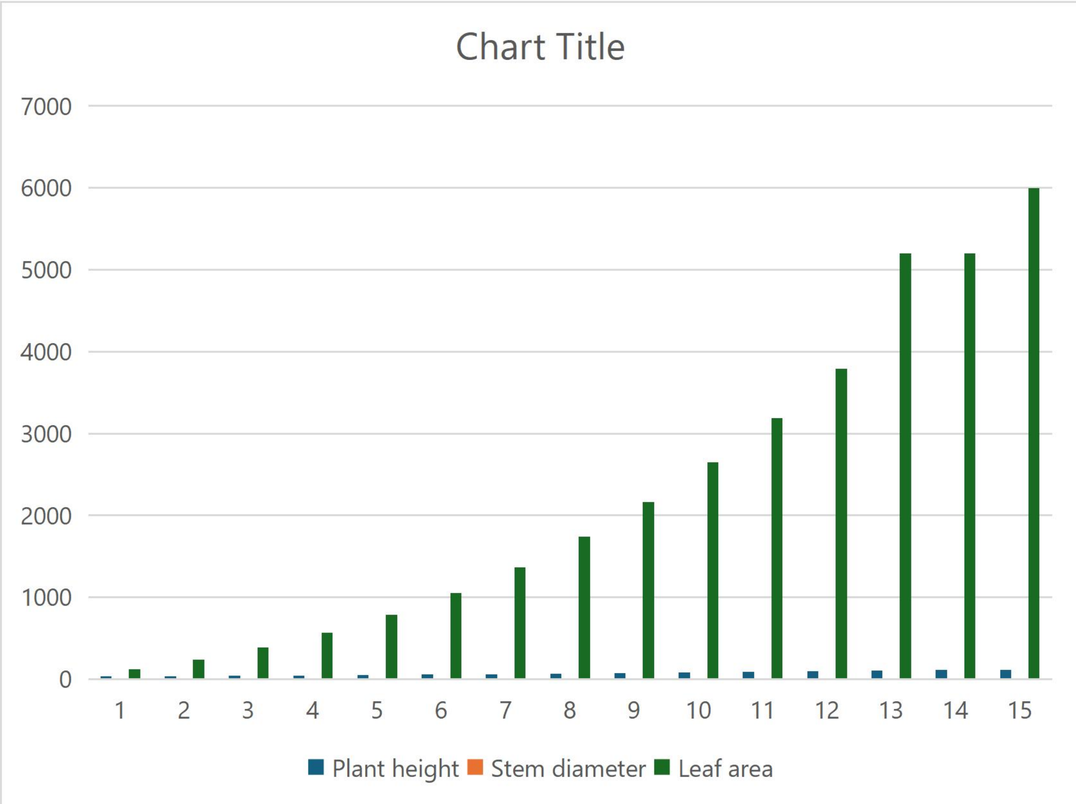

Figure 4.5: Growth Parameters of Pawpaw Plant

Bar chart representing Table 4.5 above giving clear information on the growth parameters of pawpaw plant with leaf area dominating over plant height and stem diameter

Plate 1: Cocoyam transplanted at first and second week

Plate 2: Growth of cocoyam as at 14 weeks, plant height, leaf area and stem diameter increase.

Plate 3: Banana plant observed in the screen house as at first week

Plate 4: Banana as at week 14 showing progressive growth, wide canopy spread and fruiting.

Plate 5: Sweet potato as at 2nd week in nursery before transplanted into the screenhouse

Plate 6: Sweet potato as at 14 weeks, showing rapid vine elongation and wide spread

Plate 7: Water leaf observed as at first week in the screenhouse

Plate 8: Growth of cocoyam as at 14 weeks in it's harvesting stage.

Plate 9: Pawpaw brought from nursery to be transplanted into the screen house

Plate 10: Pawpaw as at 14 weeks in the screen house, showing increased plant height.

4.6 A COMPARISON OF GROWTH AND ROLES

In the span of the 15- week research, the growth pattern of the five different crops which were Banana, cocoyam, sweet potato, water leaf and pawpaw was able to provide how much biomass each crop produced, how they can grow feed for snails, how they can also be effective shades for the screenhouse as well to create a more natural environment for snails to live in.

4.6.1 The Structural Anchors (Banana and Cocoyam)

These plants were seen to be the best supporting crops grown in the screen house. They showed good growth rate even with cocoyam experiencing transplant shock and the banana with Black sigatoka they recovered and created a shaded environment in the screenhouse. This goes to show that Banana and Cocoyam are essential plants which should be grown in a snail screen house as they are not only used for shades but for feeding as well which makes it perfect for snail housing.

4.6.2. The Rapid Producers (Water Leaf and Sweet Potato)

These plants showed remarkable growth spread and adjustments into the screen house. They grow really quickly and rapidly recovered from chewing insects making them a very good source of fresh leafy vegetables for plants. Their ability to grow speedily is most important for snail feeding, making fresh feed accessible and easily available for snails.

While Pawpaw can fit between these two groups, offering shade and the use of the fruits and leaves for snail feeding. They are nutrient rich and can grow better after root development from transplanting.

Table 4.7 showing comparative growth among the five crops (banana, cocoyam, sweet potato, water leaf and pawpaw) and its suitability for snail screenhouse

Table 4.7; Comparative Growth and Heliculture Suitability of Screen House Crops (15 Weeks)

Crop species	Biomass indicator (leaf area/length)	Max height(cm)	Primary Helicilture Unity	Observed Biotic Constraint	Relative RGR/Resilience
Banana (*Musa spp*.)	High structural Biomass (57.53 cm/2 LA)	287.50	Vertical shade/ Structural cover/ Digestive Fiber	Black Sigatoka(fungal)	Stable
Cocoyam (*C. esculenta*)	Exceptional Leaf Area (174,000 cm/2)	257.50	Understorey Shade/ Nutrient- rich Foliage	Isolated chlorosis/ Transplant shock	Moderate/High
Sweet potato (*I. batatas*)	Rapid Vine Elongation (430.20cm)	430.20	High - Protein/ High Vitamin continuous feed	Chewing Damage (Pests)	Very High (Post-Establishment)
Water Leaf (*T. triangulare*)	Rapid Succulent Biomass (960 cm/2)	87.46	High-Moisture Palatable Feed/ Hydration	Extensive Defoliation (Pests)	Very High
Pawpaw (*C. papaya*)	Moderate structural biomass	117.20	High Protein/ Nutrient rich Feed	Stunted growth at early stage	Moderate

4.8 **RECOMMENDED ENVIRONMENTAL VARIABLES FOR A SNAIL SCREENHOUSE**

Table 4.8 showing recommended environmental variables for snail screenhouse. Environmental variables maintained at this range is observed to be beneficial for both plants to obtain maximum yield which will in turn boost snail productivity in a screenhouse.

Table 4.8 Recommended Range of Environmental Variables for a Snail Screenhouse

Variables	**Recommended range**
Humidity	75%-85%
Temperature	23-28^{o}C
Light intensity	50%-70%
C2 levels	Ambient CO2 (400ppm to 600ppm)

CHAPTER FIVE

5.0 DISCUSSION

This study confirmed that the semi-controlled environment within the screenhouse significantly enhanced the vegetative growth of all five test crops: banana, cocoyam, sweet potato, water leaf, and pawpaw. Oladimeji, Ayinde and Olawuyi (2021) found that crops grown under screenhouse conditions exhibited greater leaf area development, reduced moisture stress, and improved overall growth compared to open-field cultivation. The combination of these crops grown showed a balanced and stable environment for snails, they excelled in quality parameters (which was seen in the colour of the leaves and firmness of the plants) also showed great yield performance such as the fruit yield observed in banana plant, the banana was able to produce fruit, that was a clear indicator of good growth performance, the cocoyam growing tall with wide leave canopy offering adequate shade and supporting the banana plant All the crops grown were shown to have complimented each other in the screen house, supporting and working together to create a stable environment.

The screenhouse successfully provided stable humidity, reduced wind stress, and moderated temperatures that are critical for steady plant development in the tropics, creating conditions that allowed each species to express its growth potential more reliably than in an open field (Nwosu *et al.*, 2020). Which confirms Adeniran *et al.* (2020) that screenhouses moderate temperature, increase relative humidity, and reduce wind speed, creates a stable microclimate that enhances crop growth and reduces environmental stress compared to open-field conditions.

While the protected setting fostered healthy growth, it also presented characteristic challenges. Nwosu *et al*. (2020) identified temperature, relative humidity, and light intensity as the major environmental variables influencing crop performance in tropical screenhouses, noting that deviations from optimal ranges result in reduced growth and physiological stress. Banana plants exhibited robust and consistent growth, though the appearance of leaf spots highlighted the persistent risk of fungal diseases like Black Sigatoka, which can thrive in humid conditions even under protection (Oladimeji *et al*., 2021). Cocoyam demonstrated excellent resiliences shown by it's recovery from transplant shock rapidly acclimating and producing abundant foliage, though occasional leaf yellowing pointed (chlorosis) to the need for precise nutrient management. The vigorous, sprawling growth of sweet potato vines made it a standout biomass producer, but the observed leaf damage served as a reminder that insect pests can still infiltrate screenhouse environments (Adeniran *et al*., 2020).

There are few studies discussing crop response to environmental variables for a snail screenhouse in which this study was carried out to provide more information about screenhouse and how it can be effective for snail farming. The findings strongly support the use of such managed environments for smallholder integrated farming, provided that attention is also given to integrated pest and nutrient management within the system (Adeniran *et al*., 2020; Omoyakhi and Osinowo, 2021).

CHAPTER SIX

6.0 CONCLUSION

This study shows that the use of a screenhouse can support and create a semi-controlled environment which can improve the growth of Banana, cocoyam, sweet potato, water leaf and pawpaw under controlled conditions and appropriate range of environmental variables such as temperature, humidity, light intensity and CO2 levels. The different crops grown in a screenhouse under appropriate conditions showed that steady plant development and growth yield much more in contrast to a open field, the screenhouse house is a positive step in producing fresh and accessible feed for snails.

While some challenges occured such as leaf spots in Banana and chewing insects on sweet potato and water leave, significant progress and quality performance of crops confirmed that they are best for the feeding of Archachatina marginata. The humid and suitable conditions within the screenhouse was also shown to be good for snail activities and wellbeing.

In other words, screenhouses through this study has shown to be a good solution for farmers in tropical regions to aid against climate changes, provide continuous supply of quality fresh feed, also mimicking the natural habitat which can lead to an increase in yield and better health of the snails. The knowledge gained on crop performance under these conditions has shown proper guidance in the selection and management of plants in further integrated farming practices.

6.1 RECOMMENDATIONS

To further provide farmers with proper guidance to successfully use and gain from this system, the following steps have been recommended;

1. Awareness of the Use of Screenhouse: Training farmers on the efficient use of screenhouse and resources on screenhouse construction, appropriate environment conditions and how to effectively mange crop and snail farming.

2. Use of Snail Friendly Crops: The use of different crops which were selected for the screenhouse created a natural environment for the snail, where the Banana created a canopy offering shade and a cool environment, sweet potato showing vine elongation covering soil and also maintaining a fresh environment. That shows that a mix of different crops grown in a screenhouse is most effective and complimentary.

3. Monitoring of Environmental Variables; The use of equipments in the screenhouse such as senors can be used to monitor environmental variables in the screen house both for snail and crops. This allows necessary adjustments to be made to maintain a suitable environment and wellbeing of both crops and snails.

4. Further Research: More research should also be done to explore additional knowledge of different crops and other efficient methods of screen house and crop responses for further improvement of snail farming.

With the use of these practices, individuals, farmers and agricultural societies can experience an increase in productivity in snail farming, the knowledge on how environmental variables affect crops and snails and strengthen food security and livelihoods

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APPENDIX

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Cocoyam as at week 15 showing excellent growth rate.

Banana plant wide leaf canopy as at 15 weeks providing shade.

Water leaf plant in the screen house at increased growth rate

Pawpaw plant showing increased growth adter recovering from stunted growth.