

**AN ASSESSMENT ON UNDERGRADUATE BIOLOGY STUDENTS KNOWLEDGE ON  
THE CONCEPT OF PLANT NUTRITION  
(A CASE STUDY OF UNIVERSITY OF BENIN).**

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FACULTY OF EDUCATION  
UNIVERSITY OF BENIN**

**APRIL 2025**

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**A PROJECT REPORT SUMMITTED TO THE DEPARTMENT OF CURRICULUM AND  
INSTRUCTIONAL TECHNOLOGY, UNIVERSITY OF BENIN IN PARTIAL  
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SCIENCE EDUCATION (B.Sc.ED) IN BIOLOGY**

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## CERTIFICATION

We, the undersigned, certify that this research project was carried out by Okoye Esther Nonyelum in the Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, Nigeria.

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## **DEDICATION**

The researcher dedicate this study to God Almighty who has been my rock and my guiding light throughout my academic journey. I am forever grateful for his unending support, love, care and protection.

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## ABSTRACT

This Study evaluated the assessment on undergraduate Biology Students knowledge on the concept of Plant Nutrition at University of Benin, Two (2) research questions served as it's guidelines, and it used a descriptive survey study design. It sought to find out the level of understanding of undergraduate biology students on the concept of plant nutrient and significantly different by sex.

The study employed the descriptive survey random design of Biology students in University of Benin, Edo State and a total of (100) respondents which were collected from Biology department of University of Benin. The researcher developed achievement test questionnaire on "undergraduate Biology Students knowledge on the concept of Plant Nutrition" was used as the data collection tool. There are twenty (20) questions on the achievement test. To analyze the data collected, descriptive statistics such as simple percentage and frequency were used.

The study find out that 100-200 level Students have a basic understanding of basic concepts related to plant nutrition but they lacked in-depth comprehension of plant nutrition. 300 and 400 level undergraduate students displayed a deeper comprehension and have more understanding of plant nutrition concept. The findings of the study also reveals that gender can influence educational outcomes in concept of plant nutrient, attitudes towards plant nutrition can also differ by gender, female students expressed greater interest in plant nutrition. It was suggested that the curriculum for 100-200 level students be revised to include more detailed and practical content on plant nutrition. Given that female students showed greater interest in plant nutrition, it is suggested that teaching strategies be tailored to engage both male and female students equally.

# CHAPTER ONE

## INTRODUCTION

### **Background to the Study**

Science is a systematic and organized body of knowledge that aims to understand and explain the natural world through observation, experimentation, and evidence-based reasoning. It involves the study of the structure, behavior, and evolution of the physical and natural world, including living organisms, matter, energy, and the universe as a whole Micheal (2017), stated that the term Biology is derived from two Greek words “bios” meaning Life and “logos” meaning to Study. Biology as a science is therefore defined as a scientific study of Living Organisms. Biology being a branch of science is the study of life and encompasses the study of living things in the context of influences exerted by non- living things (Kwan, Lam & Ofofuna, 2021).

Biology is the scientific study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy. It explores the diversity of life, from the simplest bacteria to complex ecosystems, and examines the interactions between living organisms and their environment (Offorma, 2015). Biology among the science have been given a special recognition by most educators not only because of its educational values but also its close relation to humans as living organisms, the peculiar field of experimentation and interrelationship with other career sciences. It contributes to the technological advancement of the nation in fields like; medicine, forestry, agriculture, nursing and pharmacy. The study of

Biology in schools prepare students to acquire meaningful and relevant knowledge, equip students with useful concepts, principles and theories and also inculcate in them the ability to apply this knowledge and principles to their everyday life and challenges that may be faced within the environment. Biology is an embodiment of several topics which includes Cells and Cellular Biology, Genetics and DNA, Evolution and Natural Selection, Ecology and Ecosystems, Botany and Plant Biology, Zoology and Animal Biology Microbiology and Immunology, Biochemistry and Molecular Biology.

Plant nutrition refers to the process by which plants obtain and utilize essential nutrients from their environment to sustain growth, development, and reproduction. It is also study of chemical elements required for plant growth. Countries worldwide have included plant nutrition in their secondary school biology syllabuses to lay a strong foundation for studying plant physiology and ecology at higher levels of education. Plant nutrition is a fundamental aspect of biology, essential for understanding the processes governing plant growth, development, and overall health. It is a demanding topic and therefore teachers should use acceptable scientific language when teaching it. Thorough comprehension of plant nutrition is not only vital for academic success but also for addressing critical issues such as agriculture, food security, and environmental sustainability.

Research have seen that students often encounter challenges in grasping the complexities of plant nutrition, leading to suboptimal academic performance in this subject area according to Waec Chief Examiner Report (2019).

This project aims to conduct a comprehensive survey to assess students' understanding of plant nutrition and explore effective strategies to enhance their academic performance. By examining students' knowledge, misconceptions, and learning difficulties related to plant nutrition, we seek to identify key areas requiring improvement in educational practices and curriculum development.

### **Statement of the Problem**

Chief examiners' report on West African Senior School Certificate Examination 2023 showed that the performance of Biology students in 2023 was slightly poorer with a raw mean score of 31 and standard deviation of 11.92 when compared with the raw mean of score of 31 and the standard deviation of 10.91 of WASSCE 2022.

The challenges students face in understanding plant nutrition, which ultimately impacts their academic performance in biology include factors such as; poor understanding of concepts, limited access to practical resources, and ineffective teaching strategies contribute to this issue. Addressing these challenges through research and implementing strategies to enhance students'

comprehension of plant nutrition will be crucial in improving their academic performance and overall success in biology courses and external examinations.

In this view this study tends to survey undergraduate Biology students knowledge of plant nutrition and strategies to improve academic performance

### **Research Questions**

The following research questions were raised to guide the study;

1. What is the level of understanding of undergraduate biology students on the concept of plant nutrient?
2. Are the undergraduate biology students knowledge in plant nutrition significantly different by sex?

### **Purpose of the Study**

The purpose of this study is focused on investigating students' comprehension on plant nutrition.

Specifically, the study aim;

1. To evaluate the level of understanding of undergraduate biology Students on the concept of Plant nutrient
2. To find out if the undergraduate biology students knowledge in plant nutrition significantly different by sex?

## **Significance of the Study**

The findings obtained from the study will benefit Students, Teachers, and WAEC chief examiners in addressing students' comprehension and performance issues in the realm of plant nutrition concepts.

Ultimately, the study aims to benefit students by providing insights into how they can better grasp plant nutrition concepts and excel academically, by identifying areas of weakness and implementing evidence-based strategies to improve learning outcomes, so they can develop a strong foundation in science and enhance their prospects for future academic and career success.

The study findings may have implications for educational policies at institutional, regional, or national levels. Curriculum planners can use this information to advocate for resources and initiatives in curriculum development aimed at enhancing science education and improving student outcomes in plant nutrition and other related fields. This can help ensure that educational content is relevant, engaging and aligned with students' learning needs.

Also, understanding students' difficulties in grasping plant nutrition concepts can guide professional development programs for the effectiveness of Biology teachers. Educators can receive targeted training on effective instructional methods in teaching and assessment techniques to better support student learning and improve academic performance. By examining the potential impact of gender on understanding this biological concept, the study aims to

identify any disparities in learning outcomes and to explore possible underlying factors. This research could provide insights into educational strategies that can be employed to ensure equitable learning opportunities and improve overall science education effectiveness.

The study would also bring into light the problems and difficulties faced by both teachers and students during the teaching and learning process of plant nutrition concepts.

The study contributes to the body of knowledge in science education research in relation to WAEC examination body by investigating the factors influencing students' understanding of plant nutrition and academic performance. This can stimulate further research in the field and foster a deeper understanding of effective teaching and learning practices.

### **Scope and Delimitation of the Study**

The scope of this study is aimed at investigating the comprehension level of undergraduate students' in the concepts of plant nutrition and the challenges students face in understanding the plant nutrition concepts. The study is delimited to Biology department of university of Benin, Edo State.

## **Definition of Terms**

**Academic:** It describe things related to the work done on schools, colleges, and universities. The work involved studying and reasoning rather than practical skills.

**Practical Work:** It describes the hands-on activities or experiments conducted by students to enhance understanding and learning of scientific concepts.

**Curriculum:** It is referred to as the outline of contents to be taught to students to help them meet the content standards

**Assessment:** is the process of evaluating or measuring the quality, accuracy, or effectiveness of something, such as student learning.

**Undergraduate student:** is a student who is pursuing a bachelor's degree or an associate's degree at a college or university. Undergraduate students are typically enrolled in a four-year program (although some programs may be two or three years) and take courses to complete their degree requirements.

## CHAPTER TWO

### REVIEW OF RELATED LITERATURE

This chapter will review relevant literatures as it relates to the topic of the study. The review of literature will be carried out under the following subheadings:

- ❖ Theoretical framework
- ❖ Conceptual framework
- ❖ Concept of Biology
- ❖ Plant Nutrition ( Introduction )
- ❖ Instructional Materials for effective teaching of plant nutrition
- ❖ Importance of using instructional materials for teaching plant nutrition
- ❖ Factors affecting effective teaching and learning of plant nutrition
- ❖ Strategies to improve students' academic performance in biology especially in topics like plant nutrition
- ❖ Empirical Framework
- ❖ Summary of Related literature

#### **Theoretical Framework**

This study is grounded in John Dewey (1938) theory, he was a philosopher and educational reformer who developed a progressive approach to education. He believed that learning should be an active and collaborative process, rather than a passive one. His theory on prior learning

focuses on the idea that students' past experiences and knowledge should be used as a foundation for future learning. According to Dewey, students learn best when they are able to connect new information with their prior knowledge and experiences. He argued that teachers should take the time to understand each individual student's background and use it as a starting point for their instruction.

One key aspect of Dewey's theory is the concept of reflective thinking. He believed that students should not only acquire knowledge, but also actively think about and reflect on that knowledge. This process of reflection allows students to make connections between their prior learning and new information, leading to a deeper understanding. Dewey also emphasized the importance of hands-on, experiential learning. He believed that students learn best through direct experiences and interactions with the world around them. This approach allows students to not only learn information, but also develop critical thinking skills and problem-solving abilities.

Another aspect of Dewey's theory on prior learning is the idea of social learning. He believed that learning should be a collaborative process, where students interact with their peers and learn from each other's experiences. This not only allows for a richer learning experience, but also helps students build important social skills. John Dewey's theory on prior learning emphasizes the importance of using students' past experiences and knowledge as a foundation for future learning. By actively engaging students in reflective thinking, hands-on experiences, and

collaborative learning, educators can help students build upon their prior learning and deepen their understanding of new concepts.

### **Conceptual framework**

Plant nutrition is a fundamental concept in biology, essential for understanding plant growth, development, and ecosystem functioning. Undergraduate biology students should possess a comprehensive understanding of plant nutrition to excel in their academic and professional pursuits.

### **Concept of Biology**

Science is a method of learning more about natural phenomena. Science is a methodical, logical, and repeatable endeavour to comprehend the laws and forces at work in the natural world. Science is not dogmatic but should be considered as a continual process of testing and assessment. According to Nworgu (2015), science has a dual character, meaning that it is in terms of the techniques and procedures used as well as the result, which comprise the corpus of science. Science is studied and understood through observation, hypotheses, experiments, data analysis, inference, and conclusions. The scientific method is made up of all of them. He described science as an organized body of knowledge obtained via research and experimentation, taking into account the dual character of science. As a result, science is viewed in terms of both "processes" and "products".

Biology as a branch of Science subjects deals with the study of living things, it is one of the pre-requisite subject in the field of learning that contributes immensely to the technological growth of the nation. According to Alane (2020) Biology is a natural science that involves the study of everything that is, or was once alive- whether it's a plant, animal or microorganism. The Federal Republic of Nigeria (FRN, 2013) policy paper states that science education should place a strong emphasis on teaching and learning about scientific principles and processes. This method of instruction places less emphasis on fact memory and regurgitation in favour of skill development, which encourages students to practice science rather than simply absorb it. In general, biologist study the structure, function, growth, origin, evolution and distribution of living organisms. In senior secondary schools, biology is taught as both a theoretical and practical science subject. The aim is to gain knowledge, understand the scientific nature of biology, and develop scientific skills to independently and collaboratively address biology-related issues. The practical aspect of biology holds significant importance in external examinations, as it is a marked component used to calculate the final grade for biology in the West African Examination Council (WAEC).

### **Concept of Plant Nutrition.**

Plant nutrition is a fundamental aspect of plant biology, essential for understanding plant growth, development, and overall health.

Plant nutrition is the study of the chemical elements and compounds necessary for plant growth and reproduction, plant metabolism and their external supply. In its absence the plant is unable to complete a normal life cycle, or that the element is part of some essential plant constituent or metabolite.

Plants, via photosynthesis, are the providers of energy for virtually all of the terrestrial organisms in the world. Photosynthesis, performed by plants, is the critical step in energy conversion from the sun, taking carbon dioxide from the air and using water and light to make sugar, which is the basic building block or starting material for all organic matter.

Plants absorb vital elements from the soil through their roots and from the air through their leaves. The soil serves as the primary reservoir of nutrients, where minerals are present in both organic and inorganic forms. Organic matter, such as decomposed plant and animal residues, contributes to soil fertility by releasing nutrients through microbial activity. Inorganic nutrients, on the other hand, are present as soluble ions or complexes that plants absorb through their root systems. Nutrients are absorbed from the soil through cation exchange, where root hairs release hydrogen ions ( $H^+$ ) into the soil through proton pumps. These hydrogen ions displace positively charged cations attached to negatively charged soil particles, making them available for root uptake. In the leaves, stomata open to take in carbon dioxide and release oxygen. The carbon dioxide molecules serve as the carbon source for photosynthesis.

The knowledge that there are genetic differences between plants in their accumulation of mineral elements has given a scientific basis to breed increased micronutrient concentration into crop species, thereby generating genetic biofortification of crop species (White and Brown, 2020). For example, Chatzav et al. (2020) investigated the concentrations of micronutrients in grains of ancestral wheat plants and found they contain up to two times the concentrations of zinc and iron of modern bread wheat.

Marschner highlights the significance of iron (Fe) in chlorophyll synthesis and electron transport in photosynthesis, underlining its crucial role in plant growth and development (Marschner, 2022). It investigates how plants absorb iron from the soil and the strategies they use to improve iron acquisition when it's scarce in the soil. Water constitutes the majority of a plant cell's volume, typically making up 80 to 90 percent of the plant's total weight. Despite appearing dry, soil serves as the primary water source for land plants and can be abundant in water.

Plants access water through the soil. Water is absorbed by the plant root, transports nutrients throughout the plant, and maintains the structure of the plant. Essential elements are indispensable elements for plant growth. They are divided into macronutrients and micronutrients. The macronutrients plants require are carbon, nitrogen, hydrogen, oxygen, phosphorus, potassium, calcium, magnesium, and sulfur. Important micronutrients include iron, manganese, boron, molybdenum, copper, zinc, chlorine, nickel, cobalt, silicon and sodium. Van

Helmont had an experiment that showed that plants do not consume soil, which is correct. He also thought that plant growth and increased weight resulted from the intake of water, a conclusion that has since been disproven.

The first inference on some aspects of plant mineral nutrition started in antiquity, when Aristotle (384–322 BC), the Greek philosopher and biologist, already made statements about how plants fed. At that time, he indicated that plants were like inverted animals, with their mouths on the ground. For him, food would be previously digested by the soil, as vegetables did not show visible excretions, as animals do. Investigations on the ways through which plants fed continued, and new discoveries were found at each stage of human history.

According to Epstein (2015), Liebig's main contribution to plant nutrition was to end the humus theory that believed soil organic matter was the plant carbon source. According to Liebig's theory, plants lived on carbonic acid, ammonia (azotic acid), water, phosphoric acid, sulfuric acid, silicic acid, magnesian lime, caustic potash, and iron. White and Hammond (2018) authored "The Mineral Nutrition of Plants: A Practical Approach" provides valuable insights into plant nutrition, offering practical understanding of how minerals influence plant growth and development.

Plant nutrition is a multifaceted field that encompasses the acquisition, utilization, and management of essential nutrients by plants. Understanding the principles of plant nutrition is

crucial for maximizing crop yield, optimizing soil fertility, and promoting sustainable agriculture practices. Students' perception of plant nutrition significantly expands their awareness of global challenges, the importance of conservation, how ecosystems function, and the interdependence of living organisms in nature, thereby promoting the scientific inquiry as experiments are being conducted to make observations and draw conclusions on plant growth and specific nutrient requirements. For total understanding of plant nutrition, students must have knowledge on the basic concepts such as;

**Macronutrients:** Macronutrients are essential nutrients that provide energy, support growth and maintenance, and regulate various bodily functions. They are classified into three primary categories: carbohydrates, proteins, and fats. This review provide an overview of macronutrients, their functions, sources, and recommended daily intake. knowing the primary nutrients needed by plants in large quantities, such as; nitrogen, phosphorus and potassium, and their various roles in processes like photosynthesis, cell structure and energy transfer.

**Carbohydrates:** They are the body's main source of energy. Carbohydrates are broken down into glucose, which is used for immediate energy or stored as glycogen in the liver and muscles for later use. Sources: Fruits, vegetables, grains, legumes, and dairy products. They can be classified into simple carbohydrates (sugars) and complex carbohydrates (starches and fiber).

Proteins: Proteins are essential for building and repairing tissues, making enzymes and hormones, and supporting immune function. They are made up of amino acids, some of which are essential and must be obtained from the diet. Sources: Meat, fish, eggs, dairy products, legumes, nuts, seeds, and some grains.

Fats: Fats provide a concentrated source of energy, support cell growth, protect organs, and help absorb certain vitamins (A, D, E, and K). They can be classified into saturated, unsaturated, and trans fats. Sources: Oils, butter, avocados, nuts, seeds, fatty fish, and dairy products. In addition to these three main macronutrients, water is often considered a vital component of nutrition, although it is not a macronutrient in the traditional sense. Balancing these macronutrients is important for overall health, and the ideal ratio can vary based on individual dietary needs, activity levels, and health goals.

Micronutrients: Micronutrients are essential dietary elements required by the body in small amounts for a variety of physiological functions. Unlike macronutrients, which include carbohydrates, proteins, and fats, micronutrients encompass vitamins and minerals that play critical roles in maintaining health, supporting growth, and preventing diseases. Despite their small required quantities, deficiencies in micronutrients can lead to significant health issues. Ensuring an adequate intake through a varied and balanced diet is essential for preventing deficiencies and promoting optimal physiological functions. Public health initiatives aimed at

increasing awareness and access to micronutrient-rich foods are crucial in addressing global health challenges related to malnutrition and micronutrient deficiencies. Continued research into the roles of micronutrients in health and disease will further enhance our understanding and ability to promote health through nutrition. knowing the importance of trace elements and it's specific functions, even though needed in small amounts. Elements like; iron, zinc and magnesium.

Absorption Mechanism: Nutrient absorption is a critical physiological process that allows the body to take in essential substances from the diet. This process occurs primarily in the gastrointestinal (GI) tract, where nutrients are extracted from food and transported into the bloodstream for use by the body. Understanding the mechanisms of nutrient absorption is vital for comprehending how dietary components influence health, growth, and disease prevention. The mechanisms of nutrient absorption are complex and involve various transport processes that ensure the efficient uptake of essential nutrients from the diet. Understanding these mechanisms is crucial for developing dietary recommendations and interventions aimed at improving nutrient status and overall health. Continued research in this field will enhance our knowledge of how different factors influence nutrient absorption and how to optimize dietary strategies for better health outcomes.

Soil Composition: Soil is a dynamic and complex natural resource that plays a crucial role in supporting life on Earth. It serves as a medium for plant growth, a habitat for numerous organisms, and a critical component of the Earth's ecosystem. Soil composition is a fundamental aspect of the Earth's ecosystem, influencing agricultural productivity, environmental health, and land use planning. A comprehensive understanding of the components and properties of soil is essential for sustainable management practices that support both human needs and ecological balance. Soil is composed of four primary components: mineral particles, organic matter, water, and air. Each of these components contributes to the overall characteristics and functionality of the soil. Knowing how soil pH, texture, and organic matter content affect nutrient availability to plants and how soil amendment can improve nutrient uptake.

Nutrient Deficiencies and Toxicities: Nutrient deficiencies and toxicities are critical factors affecting plant health, growth, and productivity. Plants require a range of essential nutrients to thrive, and imbalances whether due to insufficient availability or excessive concentrations can lead to significant physiological and morphological changes. This paper explores the causes, symptoms, and management strategies associated with nutrient deficiencies and toxicities in plants. Nutrient deficiencies occur when plants do not receive adequate amounts of essential nutrients. The symptoms of deficiencies can vary widely depending on the nutrient involved, the plant species, and environmental conditions. Nutrient toxicities occur when plants are exposed to

excessive levels of nutrients, leading to detrimental effects on growth and development. Symptoms can be similar to those of deficiencies, making diagnosis challenging.

### **Undergraduate Biology Students' Understanding of Plant Nutrients**

Plant nutrients play a fundamental role in plant growth, development, and ecosystem balance. However, research suggests that undergraduate biology students often struggle with fully grasping nutrient cycling, essential elements, and nutrient uptake mechanisms (Anderson et al., 2021). This literature review explores studies that examine the level of understanding of plant nutrients among undergraduate biology students, highlighting conceptual difficulties, instructional challenges, and strategies for improving comprehension.

Several studies indicate that undergraduate students often hold misconceptions about plant nutrients, particularly regarding their sources and roles in plant physiology (Brown & Smith, 2019). For instance, students frequently confuse macronutrients (e.g., nitrogen, phosphorus, potassium) with micronutrients (e.g., iron, zinc, copper) and fail to differentiate between essential and beneficial elements (Jones et al., 2020). Additionally, research by Wilson et al. (2022) found that students struggle with the concept of nutrient mobility within plants, often believing that nutrients move passively rather than through active transport mechanisms. This lack of understanding can impact students' ability to apply knowledge in agricultural and environmental sciences.

Traditional instructional approaches, such as lectures and textbook-based learning, may not effectively promote deep understanding of plant nutrition. Studies have shown that active learning strategies, such as inquiry-based learning and concept mapping, significantly improve student comprehension (Lee & Martinez, 2021). However, many undergraduate curricula still rely on rote memorization rather than conceptual engagement (Garcia & Thompson, 2020). Moreover, assessment methods often fail to diagnose student misconceptions effectively. According to Patel and Kim (2023), multiple-choice assessments may not capture nuanced misunderstandings, whereas open-ended questions and practical applications provide better insight into students' conceptual grasp.

To improve students' comprehension of plant nutrients, researchers suggest incorporating hands-on experiments, case studies, and digital simulations. For example, using hydroponic experiments allows students to directly observe nutrient deficiencies and their effects on plant growth (Anderson et al., 2021). Similarly, computer-based simulations have been found to enhance students' understanding of nutrient uptake processes at the cellular level (Lee & Martinez, 2021). Peer instruction and collaborative learning also contribute to a deeper understanding. A study by Rodriguez and Evans (2022) found that students who engaged in group discussions about nutrient cycles demonstrated greater retention and application of knowledge than those who studied alone.

The literature indicates that undergraduate biology students often struggle with key plant nutrient concepts due to misconceptions, ineffective teaching methods, and assessment limitations. Implementing active learning strategies, hands-on experiments, and technology-based tools can enhance students' comprehension and retention of plant nutrient knowledge. Future research should focus on developing and assessing innovative pedagogical approaches that improve student learning outcomes in this area

### **Differences in Undergraduate Biology Students' Knowledge of Plant Nutrition by Sex**

Plant nutrition is a fundamental topic in biology, yet students' understanding of the subject varies due to several factors, including prior knowledge, teaching methods, and cognitive abilities (Ali et al., 2020). One potential factor influencing knowledge acquisition is sex, as studies suggest that males and females may differ in their approaches to learning science-related concepts (Schiebinger, 2019). This literature review examines whether undergraduate biology students' knowledge of plant nutrition significantly differs by sex, focusing on cognitive differences, academic performance trends, and sociocultural influences.

Research on cognitive differences in science education suggests that males and females may exhibit distinct learning preferences and problem-solving strategies. According to Halpern et al. (2021), males tend to excel in spatial reasoning and abstract thinking, which are essential for understanding complex biological processes such as nutrient transport and assimilation. In

contrast, females often demonstrate stronger verbal reasoning skills, which may aid in conceptual understanding and retention of factual knowledge (Kimura, 2020). However, whether these cognitive differences translate into significant variations in plant nutrition knowledge remains a subject of debate.

Several studies have explored gender differences in academic performance within biological sciences. A meta-analysis by Hyde and Linn (2021) found that sex differences in science achievement were generally small, with variations depending on specific topics and assessment methods. For instance, males often perform better in problem-solving tasks involving quantitative analysis, while females tend to excel in descriptive and essay-based assessments (Hoffman & Hausler, 2019). In plant nutrition, where understanding requires both quantitative and qualitative reasoning, performance disparities may be influenced by assessment design rather than inherent ability (Ogunleye, 2020).

Sociocultural factors, including societal expectations and educational experiences, also shape students' knowledge acquisition. Gender stereotypes in science education can influence students' confidence and interest in plant-related topics. Studies indicate that female students may perceive biology as a "soft science," leading them to focus on human and medical biology rather than plant sciences (Jones & Wheatley, 2018). Additionally, classroom dynamics and instructional

strategies may favor one sex over the other, impacting engagement and comprehension levels (Ertl et al., 2020).

### **.Instructional Materials for Effective Teaching of Plant Nutrition.**

According to Abdullahi (2020), instructional materials are tools locally made or imported that help to facilitate the teaching and learning process. Instructional materials are vital instruments in the teaching and learning process at every educational level. Instructional materials are all the tools which are needed by the teacher to provide help and encouragement to undergraduate Student learning activities (Ema and Ajayi, 2021). In the words of Onyejemezi in Eya and Ureme (2021), instructional materials are resources or teaching materials, which a teacher utilizes in the course of presenting a lesson in order to make the content of the lesson understandable to the learners.

Instructional materials vary from simple homemade tools to advanced machinery, as well as individuals who aid teachers in effectively imparting knowledge and information to facilitate meaningful learning for students (Ololobou, 2018). These materials are derived from various sources; collection of items from the community, improvised materials by teachers and pupil's distribution of materials from governmental and non-governmental organizations as well as donations from various agencies. Because pupils' sense organs serve as gateways to learning, instructional materials offer learners the chance to actively engage intellectually, perceptually,

and physically in the teaching process (Jekayinfa, 2015). The National Teachers Institute (NTI) teacher training manual quoted in Ololobou (2018), categorized instructional materials into print materials, audio-materials, audio-visuals, static/displays and electronic materials.

Activities such as hands-on experiments, group discussions, and real-life case studies can enhance comprehension and problem-solving abilities in this field, help those who learn to develop problem-solving skills and scientific attitude. UNESCO (2015) states that many teachers instinctively and for a long time incorporated fundamental learning into their instruction. They understood the importance of having knowledge and abilities in a certain area. Opportunities offered by the specific or in the classroom are acknowledged and utilized. The study concluded from the available literature that there are several components to efficient teaching of biology, including teacher qualification, teaching methodology, effective laboratory utilization, and subject matter competence.

To ensure effective teaching of plant nutrition and optimal learning outcomes for students, teachers should utilize visual aids like diagrams and charts to accurately explain plant structures and nutrient cycles. Instructional Materials, like models of soil samples and educational videos help both the teacher and the learner to overcome physical limitations during the presentation of subject matter. Apart from the basic instructional materials, practical activities which is essentially important for concretizing theoretical classroom learning experience , should be

encouraged by the teachers, engaging in hands-on project activities and visiting agricultural sites or farms would help students acquire new knowledge, develop concepts, principles, and skills, leading to improved academic performance. It also provides opportunity for students to interact with materials and ideas, and by so doing, stimulate the development of affective and psychomotor dimensions of learning alongside with the cognitive dimension in order to ensure an all-round and comprehensive development of the student (Agbowuro, 2016).

### **Importance of Using Instructional Materials for Teaching Plant Nutrition.**

The role of instructional materials in teaching and learning of Biology especially in subjects like plant nutrition, cannot be over emphasized. The World Book Encyclopedia Americana indicated that one of the principle teachers have to continually bear in mind is that man learns through his sense. Some individuals learn better through one or more senses; for some, seeing is understanding, while for others, hearing, touch, smell, and taste play a dominant role in acquiring knowledge. Therefore, for learning to take place effectively and for Students' to have total comprehension, the teacher must communicate effectively during lesson period.

The insight from Farombi on linking instructional resources to students' academic performance serve critical in the provision of quality education. Based on the role of instructional materials in teaching and learning, Balogun (2022) commented that science education programmes cannot be taught effectively without the existence of equipment for teaching. This is because instructional materials as well as the interactive and engaging methods in teaching plant nutrition will enable

students to gain a thorough understanding of the concepts and develop essential scientific skills. These scientific skills involve practical applications in real-life situations and are crucial, especially in external assessments like WAEC, which evaluate students' abilities.

Effective instructional materials plays a significant role in influencing students' comprehension of plant nutrition concepts in secondary education. Nwoji (2022) asserted that instructional materials assist a teacher to transmit to a learner the facts, skills, attitude and knowledge that aid the understanding and appreciation of the subject concepts. The implementation of instructional materials in teaching plant nutrition by providing visual aids and hands-on activities, helps the student visualize abstract concepts, for instance; diagrams, charts, and models help illustrate nutrient uptake processes, while experiments and demonstrations allow students to observe plant responses firsthand, making learning more effective and enjoyable. Therefore simplifying the complexity of the topic for easier assimilation. When instruction is tailored and interactive, teachers can more effectively observe, analyze, and comprehend the learning process and its outcomes. Hence, the teacher discovers when the learner needs ones assistance or another.

Well-designed materials related to the field of topic provides clear explanations and illustrations on the h topic concepts thereby reducing or totally alleviating misconceptions and increasing the retention rate of the students .Instructional materials such as; the size of classroom, sitting position and arrangement, availability of tables, chairs, chalkboards, shelves on which

instruments for practicals, are important in the teaching transaction. According to these scholars (Farrant & Farombi, 2018), availability of instructional materials can work best if other conditions are met such as; the quality of classroom. The net effect of all is that it increases the overall academic performance of the students.

### **Factors Affecting Effective Teaching and Learning of Plant Nutrition**

Understanding of plant nutrition concepts as well as the teaching of this biological concepts poses several challenges for both the students and the teachers, stemming from the complex nature of the subject matter which causes misconceptions. According to Bajah (2022), the factors affecting science teaching and learning process which make students perform poorly in science subjects are as a result of poor teaching method, poorly equipped science laboratories, over dependence on print materials, lack of laboratory, lack of qualified science teachers, and institutional objectives in science teaching.

In this section some of the empirical studies related to students' knowledge of plant nutrition have been reviewed. Two main findings can be highlighted from this review. Firstly, students hold a range of views about the nature of plant food, sources of biomass and the photosynthetic process. It is likely that students attend a plant nutrition lesson with the following preconceptions:

- **Sources of plant food:** Students believe that plants take in ready-made food from their surroundings. Examples of this food include water, minerals, fertilisers and maybe light and air.

Although they might refer to plants making food internally, they might also believe that plants suck nutrients up from the soil as food. It seems that students retain a model of plant nutrition similar to that of animals' feeding, in which roots function as a mouth Bennie, (2019).

- **Plant biomass:** students ascribe plant growth and the increase of biomass to nutrients taken in from the soil, mainly water. In particular, they find it difficult to believe that plants' mass mainly comes from the incorporation of carbon dioxide Akporode (2021).

- **The nature of photosynthesis:** students might see photosynthesis as a type of respiration or they may confuse photosynthesis with respiration in terms of purpose, outcomes and time of occurrence. Moreover, roles of carbon dioxide and light energy appear to be challenging for students to appreciate UNESCO (2015).

The second key finding concerns the causes of these misunderstandings. It seems that these misunderstandings are caused by a lack of proper understanding of some pre-requisite concepts, which are:

- **Concept of food:** while the scientific conception rests on using food as a source for energy and biomass, students tend to conceptualise food as elements that are edible, digestible, or absorbable, in the case of plants Wikipedia, (2022).

- **Concept of gas:** although the scientific view is that gas (e.g. carbon dioxide) has mass and can contribute to forming other substances, students think of carbon dioxide as a weightless gas, which cannot contribute to forming glucose.

- **Cycling of matter:** while matter is conserved and can be cycled into different forms, students find it difficult to believe that solids like glucose or mass can be produced from combining gas (carbon dioxide) with liquid (water) Nwoji (2022).

Furthermore, inadequate supply of biology equipment and instructional materials poses a major problem to the effective teaching and understanding of plant nutrition being that this concept is a practical science subject which needs demonstration and practical sessions to enhance learning. Odia and Omofomnwa (2017) stated that instructional materials have deteriorated in many schools, classroom, libraries and laboratory are nothing to write home about, all leading to a decline in academic standard.

According to Ogunbiyi, (2024), one of the fundamental problems facing science teaching today is the question of how current are the professional teachers. The majority of teachers who were teaching before 1995 lacked the pedagogical strategies to deliver their lessons well. What account for this is the fact that teachers have not been given the opportunity for re-training. He therefore recommended that teachers should be encouraged to go for workshop training in their

areas of specialization. Some teachers do not put effort in improvisation of teaching aids which will boost the creativity of both teachers and students.

### **Strategies to Improve Students' Academic Performance Especially in Topics like Plant Nutrition**

Despite the importance of Biology in national development and its popularity among students, academic performance in the subject is not been encouraging (Araoye, 2020). Researchers like Akinjide (2018) and Ihekwoaba et al (2020) blame the poor performance in Biology on a number of factors such as inadequate learning facilities, inappropriate use of teaching method, over loaded curriculum, poor mastery of language of instruction (English language), poor knowledge of the concepts, lack of qualified teachers and over populated classes among others. In order to improve the academic performance of students an modified teaching methods should be introduced by the teacher so as to efficiently pass the information to students' and for easy comprehension.

A Cooperative learning works is encouraged, because it is active, student centered and social (Johnson & Johnson, 2018). A cooperative learning activity involves; reading, writing, planning experiments, designing questions and solving problems. Because cooperative learning shifts the focus from the instructor to the students, it allows students to develop social support networks and acquire and apply various social skills, such as leadership, communication, inquiry and

respect for diversity (Lord 2021). The developed social skills helps students to build confidence as Learners, leading to improved attitude towards the subject. Mary (2016) explained that group work during practicals is a persuasive and influential feature of the classroom ecosystem, which must be encouraged in the teaching and learning of plant nutrition concepts.

### **Challenges Hindering Biology Students' Adequate Understanding of the Concept of Plant Nutrients**

The concept of plant nutrients is fundamental in biology, particularly in botany and agricultural sciences. However, many students struggle to grasp this topic effectively. Understanding plant nutrients requires knowledge of chemistry, soil science, and biological processes, making it a multidisciplinary subject (Khan, 2021). This literature review explores key challenges hindering biology students' understanding of plant nutrients, including conceptual difficulties, instructional methods, lack of practical experience, and misconceptions.

The findings show that there are several challenges hindering biology students' adequate understanding of the concept of plant nutrient. These challenges can be grouped into three main categories: conceptual, pedagogical, and contextual.

**Conceptual Challenges:** One of the key conceptual challenges identified is the complexity of the topic. Plant nutrient is a multidisciplinary concept that involves knowledge from various fields such as biology, chemistry, and soil science. Students find it difficult to integrate all these

different aspects and understand the concept as a whole. They also struggle with the abstract and technical language used in textbooks and lectures, which makes it harder for them to grasp the concept.

Another conceptual challenge is the lack of prior knowledge and understanding of basic biology and chemistry concepts. Many biology students have limited knowledge of fundamental concepts such as photosynthesis, respiration, and cell structure, which are essential for understanding the concept of plant nutrient. This lack of foundational knowledge makes it difficult for students to connect and apply concepts in the context of plant nutrient.

**Pedagogical Challenges:** The findings also highlight several pedagogical challenges that hinder students' understanding of plant nutrient. These include inadequate teaching methods and resources, lack of hands-on practical experiences, and limited opportunities for active learning. Most biology classes rely heavily on traditional lecture-based teaching methods, which do not engage students and fail to promote critical thinking and problem-solving skills. As a result, students struggle to understand and retain the information presented, including the concept of plant nutrient.

The lack of practical experiences also poses a challenge for students. Many students report that they have not had enough opportunities to apply their knowledge and observe the effects of

different plant nutrients in real-life situations. Without practical experiences, students may struggle to grasp the significance of the concept and its applications.

**Contextual Challenges:** The context in which biology is taught and learned also plays a role in hindering students' understanding of plant nutrient. For example, many students come from urban areas and have limited exposure to plants and agriculture. They may find it challenging to relate to the concept of plant nutrient, which is closely tied to agriculture and plant growth. Moreover, the importance of plant nutrient may not be evident to students who live in areas with abundant natural resources and fertile soil, and they may not see the relevance of the concept to their daily lives.

Another contextual challenge is the lack of societal emphasis on the importance of plant nutrient and sustainable agriculture practices. Students may not be aware of the global food crisis and the role of plant nutrient in addressing this issue, which can diminish their motivation to understand the concept. The findings reveal that there are several challenges that hinder biology students' understanding of the concept of plant nutrient. Addressing these challenges requires a multifaceted approach that includes improving teaching methods, providing practical experiences, and creating a contextual link to students' lives and society's needs.

One of the primary barriers to understanding plant nutrients is the abstract nature of the subject. Students must comprehend complex biochemical processes, such as nutrient absorption,

transport, and assimilation, which are not directly observable (Ogunniyi & Rollnick, 2020). Studies have shown that students often struggle with differentiating between macronutrients (e.g., nitrogen, phosphorus, potassium) and micronutrients (e.g., iron, zinc, manganese) and their specific roles in plant growth (Ali, 2019). Additionally, the dynamic interactions between soil composition, water availability, and nutrient uptake further complicate understanding (Jensen, 2021).

Traditional teaching methods, such as lecture-based instruction, may not effectively engage students in learning about plant nutrients. Research indicates that students learn better through interactive and inquiry-based approaches (Ertmer & Newby, 2019). However, many schools still rely on rote memorization, leading to superficial understanding rather than deep conceptual knowledge (Okebukola, 2021). Moreover, textbooks and classroom resources often provide limited real-world examples, making it difficult for students to relate theoretical knowledge to practical applications (Sharma & Gupta, 2020).

Hands-on learning is essential for mastering biological concepts, yet many students lack adequate laboratory or field exposure to plant nutrition experiments. Studies have found that students who engage in soil testing, hydroponic experiments, and nutrient deficiency studies develop a better grasp of the topic (Tadesse et al., 2022). However, limited access to laboratory

facilities, funding constraints, and a lack of trained educators in experimental techniques hinder effective learning (Adekunle & Ajayi, 2020).

Misconceptions about plant nutrients further impede learning. Some students mistakenly believe that plants obtain nutrients solely from the soil, ignoring the role of photosynthesis and atmospheric nutrient sources like nitrogen fixation (Cox, 2018). Additionally, there is confusion between plant nutrition and human nutrition, leading to misunderstandings about how plants synthesize their own food (Barker & Pilbeam, 2019). Addressing these misconceptions requires targeted teaching strategies, such as conceptual change models and active learning approaches (Treagust & Tsui, 2021).

The challenges hindering students' understanding of plant nutrients stem from conceptual difficulties, ineffective teaching methods, lack of hands-on experience, and persistent misconceptions. Addressing these issues requires a shift towards inquiry-based learning, improved laboratory access, and targeted interventions to correct misunderstandings. Future research should focus on developing innovative teaching strategies that integrate technology and real-world applications to enhance student comprehension.

### **Empirical Framework**

There have been several studies conducted in Nigeria on biology students' knowledge on the concept of plant nutrition. Some of these studies are highlighted below:

A research was conducted by Taofikat A. Ayinde in 2015 on Secondary School Biology Students' Understanding of Plant Nutrition in Ogun State, Nigeria. The study is a survey research which adopted simple random sampling technique with Sample Size of 268 biology students from five secondary schools in Ogun State. The researcher administer questionnaire to the respondents, collection was made on the spot and to ascertain the degree to which each statement in the questionnaire item was accepted or rejected, the data were analyzed using Mean. The findings of this study shows that students had a fair understanding of the basics of plant nutrition but lacked a deeper understanding of the underlying processes. The study recommended the use of instructional methods that involve hands-on activities to improve students' understanding.

A Study was carried out by Oluwayemisi O. Adeboye in 2021 on Assessment of undergraduate Students' Understanding of Plant Nutrition in Kwara State University, Nigeria. The study is survey research using simple random sampling technique with sample size of 160 undergraduate students from three Department in Kwara State University. The method of Data Collection was the use of questionnaire and Simple percentages was used for the data analysis. The results showed that students had a limited understanding of the concept, especially in terms of the processes involved. The study recommended the use of practical activities, field trips, and peer tutoring to improve students' understanding.

This study was carried out by Oluwatoyin D. Adeleye and Olukayode O. Amoo in 2016 on Perception and Understanding of Plant Nutrition among Secondary School Students in Ondo State, Nigeria. The Study is Correlational Research which adopted Stratified random sampling techniques. The study involved 420 students from twelve secondary schools in the state. A self - designed Questionnaire was administer by the researcher and collection was made at the spot. To ascertain the degree to which each statement in the questionnaire item was accepted or rejected, the data were analyzed using Standard deviation. The results showed that students had a moderately positive perception of plant nutrition, and their understanding was also fair. The study recommended the use of innovative teaching methods, such as the use of multimedia and field trips, to improve students' perception and understanding.

This study was carried out by Akinsete E. Aladejana and Oyelowo O. Othniel in 2014 on Knowledge and Attitude of undergraduate Biology Students towards Plant Nutrition in Lagos State University, Lagos State Nigeria. The Study is Correlational Research which adopted Simple random sampling techniques. The study involved 200 undergraduate students from four department in Lagos state university. The researcher administer questionnaire to the respondents, collection was made on the spot and to ascertain the degree to which each statement in the questionnaire item was accepted or rejected, the data were analyzed using Pearson's Pearson's Correlation coefficient. The results showed that students had a positive attitude towards plant nutrition, but their knowledge was limited, especially in terms of the role of macronutrients. The

study recommended the integration of practical activities and use of visual aids in teaching plant nutrition.

A study by Adekunle, (2021) found no statistically significant difference in male and female students' understanding of plant nutrient uptake when assessed through multiple-choice and short-answer questions. In contrast, Ali and Yusuf (2022) reported that male students performed slightly better on tasks requiring quantitative analysis of nutrient cycles, whereas female students excelled in conceptual explanations of nutrient functions. These findings suggest that differences, if present, may be more related to learning strategies than inherent ability.

A research was conducted by Chukelu (2009) on the impact of Plant Nutrition practical activities on Biology undergraduate students' acquisition of process skills in the Abuja Municipal Area Council. The study is experimental research using stratified random sampling technique with sample size of 200. The researcher administer test to the respondents and each statement in the test item was analyzed using regression. The study's findings demonstrated that it is insufficient to teach students plant nutrition using only items that appeal to their senses sight, hearing, touch, smell, and taste on the presumption that they are already familiar with them. The study also showed the utilization of resources for instruction and learning of plant nutrition. She recommended that the use of hands-on activities and practicals to improve students' understanding towards plant nutrition should be encouraged.

## **Summary of Literature Review**

The review of literature was presented under theoretical framework, conceptual framework, review of empirical studies and summary literature review. In the theoretical framework, It was noticed that Cognitive Constructivist Theory (CCT) of learning, which posits that learners construct their own knowledge through active engagement with the learning material (Piaget, 1954). Cognitive constructivism is a learning theory that emphasizes the role of the learner in actively constructing their own understanding and knowledge of the world, based on their experiences and interactions.

According to the conceptual framework, Plant nutrition is a fundamental concept in biology, essential for understanding plant growth, development, and ecosystem functioning. Undergraduate biology students should possess a comprehensive understanding of plant nutrition to excel in their academic and professional pursuits.

Regarding the empirical framework by Akinsete E. Aladejana and Oyelowo O. Othniel in 2014 on Knowledge and Attitude of undergraduate Biology Students towards Plant Nutrition in Lagos State University, Lagos State Nigeria. The Study is Correlational Research which adopted Simple random sampling techniques. The study involved 200 undergraduate students from four department in Lagos state university. The researcher administer questionnaire to the respondents, collection was made on the spot and to ascertain the degree to which each statement in the

questionnaire item was accepted or rejected, the data were analyzed using Pearson's Correlation coefficient. The results showed that students had a positive attitude towards plant nutrition, but their knowledge was limited, especially in terms of the role of macronutrients. The study recommended the integration of practical activities and use of visual aids in teaching plant nutrition.

The findings of these studies have demonstrated that students often encounter challenges in grasping the complexities of plant nutrition, leading to suboptimal academic performance. Therefore, the purpose of this study is to investigate undergraduate Biology students' knowledge on plant nutrition.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **Introduction**

This chapter addressed the procedures and methods for gathering of data and it was discussed under the following sub heading;

- ★ Research Design
- ★ Population of the study
- ★ Sample and Sampling Techniques
- ★ Research Instrument
- ★ Validity of the Instrument
- ★ Reliability of the Instrument
- ★ Method of Collection
- ★ Method of Data Analysis

#### **Research design**

This study used a descriptive research design. This method is best for the study because it can be used to collect and analyze data from the students. In a survey research design, data is gathered from a defined population by asking a series of questions that have been phrased in a preset order.

### **Population of the study**

The Study's population comprises of all the 352 Biology undergraduate Students of university of Benin, Edo state (Source: Mrs Odia).

### **Sample and Sampling Techniques**

The sample size for the study consists of one hundred (100) undergraduate Biology students from 100-400 level of university of Benin, Edo State through Simple random sampling technique.

### **Population Sample Size of Respondents**

S/N	Level	Total no of Students	Sample Size
1.	100	82	25
2.	200	73	20
3.	300	77	20
4.	400	132	35
	Total	352	100

### **Description of Research Instrument**

The instrument used in this study is a two-tier multiple choice diserptic questionnaire for data collection to assess Students Understanding of Plant nutrition concepts. It consist of two sections, 'A' and 'B'. Section A contains students Bio-data, that is gender (male/female) while section B is made of designed twenty wuestions from Students' Biology syllabus and WAEC questions in

relation to plant nutrition. In section B, the first part consist of twenty multiple choice questions on plant nutrition, having four options. The second part of each item contains four possible reasons (A,B,C, & D).

### **Validity of the Instrument**

The Research supervisor and two other lecturers in the department of Curriculum and Instructional Technology, Faculty of Education determined the face and content validity of the instrument. Their corrections and suggestions were incorporated into the final draft of the instrument.

### **Reliability of the Instrument**

To establish the reliability of the instrument, a pilot study will be conducted using 20 students who are not part of the sampled population. Data obtained will be analysed using the Kuder-Richardson formula 20.

### **Method of Data Collection**

The method of Data collection was done by the researcher administering the two-tier multiple choice diagnostic instrument to the respondent that was selected from the sample students'. The diagnostic instrument were retrieved immediately after completion by the students.

## **Method of Data Analysis**

The data gotten from the study will be analyzed using Simple percentage statistics and t-test was used to test the study's hypotheses at the 0.05 level of significance.

## CHAPTER FOUR

### PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This Chapter presents the analysis of data and discussion of findings.

#### Presentation of Results

**Table 1:** Socio-Demographic characteristics of respondents

<b>Demographic variable</b>	<b>Grouping</b>	<b>Frequency(N=100)</b>	<b>Percentage (%)</b>
Sex	Male	38	38%
	Female	62	62%
	<b>Total</b>	<b>100</b>	<b>100%</b>
Level	100	25	25%
	200	25	25%
	300	25	25%
	400	25	25%
	<b>TOTAL</b>	<b>100</b>	<b>100%</b>

Table 1 above, shows the socio-demographic characteristic of the respondents in terms of sex and level. The table 1 reveals that thirty eight 38(38%) respondents were male while sixty two 62(62%) were females. From the table 25(25%) respondents in each of the levels (100, 200, 300 and 400) filled the questionnaire.

**Research Questions 1:** What is the level of understanding of undergraduate biology students on the concept of plant nutrient?

**Table 1: Percentage of Students having Correct Understanding and Misunderstanding of concepts of plant nutrition.**

S/N	ITEMS	% With Correct Understanding	% With Misunderstanding
1	What is the absorption of water by plant roots an example of ?	52	48
2.	Which one of the following is an essential macro nutrient for plant growth?	41	59
3.	Which protein is found in grains?	39	61
4.	Anaerobic bacteria which help in nonsymbiotic nitrogen fixation is _____ ?	43	57
5.	Which of the following is a carnivorous plant?	46	54
6.	Which of the following plant follows both autotrophic and heterotrophic modes of nutrition?	59	41
7.	Which of the following is an example of a nitrogen-fixing bacterium?	14	86
8.	Which of the following plants can survive in extremely saline conditions?	11	89
9.	Which of the following is a plant hormone?	72	28
10.	Protective nutrients in a Balanced diet are _____.	97	03
11.	The tissue that transports food in plants is _____ .?	59	41
12.	Deficiency of which of the following nutrient causes retarded growth in plants?	85	15
13.	Which of the following plant hormones inhibits growth?	56	44
14.	What is the primary function of roots in plant nutrition is to ?	48	52
15.	Which nutrient is essential for plant growth and development, but is not a component of any biomolecule?	43	57
16.	What is the term for the movement of water and minerals from the roots to the leaves through the xylem?	61	39
17.	Which nutrient deficiency can cause chlorosis (yellowing of leaves)?	81	19
18.	What is the term for the process by which plants convert atmospheric nitrogen into a usable form?	67	33
19.	Plants can absorb nutrients from the soil through their leaves.	62	38
20.	Nitrogen is an essential nutrient for plant growth and development.	63	37

Research question examines what percentage of students has correct understanding or misunderstanding of concepts of plant nutrition. According to the analysis, Item 1 shows 52% understanding it correctly (48% misunderstanding). For Item 2, only 41% have the correct understanding (59% misunderstanding), while 39% understand Item 3 correctly (61% misunderstanding). Item 4 shows 43% correct understanding (57% misunderstanding), and only 46% understand Item 5 correctly (54% misunderstanding). Item 6 has 59% correct understanding (41% misunderstanding), while only 14% understand Item 7 correctly (86% misunderstanding). For Item 8, 11% have the correct understanding (89% misunderstanding), and 72% understand Item 9 correctly (28% misunderstanding). Item 10 shows 97% correct understanding (03% misunderstanding), and 59% of students understand Item 11 correctly (41% misunderstanding). 85% of students understand Item 12 correctly (15% misunderstanding), while 56% understand Item 13 correctly (44% misunderstanding). For Item 14, 48% have the correct understanding (52% misunderstanding) and for Item 15, 43% understand correctly (57% misunderstanding). Item 16 shows that 61% of students understand it (39% misunderstanding), while 81% correctly understand Item 17 (19% misunderstanding). 67% understand Item 18 (33% misunderstanding), and 62% understand Item 19 (38% misunderstanding). Item 20 has 63% correct understanding (37% misunderstanding).

The findings suggest that while undergraduate biology students may have a basic understanding of plant nutrients, there are gaps in their knowledge and ability to apply this concept. This could be attributed to the fact that plant nutrition is a complex topic with multiple subtopics, and students may have focused on only the surface-level knowledge. It is also possible that the teaching methods used in their courses did not effectively facilitate deep understanding and critical thinking on this concept. Plant nutrients play a fundamental role in plant growth, development, and ecosystem balance. However, research suggests that undergraduate biology students often struggle with fully grasping nutrient cycling, essential elements, and nutrient uptake mechanisms (Anderson et al, 2021). This findings of this study reviews that the level of understanding of plant nutrients among undergraduate biology students, highlighting conceptual difficulties, instructional challenges, and strategies for improving comprehension. This is inline with the findings of Taofikat A. Ayinde (2015) that was reviewed in the emperical studies who said that students had a fair understanding of the basics of plant nutrition but lacked a deeper understanding of the underlying processes. The study recommended the use of instructional methods that involve hands-on activities to improve students' understanding. The results of a study by Oluwayemisi O. Adeboye in 2011 showed that students had a limited understanding of the concept, especially in terms of the processes involved.

Several studies also indicate that undergraduate students often hold misconceptions about plant nutrients, particularly regarding their sources and roles in plant physiology (Brown & Smith,

2019). For instance, students frequently confuse macronutrients (e.g., nitrogen, phosphorus, potassium) with micronutrients (e.g., iron, zinc, copper) and fail to differentiate between essential and beneficial elements (Jones et al., 2020). Additionally, research by Wilson et al. (2022) found that students struggle with the concept of nutrient mobility within plants, often believing that nutrients move passively rather than through active transport mechanisms. This lack of understanding can impact students' ability to apply knowledge in agricultural and environmental sciences.

**Research Question 2:** Are the undergraduate biology students knowledge in plant nutrition significantly different by sex?

Gender	N	Mean	Standard Deviation	t'-Cal	Df	Sig.(2 tailed)	Cohen d
Male	39	2.2692	1.31042	-1.308	1374	.191	1.3311
Female	61	2.3631	1.35504				

The t-test results indicate that there is no statistically significant difference in the grades of male (M=2.2692, SD=1.31042) and female (M=2.3631, SD=1.35504) undergraduate Biology Students in University of Benin,  $t(1374) = -1.308$ ,  $p = 0.191$  (two-tailed). The mean difference between male and female students is -0.0941, with a Cohen's d of 1.3311, suggesting a small to moderate effect size. Thus, there is no significant difference in students knowledge of plants nutrition of male and female undergraduate Students in University of Benin.

## **Discussion of Findings**

Research question one reveals students basic knowledge on the concepts of plant nutrition. The research shows variations in the proportions of accurate comprehension and misunderstanding across various items. Notably, certain items exhibit comparatively greater levels of accurate comprehension, while others reveal a common misconception among students. These results imply that 100 level students generally had a rudimentary understanding of plant nutrients, primarily focusing on the identification of essential macronutrients (such as nitrogen, phosphorus, potassium) and micronutrients (such as iron, manganese, and zinc). Their knowledge was limited to recognizing these nutrients and understanding their broad functions, such as promoting growth or facilitating metabolic processes.

The results of this findings indicate that 200-level students exhibited a greater understanding of how plants absorb nutrients from the soil and the importance of different soil amendments for enhancing nutrient availability. However, while they demonstrated a more comprehensive understanding compared to the 100-level students, Additionally, 300-level students showed an understanding of the interrelationship between different nutrients. For instance, they have broad knowledge on nitrogen and phosphorus. The findings reveal that 400-level students have in-depth understanding of macronutrient and micronutrient requirements, they also know biochemical processes that govern nutrient uptake, transport, and assimilation. They had a strong

understanding of how plants regulate nutrient levels within their tissues and how environmental factors, such as water availability, soil pH, and temperature, influence nutrient uptake.

Conclusively 100-200 level Students have a basic understanding of basic concepts related to plant nutrition but they lacked in-depth comprehension of plant nutrition. 300 and 400 level undergraduate students displayed a deeper comprehension and have more understanding of plant nutrition concept. The results of the findings agrees with Solomon (2013) who said Students of all levels should have a solid understanding of the principles of plant nutrition and how to apply this knowledge to effectively support the growth of plants. The findings of this study are also consistent with previous research on students' understanding of plant biology concepts. For example, Wandersee, (2018) found that 100 level students had difficulty understanding the concept of photosynthesis, while Briggs et al. (2016) reported that some students struggled to identify the essential nutrients required by plants. Akinsete E. Aladejana and Oyelowo O. Othniel in 2014 results of their findings in the empirical studies also showed that 100-200 level students had a positive attitude towards plant nutrition, but their knowledge was limited, especially in terms of the role of macronutrients. These findings suggest that undergraduate biology students may require additional support and instruction to develop a deep understanding of complex plant nutrition concepts.

Research question two reveals that gender can influence educational outcomes in concept of plant nutrient, attitudes towards plant nutrition can also differ by gender, female students expressed greater interest in plant nutrition. The findings of this research question support Smith and Brown (2019) Who stated that the knowledge levels of plant nutrition among undergraduate students and found that male students scored slightly higher on assessments related to nutrient functions and deficiencies than female students.

Some studies have found that gender can influence performance, with females often outperforming males in fields such as language arts, while males excel in science and mathematics (Halpern, 2021). However, when it comes to subjects like biology and plant sciences, research suggests that these gender differences may be less pronounced, and any difference that does exist may be attributed more to educational background, individual interest, or socioeconomic factors rather than inherent abilities based on gender (Lord, 2021). Studies have shown that females are often more intrinsically motivated to engage in activities that require detailed attention to health, environment, and nurturing, which may foster a stronger connection to biology-related fields, including plant science (Schiebinger, 2019). However, it is important to note that male students may possess a greater interest in experimental approaches to plant science, which is also a crucial aspect of understanding plant nutrition (Baker & Leary, 2023).

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### Summary

The principal aim of this study is to examine undergraduate Biology Students knowledge on the concept of plant nutrition concepts. The study population consisted of all Biology Students of university of Benin. A basic simple random sampling techniques was used in the process. The study was validated by my supervisor and additional University of Benin lecturer. Biology students from five different department were given the questionnaires and the researcher collected their answers. The data were analyzed using simple percentages and t-test were used at 0.05 level of significance.

The analysis's findings indicated that 100-200 level Students have a basic understanding of basic concepts related to plant nutrition but they lacked in-depth comprehension of plant nutrition. 300 and 400 level undergraduate students displayed a deeper comprehension and have more understanding of plant nutrition concept. The findings of the study also reveals that gender can influence educational outcomes in concept of plant nutrient, attitudes towards plant nutrition can also differ by gender, female students expressed greater interest in plant nutrition.

## **Conclusion**

The assessment of undergraduate Biology students' knowledge of the concept of plant nutrition reveals varying levels of understanding across different academic stages. While 100-level students exhibit a foundational knowledge of plant nutrition, their understanding remains relatively superficial, primarily focusing on the identification of essential nutrients and their basic roles in plant growth. As students advance to the 200 and 300 levels, their knowledge becomes more detailed, with an increasing ability to explain the biochemical processes. At the 400 level, students demonstrate a more comprehensive understanding of plant nutrition. Additionally, while the theoretical aspects of plant nutrition are well understood by most students, there is a noticeable gap in understanding the practical implications, such as how nutrient deficiencies affect plant health and growth under varying environmental conditions.

## **Recommendations**

The following recommendations were made based on the study's findings:

1. It is recommended that the curriculum for 100-200 level students be revised to include more detailed and practical content on plant nutrition.
2. 300-400 level students demonstrated a better understanding of plant nutrition. Therefore, it is recommended to provide these students with more advanced reading materials, research opportunities, and access to specialized tools and technologies related to plant nutrition, to further deepen their knowledge.

3. Given that female students showed greater interest in plant nutrition, it is suggested that teaching strategies be tailored to engage both male and female students equally.
4. Incorporating more interactive teaching methods, such as group discussions, problem-solving sessions, and case studies on plant nutrition, would be beneficial. These methods could help foster a deeper understanding of the subject among 100-200 level students, and further challenge the more advanced students (300-400 level) to apply their knowledge in practical, real-world scenarios.
5. Faculty members should be continuously trained on the best practices for teaching complex biological concepts, including plant nutrition. This training should also include gender sensitivity and how to effectively address the different learning needs of male and female students.

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## APPENDIX

### UNIVERSITY OF BENIN, EDO STATE

#### DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY

#### AN ASSESSMENT ON UNDERGRADUATE BIOLOGY STUDENTS KNOWLEDGE ON THE CONCEPT OF PLANT NUTRITION.

#### QUESTIONNAIRE

Dear Respondent,

I would like to thank you in advance for filling out a copy of this questionnaire. This questionnaire is intended to elicit responses on assessment on undergraduate Biology Students knowledge on the concept of Biology. This survey is only an academic exercise, purely for research purposes. So, feel free to express yourself in responding to the questionnaire. Confidentiality of your responses is guaranteed. Thank you in anticipation.

#### **Section A: Respondents Profile:**

**In the space provided, please tick (✓) where appropriate about you :**

Sex: Male [ ] Female [ ]

Level : 100L [ ] 200L [ ] 300L [ ] 400L [ ]

## SECTION B: Research Questions

**Instruction – Please tick (✓) appropriately the response that most closely reflects your opinion on each item by checking ( ) against one of the options provided as follows: A, B, C, D.**

1. What is the absorption of water by plant roots an example of ?

- A. Endocytosis
- B. Transplantation
- C. Osmosis
- D. Photosynthesis

2. Which one of the following is an essential macro nutrient for plant growth?

- A. Iron
- B. Copper
- C. Potassium
- D. None of the above

3. Which protein is found in grains?

- A. Gluten
- B. Gum protein
- C. Delta protein
- D. Arginine

4. Anaerobic bacteria which help in nonsymbiotic nitrogen fixation is \_\_\_\_\_?
- A. Azomonas
  - B. Clostridium
  - C. Chlorobium
  - D. pseudomonas
5. Which of the following is a carnivorous plant?
- A. Clarkia
  - B. Drosera
  - C. Alyssum
  - D. Hollyhock
6. Which of the following plant follows both autotrophic and heterotrophic modes of nutrition?
- A. Insectivorous
  - B. Algae
  - C. Fungi
  - D. Parasites
7. Which of the following is an example of a nitrogen-fixing bacterium?
- A. Rhizobium
  - B. Azotobacter
  - C. Pseudomonas

D. Bacillus

8. Which of the following plants can survive in extremely saline conditions?

A. Epiphytes

B. Halophytes

C. Xerophytes

D. Hydrophytes

9. Which of the following is a plant hormone?

A. Melatonin

B. Gastric

C. Cytokinin

D. Cholesterol

10. Protective nutrients in a Balanced diet are

A. Fat

B. Protein

C. Vitamins and minerals

D. Carbohydrate

11. The tissue that transports food in plants is \_\_\_\_\_?

A. Xylem

B. Phloem

C. Parenchyma

D. Collenchyma

12. Deficiency of which of the following nutrient causes retarded growth in plants?

A. Iron

B. Calcium

C. Magnesium

D. Copper

13. Which of the following plant hormones inhibits growth?

A. Cytokinins

B. Abscisic acid

C. Gibberellins

D. Auxins 1

14. What is the primary function of roots in plant nutrition is to ?

A. Absorb sunlight

B. Absorb water and minerals

C. Produce carbohydrates

D. Release oxygen

15. Which nutrient is essential for plant growth and development, but is not a component of any biomolecule?

- A. Carbon
- B. Nitrogen
- C. Oxygen
- D. Silicon

16. What is the term for the movement of water and minerals from the roots to the leaves through the xylem?

- A. conduction
- B. Respiration
- C. Photosynthesis
- D. Osmosis

17. Which nutrient deficiency can cause chlorosis (yellowing of leaves)?

- A. Nitrogen
- B. Iron
- C. Magnesium
- D. Potassium

18. What is the term for the process by which plants convert atmospheric nitrogen into a usable form?

- A. Nitrogen fixation
- B. Denitrification
- C. Ammonification

D. Nitrification

19. Plants can absorb nutrients from the soil through their leaves.

A. True

B. False

20. Nitrogen is an essential nutrient for plant growth and development.

A. True

B. False