AGRONOMIC RESPONSE OF MAIZE (*Zea mays* L.) TO THE APPLICATION OF GUINEA GRASS *(Panicum maximum Jacq.)* LEAF POWDER

BY

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BENIN CITY

NOVEMBER, 2025

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF CROP SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE BACHELOR OF AGRICULTURE DEGREE (B. AGRIC.) IN CROP SCIENCE, UNIVERSITY OF BENIN, BENIN CITY, NIGERIA.

NOVEMBER, 2025

CERTIFICATION

This is to certify that the work contained in this report titled "**Agronomic response of maize (*Zea mays* L.) to application of GUINEA GRASS (*Panicum maximum Jacq.*) leaf powder**" was carried out by **Beatrice Chidinma OKOH (Miss)** (**AGR2004350)** of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City, Edo State, Nigeria.

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Prof. S.U. Ewansiha **Date**
Project Supervisor

____________________ _________________

Prof. S.U. Ewansiha **Date**
Head of Department

DEDICATION

This work is dedicated, first and foremost, to the Almighty God, the ultimate source of my resilience, strength, and intellectual capacity. Without His grace, this project would not have been possible.

To my family, for their endless support and sacrifices throughout my stay at the University of Benin, Benin City, Edo State, Nigeria.

And to me, Beatrice Chidinma Okoh, this degree of personal commitment is a victory of will.

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My heart is full of unending thanks, and I begin, as always, by bowing before the Almighty God, the author of my life and the source of all my capabilities. He provided clarity in the moments of confusion, the strength when I felt weak, and the wisdom to complete this work.

My appreciation goes to my supervisor, Prof. S.U. Ewansiha, for his remarkable patience, clear direction, and insightful guidance that moulded this project into a coherent and professional body of work.

I extend my sincere thanks to the Dean of the Faculty of Agriculture, Prof. C.O. Emokaro, the Head of the Department of Crop Science, Prof. S.U. Ewansiha, and all the distinguished professors and lecturers who shaped my academic journey: Prof. S.A. Ogedegbe, Prof. A.T. Adekunle, Prof. K.E. Law-Ogbomo, Prof. C.N.C. Nwaoguala, Prof. A.U. Osaigbovo, Prof. T.O. Emede, Dr. (Mrs.) E.J. Falodun, Dr. (Mrs.) M.E. Omoregie, Dr. J.I. Osagie, and every other staff member in the Department of Crop Science.

A special note of gratitude goes to Dr. (Mrs.) M.E. Omoregie. Thank you for your specialized guidance and your open doors, your assistance was truly a lifeline.

This achievement belongs first to my family. To my parents, Mr. and Mrs. Okoh, for whom I work so diligently to make proud, words fail to capture my gratitude. You are the foundation upon which I stand. Without your sacrifices, your belief, and the consistent financial and spiritual investment in my education, I would simply not be here today. Every page of this project is a silent thank you to you both.

To my beautiful siblings, Jeffrey and Favour Okoh; thank you both for your continuous cheer, emotional support and unwavering belief in my ability to finish strong. You both are a treasure.

To my dearest unseen partner in this journey, Esijemide-Dore Derek. From the moment this project started, you took it on as if it were your own. Your dedication, the hours spent helping me, your support through every single step, were extraordinary. I am eternally grateful for your unwavering commitment and for shouldering the burden with me. Thank you for everything.

To my project partners, Adeyinka Kent and Apemiye Clare; Thank you for the spirit of collaboration, for sharing the workload, and for the commitment to seeing this project through to the end.

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To Odimgbe Vera and Osagie Solomon, my constant reliable guides; I am immensely grateful. Thank you for your patience, for answering every single question, no matter how small or repetitive, and for the continuous, ever-available guidance you provided throughout this entire project. Your detailed help was a blessing I cannot fully quantify.

Finally, I dedicate a moment of deep gratitude to myself, Beatrice Chidinma Okoh. Thank you for not giving up. Thank you for putting in the long, arduous work, for enduring the sleepless nights, for the discipline on the field, and the mental fortitude through this project. This moment of achievement is earned. I look back at the journey and stand proud of the resilience and commitment that brought this project to a successful close.

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ABSTRACT

Maize (*Zea mays* L.) is a key global staple, particularly in Sub-Saharan Africa., but its productivity is often constrained by the high cost and documented environmental risks of conventional inorganic fertilizers. This study investigated the use of *Panicum maximum* leaf powder, a locally available organic nutrient source, application on the agronomic response of maize. The field trial was conducted at the Teaching and Research Farm, University of Benin, Benin City. The experiment utilized a Randomized Complete Block Design (RCBD) with five replications. The treatments consisted of four rates of *P. maximum* application: 0kg/ha, 60kg/ha, 120kg/ha and 180kg/ha. The variables measured included percentage emergence, percentage establishment, days to tasselling, plant height, number of ears, and stover yield. Results showed that the control exhibited significantly poorer establishment, delayed tasselling, shorter plants and reduced stover yield compared to all fertilized plots. The 60kg/ha rate was sufficient to maximize benefits for establishment and maturity, though the total number of ears was not significantly affected by treatment. It is concluded that *P. maximum leaf powder* is an effective, sustainable organic fertilizer for enhancing maize vegetative growth and stand establishment.

CHAPTER ONE

INTRODUCTION

Maize (*Zea mays* L.) is fundamental to global food security and economic stability, particularly in Sub-Saharan Africa. (Kamweru *et al*., 2023) In Nigeria, it is a key staple, income source, and industrial raw material, with its cultivation expanding to meet increasing population demands (Adiaha, 2017; Wossen *et al*., 2023).

Significant and well-balanced mineral nutrient supplies are necessary for the best possible maize growth and yield (Amissah *et al*., 2023). Essential nutrients like nitrogen (N), phosphorus (P), and potassium (K) are critical, as nutrient imbalances can severely reduce productivity (Aliyu *et al*., 2021; Ismail *et al*., 2025). Even though inorganic fertilizers have greatly increased maize yields, there are still issues with their widespread use in Africa, including declining profitability and yield response (Ragasa *et al*., 2025). Furthermore, their over-reliance contributes to nutrient inefficiency, environmental pollution, and soil degradation (Chen *et al*., 2024; Kemal and Abera, 2015; Mulyati *et al*., 2021).

In response to these challenges, sustainable agricultural practices increasingly advocate for the adoption of organic nutrient sources (Khan *et al*., 2024; Ntsomboh-Ntsefong *et al*., 2025). Organic fertilizers are known to enrich soil fertility and enhance organic matter content (Matišić *et al*., 2024). They also improve soil structure and water-holding capacity (Mastro *et al*., 2025), while stimulating beneficial microbial activity, thereby fostering a healthier soil ecosystem (Badagliacca *et al*., 2024; Wang *et al*., 2023). The integration of organic manures with mineral fertilizers is widely recognized for its synergistic effects, improving crop productivity, nutrient uptake, and maintaining long-term soil health (Abid *et al*., 2020; Kemal and Abera, 2015).

Panicum maximum, a prevalent tropical forage in Africa, is known for its high biomass and rich nutritional profile, including nitrogen, phosphorus, potassium, iron, and zinc (Aganga and Tshwenyane, 2003; Alsunaydi *et al*., 2024). Its decomposition releases nutrients, benefiting crops (Soratto *et al*., 2019). The local abundance and nutrient content of *Panicum maximum* position its leaf powder as a promising organic fertilizer alternative. This approach aligns with sustainable practices, mitigating environmental impacts and reducing reliance on costly synthetic inputs, while potentially improving soil health and maize yields (Oluwafemi and Funsho, 2015).

This study is crucial for promoting sustainable maize production in Nigeria. By exploring the agronomic response of maize to locally sourced *Panicum maximum* leaf powder, it seeks to provide an environmentally sound and economically viable alternative to inorganic fertilizers, thereby enhancing food security and soil health.

1.1 Objectives of the Study

The objectives of this study were to:

i. Determine the effect of *Panicum maximum* leaf powder application on the growth and yield of maize.
ii. Evaluate the nutrient composition of *Panicum maximum* leaf powder and its sustainability as a source of plant nutrient for maize.
iii. Compare the response of maize fertilized with *P. maximum* leaf powder and a control.

CHAPTER TWO

LITERATURE REVIEW

2.1 Panicum maximum

Panicum maximum Jacq., commonly known as guinea grass, is a highly valued tropical forage species characterized by its vigorous growth, high biomass production, and considerable nutritive value (Alsunaydi *et al.,* 2024; Goussanou *et al.,* 2023). In Nigeria, *Panicum maximum* is a nutritious and well-liked forage for livestock. This tall, rapidly growing grass forms large clumps from underground stems (rhizomes), reaching heights of 1-3 meters; it features erect stems, hairy nodes, leaves that are bright green and flat (15-76 cm long and 1-3.5 cm wide), and a ligule 4-6 mm long, the leaf sheaths can be hairy or smooth but are usually pubescent at the collar (Agyare *et al*., 2023).

Panicum maximum thrives in well-drained, fertile soils and effectively prevents soil erosion (Aganga *et al.,* 2004). Its extensive root system allows it to endure both quick fires and droughts. As a perennial, it is well-suited to warm, frost-free climates with over 900 mm of annual rainfall. Its high protein content, reported to be between 5-5.6% fresh weight with 88% digestibility, makes it suitable for livestock forage and indicative of its potential as a nutrient source for crop fertilization (Goussanou *et al.*, 2023). The chemical composition of *Panicum maximum* is dynamic and influenced by several factors, including the type of phosphorus fertilization, which can affect concentrations of crude protein, calcium, phosphorus, magnesium, and potassium (Dias *et al*., 2007). The stage of maturity is another critical determinant; as the grass matures, crude protein content tends to decrease, while crude fiber increases significantly. For instance, crude protein can decline from 9.8% to 6.6%, and crude fiber can rise from 32.1% to 39.4% as the grass ages from 2.5 weeks to 2.5 months (Johnson, Hardison and Castillo, 1967).

Cultivar selection also plays a role, with studies showing variations in nutritive value among different *Panicum maximum* cultivars. For example, cv. Massai has been observed to exhibit lower crude protein and digestibility, and higher neutral detergent fiber, acid detergent fiber, and lignin compared to other cultivars (Brâncio *et al*., 2002, 2003). Furthermore, nitrogen fertilization and water stress levels can alter the concentrations of essential nutrients like phosphorus, potassium, iron, and zinc within the plant tissue (Alsunaydi *et al.*, 2024). Defoliation frequency and intensity also impact green dry matter yield and the chemical composition, including levels of calcium, magnesium, nitrogen, phosphorus, and potassium (Costa *et al.*, 2021). The ability of *Panicum maximum* to accumulate these essential nutrients underscores its potential as a rich organic amendment once its biomass is returned to the soil. Optimal growth and dry matter production for *P. maximum* are achieved with specific nitrate and ammonium ratios in nutrient solutions, further highlighting its sensitivity to nutrient availability (Santos, Bona and Monteiro, 2013).

2.2 Use of plant parts in soil fertility improvement

The incorporation of *Panicum maximum* leaf powder into agricultural soils is a well-established practice for enhancing soil fertility and promoting sustainable agriculture. These organic amendments function as slow-release, long-term fertilizers that are crucial for maintaining and restoring soil organic matter (Siedt *et al.*, 2023). The increasing emphasis on reducing mineral fertilizer use and enhancing carbon sequestration further highlights the importance of integrating carbon-rich organic materials, such as plant-based waste, into agricultural systems (Siedt *et al.*, 2023).

Panicum maximum leaf powder contribute to soil health through a multitude of mechanisms; organic amendments, including compost, vermicompost, and biochar, are pivotal in enhancing soil quality by increasing soil organic matter content, fostering aggregate formation, and improving soil structure in both the short and long term (Diacono and Montemurro, 2009; Matišić, Dugan and Bogunović, 2024). This leads to improved soil physical fertility, primarily by enhancing aggregate stability and decreasing soil bulk density (Diacono and Montemurro, 2009; Ryals *et al*., 2013). Increased SOM also positively influences water retention capacity, aeration, and reduces soil bulk density, making the soil more resistant to compaction and erosion (Aytenew and Bore, 2020; Bauer, 1974; Matišić, Dugan and Bogunović, 2024; Neupane *et al*., 2019). The improvements in soil structure and porosity facilitate better water infiltration and reduce surface runoff, which are critical for sustainable land management (Gabriel *et al*., 2019). The influence of SOM on physical properties is most pronounced in the surface layers (up to 20 cm), a critical zone for soil productivity (Murphy, 2015).

Panicum maximum leaf powder are significant sources of labile organic carbon and essential nutrients, which profoundly influence soil microbial activity and the function of extracellular enzymes (Zhang *et al.*, 2020). The decomposition of these materials provides substrates for microorganisms, boosting their biomass and enzymatic activity, which in turn catalyzes the mineralization of soil organic carbon and converts nutrients from organic to inorganic, plant-available forms (Aytenew and Bore, 2020; Liu *et al*., 2022; Zhang *et al*., 2020). This process, regulated by soil microbial communities, ensures nutrient cycling and contributes to the formation and stabilization of soil aggregates (Balík *et al*., 2025; Pantelides *et al*., 2023). The chemical composition of *Panicum maximum* leaf powder, particularly their C:N ratio, largely dictates the microbial community's response, mediating decomposition and the incorporation of organic carbon and nitrogen into stable aggregates (Almagro *et al*., 2021). High-quality *Panicum maximum* leaf powder, rich in readily decomposable compounds, can significantly increase the soil's available phosphorus content, microbial biomass phosphorus, and acid phosphatase activity, indicating enhanced phosphorus mineralization (Miao *et al*., 2024). Plant-derived carbon inputs are recognized as a dominant factor controlling soil organic carbon sequestration, particularly in agroecosystems with appropriate management practices (Wang *et al*., 2023). Through microbial metabolic processes, residue-derived carbon and nitrogen are transformed into persistent organic compounds, increasing sequestration in stable SOC pools (Xie *et al*., 2022).

2.3 Use of *Panicum maximum* in soil fertility improvement

The application of *Panicum maximum* biomass directly contributes to the improvement of soil fertility through similar mechanisms observed with general *Panicum maximum* leaf powder. As *Panicum maximum* residues decompose, they enrich the soil organic matter pool, which is a key indicator of soil health (Gurgel *et al*., 2020). Studies comparing different tropical forage varieties, including *Panicum maximum*, indicate that while some *Brachiaria humidicola* varieties might show greater improvements in soil aggregate stability, friability, and SOC concentration, *Panicum maximum* still plays a valuable role in contributing to soil health metrics (Horrocks *et al*., 2019). The use of perennial grasses like *Panicum maximum* has been explored for increasing soil organic carbon levels in grazing systems, demonstrating its capacity for carbon sequestration (Sanderman *et al.*, 2013).

The decomposition rate and subsequent nutrient release from *Panicum maximum* phytomass are crucial for its efficacy as an organic amendment. These processes are significantly influenced by factors such as nitrogen fertilization. Nitrogen application to cover crops, including *Panicum maximum*, can increase the accumulation of dry weight and nutrients, which in turn favors subsequent crops by enhancing nitrogen availability (Soratto *et al*., 2019). However, nitrogen fertilization can also alter the decomposition dynamics, potentially impacting the beneficial effects of cover crops by influencing cellulose and lignin breakdown and nutrient release (Soratto *et al*., 2019). The inherent quality of organic amendments, specifically their carbon-to-nitrogen (C:N) ratio, plays a pivotal role in dictating nutrient immobilization or mineralization dynamics, thereby affecting their immediate impact on crop nutrition (Sloot *et al*., 2022). A balanced C:N ratio is essential for efficient nutrient cycling and minimizing nutrient immobilization. Soil improvements under *Panicum maximum* cover, such as increased soil organic carbon, lead to higher cation exchange capacity and an enhanced ability to retain nutrients (Patidar *et al*., 2023). The presence of a fine root network from grasses like *Panicum maximum* can improve aggregate resistance to stress and contribute to soil structure (Osinaga, Álvarez and Taboada, 2018). Furthermore, *Panicum maximum* can increase soil porosity by 4–40% and lower soil bulk density by up to 15% in surface soil layers compared to fallow land, thereby improving soil physical conditions and water retention (Patidar *et al*. 2023; Udom and Omovbude, 2018). The decomposition of *Panicum maximum* can also lead to increased dissolved organic carbon and microbial biomass carbon, contributing to active organic carbon pools that enhance soil sustainability (Kumar *et al*., 2023).

2.4 Yield performance of crops when fertilized with *Panicum maximum* leaf powder

While specific, extensive literature solely dedicated to the broad application of *Panicum maximum* leaf powder as a fertilizer across various crops is emerging, the general principles derived from other plant biomass applications are highly relevant. The benefits observed with organic amendments derived from diverse plant sources strongly suggest positive impacts on crop yields when *Panicum maximum* leaf powder is utilized. Organic amendments generally act as effective slow-release fertilizers that enrich the soil with vital nutrients, improve soil structure, and foster a healthy microbial environment, all of which are conducive to enhanced crop productivity (Scotti *et al*., 2015).

Research indicates that the judicious combination of organic inputs with mineral fertilizers can significantly enhance overall crop yield and soil productivity (Mucheru-Muna *et al*., 2013). Organic amendments directly contribute to improved crop growth by increasing the availability of nutrients in the soil (Kandil *et al*., 2020). The impact of these amendments can be particularly pronounced under conditions of water stress, where they can lead to substantial increases in crop yields (Kandil *et al*., 2020). Field experiments have shown that applying organic matter can result in considerable increases in yield, with some studies reporting increases of up to 33.14% in maize grain yield over conventionally fertilized plots, depending on the type of amendment (Rao *et al*., 2022). These benefits stem from the improved soil physical environment, enhanced nutrient availability due to increased biological activity, and the direct supply of nutrients by the organic materials (Rao *et al.*, 2022).

2.5 Yield performance of maize when fertilized with *Panicum maximum* leaf powder

The agronomic response of maize (*Zea mays* L.) to organic amendments, including *Panicum maximum* leaf powder, is largely positive, manifesting in improved growth parameters, nutrient uptake, and ultimately, enhanced grain yield. Studies focusing on maize cultivation have consistently shown that incorporating organic materials significantly boosts productivity. For example, the application of plant biomass, manure, or their combinations with inorganic fertilizers has led to significantly higher maize grain yields compared to the sole application of inorganic fertilizers (Mucheru-Muna *et al.*, 2013; Mugwe *et al*., 2010).

The positive effects on maize growth are evident in various physiological parameters. Organic soil amendments stimulate plant growth, leading to observed increases in plant height and stem girth (Abimbola *et al*., 2022). This improved growth is often attributed to the release of nitrogen from the decomposing organic matter, which is essential for chlorophyll and protoplasm formation, enhancing photosynthetic efficiency (Abimbola *et al*., 2022). Furthermore, integrated nutrient management strategies that combine organic and inorganic sources of nitrogen significantly influence grain yield, total dry matter accumulation, agronomic nitrogen-use efficiency, and harvest index in maize (Kumar, Singh and Singh, 2018).

Specific effects of organic fertilization on maize include increases in plant height, ear length, grain number per row, 100-grain weight, biological yield, straw yield, and grain yield (Kandil *et al*., 2020). These improvements are directly correlated with the enhanced soil properties and increased nutrient availability resulting from the organic amendments (Kandil *et al*., 2020). The application of organic matter has also been shown to improve the rooting system of maize, particularly in the top soil layers, which is crucial for nutrient and water uptake (Boscaro *et al*., 2023). This enhanced root development contributes to a more vigorous plant capable of higher productivity.

The integration of *Panicum maximum* with maize in intercropping systems also highlights its benefits for maize performance. When maize is intercropped with *Panicum maximum* cultivars, it can improve silage yield and quality, indicating a beneficial interaction that enhances overall productivity (Silva *et al*., 2024). Such intercropping strategies contribute to maintaining sustainable agroecosystems and offer benefits in economic, environmental, and social aspects (Herrera *et al*., 2023). The consistent findings across various studies underscore the efficacy of plant-derived organic fertilizers in boosting maize growth, yield, and overall physiological health, providing a strong basis for the application of *Panicum maximum* leaf powder as a viable organic fertilizer.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental site

The field experimentation was conducted during the late cropping season (June to September) of 2025 at the Teaching and Research Farm of the Faculty of Agriculture, University of Benin, Benin City, Nigeria. The site is geographically located at coordinates lat 6.3997^o N and long. 5.6290^o E; 78 m asl. The area is characterized by a humid tropical climate. It is within the rainforest agro-ecological zone of Nigeria. It has an annual rainfall of about 2000 mm per annum, with average temperatures of 27°C (80.6°F) and 41°C (105.8°F) (Molindo *et al*., 2010). The experiment was conducted during the transition from the late part of the early rainy season into the peak rainy season.

A pre-planting soil sample was collected and analyzed to determine the initial physical and chemical properties of the experimental field. The soil texture analysis (74% sand, 21% clay, and 5% silt) classified the soil as Sandy Clay Loam. Chemically, the soil was strongly acidic, with a measured pH (H_2O) of 4.7. It contained 1.05% Organic Carbon (OC) and exhibited low fertility, evidenced by a Total Nitrogen content of 0.084% and a low Effective Cation Exchange Capacity (ECEC) of 3.14 cmol+/kg. The available Phosphorus was 17.43 ppm, while the Exchangeable Potassium content was 0.55 cmol+/kg.

3.2 Maize cultivar

The maize variety used for the study was the Open Pollinated (OP) cultivar Oba Super 6, which was obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. This cultivar is characterized by being more adapted to the Southern and Northern Guinea Savanna ecologies, exhibiting high yield (potential yield of 7–8 t/ha), drought tolerance, and efficiency under low soil nitrogen conditions.

3.3 Experimental design and treatments

The field experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated five times. The treatments consisted of four rates of *Panicum maximum* leaf powder (0.0, 60.0, 120.0, and 180.0 kg ha^{-1}). Each treatment plot measured 2.25 m x 2.0 m. Individual plots were separated by a distance of 0.50 m, and the entire replications were separated by 0.50 m.

3.4 *Panicum maximum* leaf powder preparation

Leaves of *Panicum maximum* were collected from various areas around the Faculty of Agriculture. The collected leaves were accurately weighed and then chopped into small pieces to facilitate easy drying and subsequent grinding. The chopped material was spread out in a thin layer and allowed to air-dry for one week. Care was taken throughout the process to avoid contamination. Following air-drying, the material was ground into a fine powder for application.

Pre-application nutrient analysis of the final leaf powder confirmed its quality as an organic amendment, showing a composition of Nitrogen (N), Phosphorus (P), and Potassium (K) on a dry weight basis.

3.5 Land preparation

Land clearing was carried out manually using a cutlass, starting on May 24th and concluding on May 28th, 2025. All cut debris and residue were gathered and removed from the field without burning. The field layout, including the demarcation and pegging of individual plots, was successfully completed on May 29th, 2025.

3.6 *Panicum maximum* leaf powder application

The *Panicum maximum* leaf powder was applied once during the trial. The powder was incorporated into the soil along the intended plant rows within each plot and was conducted on June 7th, 2025 (one week before sowing).

3.7 Sowing

Sowing was performed on June 14th, 2025. Seeds of the OP maize cultivar were sown at a depth of 4–5 cm into the moist soil. To establish the desired population without the need for thinning, one seed was sown per hole. The seeds were planted at a spacing of 75 cm x 25 cm to achieve a plant population of 53,333 plants ha^{-1}.

3.8 Armyworm and bird control

Armyworm control utilized a solution prepared from neem leaves. The neem leaves were put in water and allowed to sit for about 3 days before application to allow for proper extraction and potentiation of the neem solution. The prepared solution was applied directly into the funnel of each maize plant, commencing at maize emergence.

Application was continued at a 5-day interval without skipping any application time until the plants were fully tasselled.

For bird control, once the ears were fully silked and grain filling had progressed, each ear was manually wrapped with transparent nylon to prevent damage.

3.9 Weed control

Weeding was carried out manually two times, at 2 and 4 weeks after sowing (WAS).

3.10 Data collection

Data were collected from the net plot, which consisted of the one central row containing 8 plants in each treatment plot.

3.10.1 Days to tasselling

The number of days from sowing to the date when the first tassel emerged in a plot was recorded.

3.10.2 Plant height

Plant height was determined in centimetres (cm) for five consecutive plants, measured from the base of the plant to the point where the tassel branching begins.

3.10.3 Percentage establishment

Percentage establishment was calculated as the ratio of the number of plants established at the onset of flowering to the number of plants emerged two weeks after sowing, multiplied by 100.

3.10.4 Percentage emergence

Percentage emergence was calculated as the ratio of the number of seeds sown to the number of plants emerged two weeks after sowing, multiplied by 100.

3.10.5 Number of ears

The total number of ears harvested from the plants in the net plot was recorded.

3.10.6 Stover yield

Stover yield was calculated per hectare by adding the dry leaf weight, dry husk weight, and dry stem weight.

3.11 Data analysis

The data obtained from various variables were subjected to analysis of variance (ANOVA) using the PROC ANOVA procedure of SAS, separating mean using LSD test at p=0.05%.

CHAPTER FOUR

RESULTS

4.1 Percentage emergence and percent establishment

No significant difference occurred in percentage emergence among the various concentrations of *Panicum maximum* leaf powder applied (Fig 1.). Percentage establishment was significantly affected by the plant residue treatments (Fig 2). The control group (0kg/ha) is significantly worse than all plant residue treatments. There was no significant difference between the 60kg/ha, 120kg/ha, and 180kg/ha treatments.

4.2 Days to tasselling and plant height

Panicum maximum leaf powder influenced days to tasselling (Fig 3). The control (0 kg/ha) took significantly longer to reach tasselling compared to all treatments. This indicates nutrient deficiency delayed maturity in the control. The 60kg/ha, 120kg/ha, and 180 kg/ha treatments all promoted early tasselling, with no significant differences between them.

Significant differences in plant height occurred among the various treatments applied (Fig 4). There was no significant different in height of plants fertilized with 180 kg/ha and 120kg/ha.

4.3 Number of ears and stover yield

For numbers of ears, there was no significant difference among *Panicum maximum* leaf powder (fig 5). There was a significant difference in stover yield among all treatments (Fig 6). The highest stover yield occurred at 180kg/ha and the lowest at 0kg/ha.

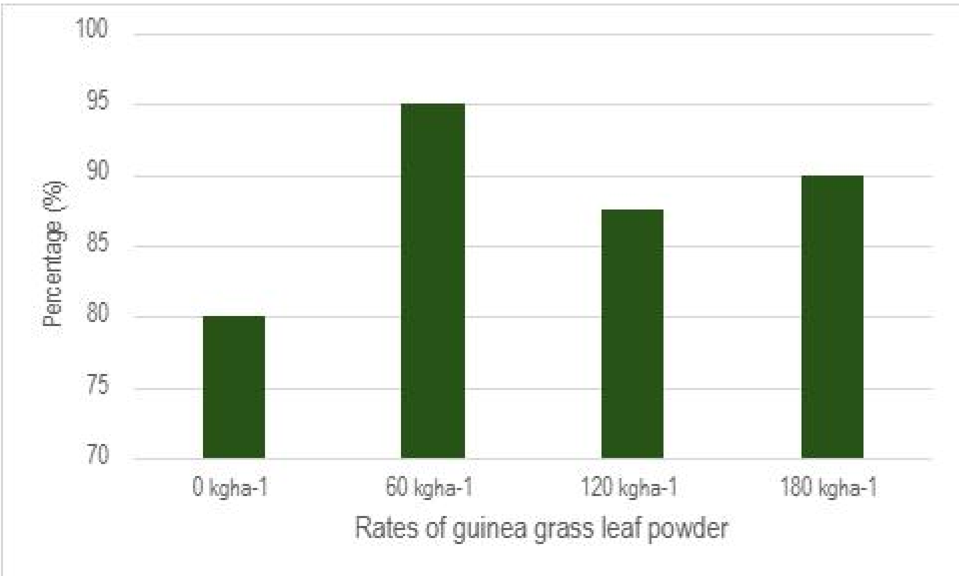

Figure 1: Percentage emergence of maize fertilized with *Panicum maximum*

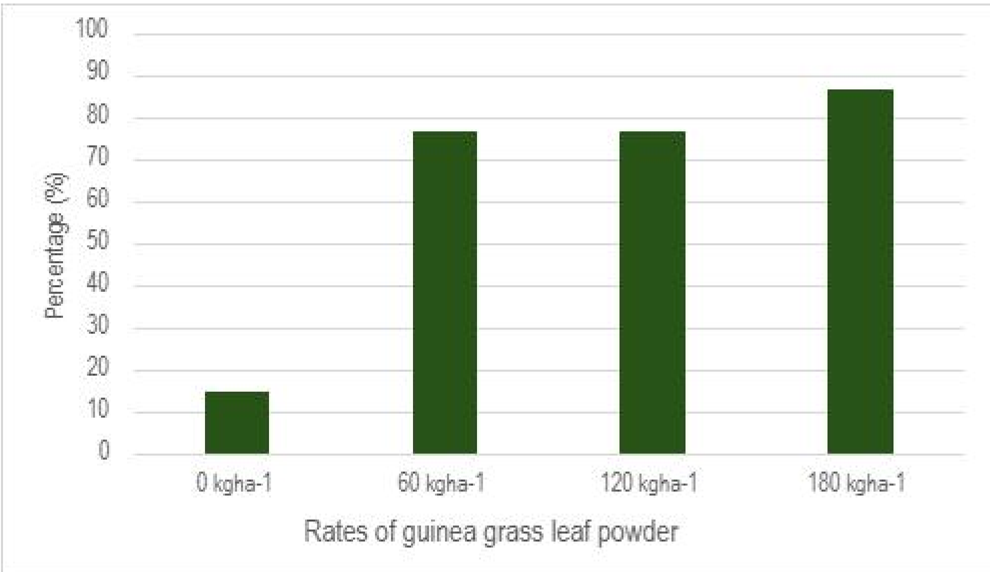

Figure 2: Percentage establishment of maize fertilized with *Panicum maximum*

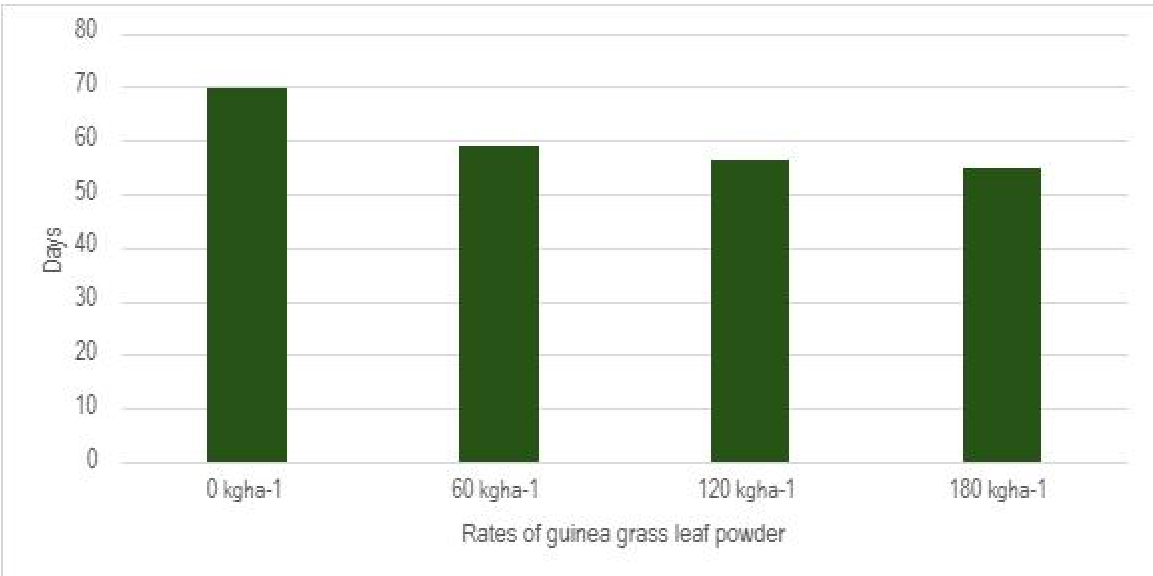

Figure 3: Days to tasselling of maize fertilized with *Panicum maximum*

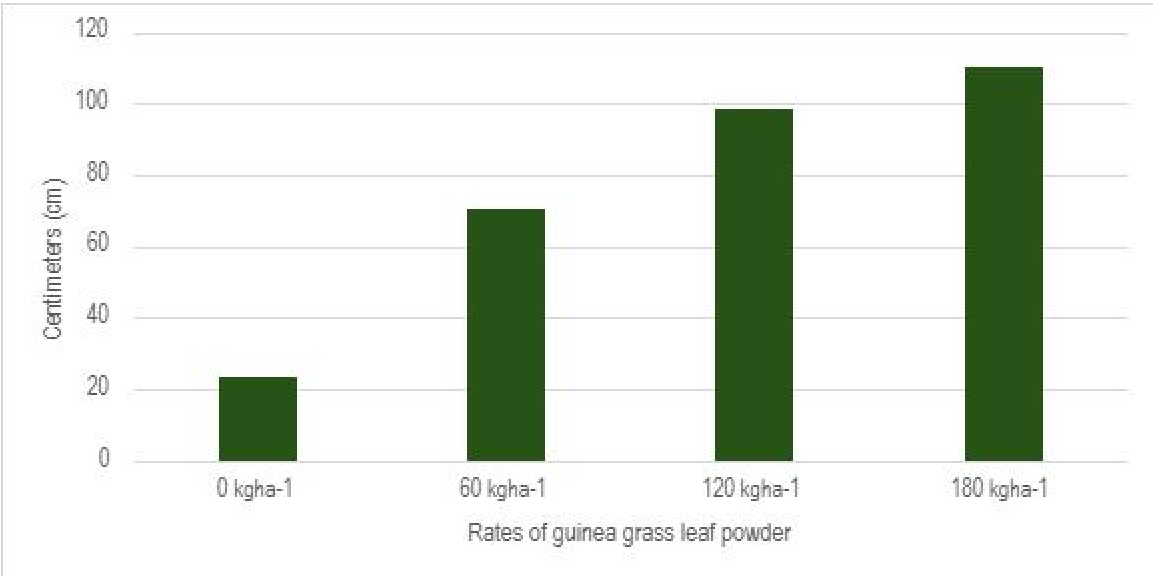

Figure 4: Plant height of maize fertilized with *Panicum maximum*

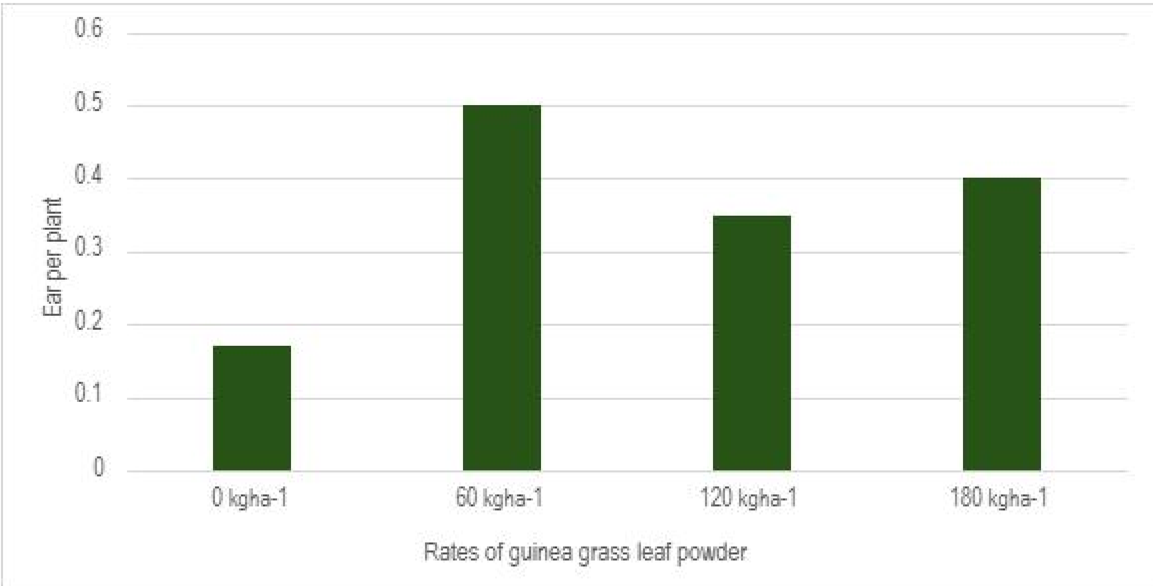

Figure 5: Number of ears of maize fertilized with *Panicum maximum*

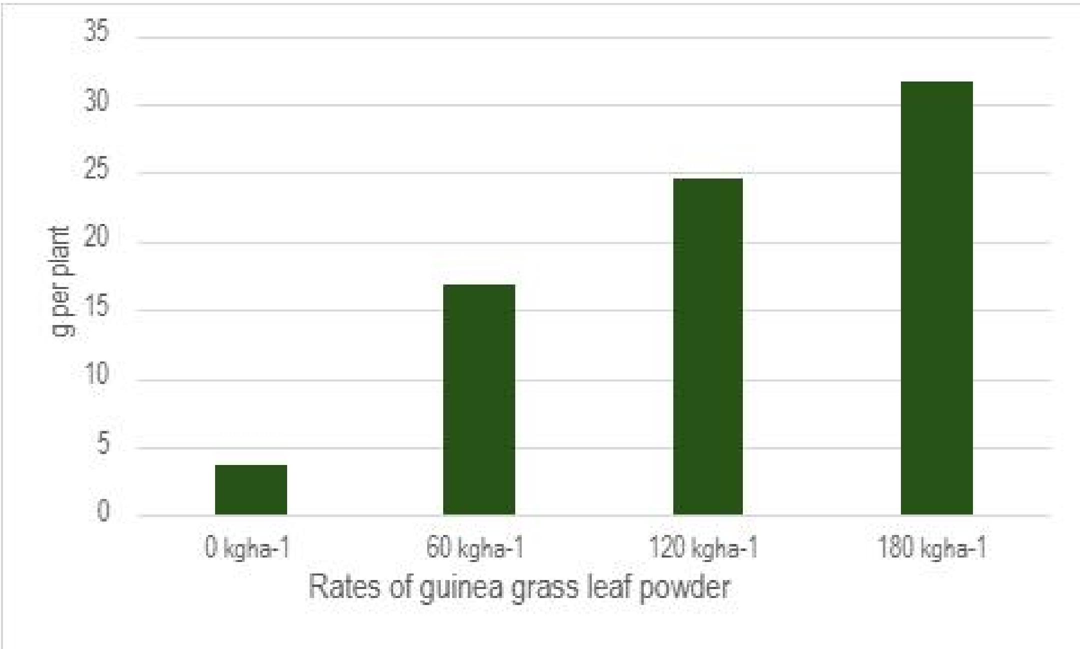

Figure 6: Stover yield of maize fertilized with *Panicum maximum*

CHAPTER FIVE

DISCUSSION

This study focused on the use of different concentrations of *Panicum maximum* leaf powder in improving growth and yield of maize. The application of *P. maximum* leaf powder served an organic amendment, significantly influencing several key growth and productivity traits in maize such as the plant height, tasselling, emergence, establishment, number of ears produced and stover yield.

The percentage establishment was significantly lower in the control (0kg/ha) compared to all three fertilizer rates (60kg, 120kg and 180kg), with no significant difference among the fertilized rates. And there was no significant difference in percentage emergence among treatments. The dramatic improvement from the control is directly attributable to the provision of essential nutrients, particularly Nitrogen (N), released during the mineralization of the *Panicum maximum* leaf powder. This validates findings by Abimbola *et al*. (2022) which reported that improved growth was attributed to the release of nitrogen from the decomposing organic matter, which is essential for chlorophyll and protoplasm formation, enhancing photosynthetic efficiency. This indicates that even a minimum application rate (e.g. 60kg/ha) is sufficient to overcome severe nutrient deficiency in the early crop phase, ensuring a healthy establishment and emergence and reducing seedling mortality. This also supports findings by Kandil *et al*., (2020) which link organic amendments to enhanced soil properties and increased nutrient availability, leading to improved crop growth and establishment.

The control treatment (0kg/ha) took significantly longer to reach the tasselling stage than all other treatments; all fertilized rates resulted in similar, accelerated tasselling dates. tasselling is a critical indicator of maturity and reproductive transition. The delay observed in the control group is a classic symptom of nutrient stress or deficiency, where the plant conserves resources and slows its metabolic rate. The application of the organic leaf powder alleviated this stress, allowing the plants to progress rapidly through their vegetative and reproductive cycles. Delayed tasselling extends the crop's vulnerability to adverse environmental conditions (like terminal drought) and reduces the growing season efficiency. The *Panicum maximum* leaf powder is effective in ensuring a timely physiological schedule.

Plant height differed among treatments, with the highest rate (180kg/ha) producing plants that were significantly taller than all other treatments except 60kg/ha. The highest treatment rate (180kg/ha) provided a larger supply of nutrients, sustaining a longer and more vigorous period of cell elongation and stalk growth.

The number of ears per plant was not significantly influenced by any of the fertilizer treatments, although numerical increases were observed. The non-significant result suggests that ear development may have been more influenced by genetic factors or environmental elements not accounted for, such as precise timing of water availability during silking, rather than simply the nutrient dose provided in this experiment. Stover yield increased with increasing rate; the control had a significantly lower stover yield (biomass) than all treatments. There was a significant difference in stover yield among the treatments 60kg/ha, 120kg/ha and 180kg/ha. The significant increase in stover biomass is a direct consequence of the better emergence, establishment, and vegetative growth fuelled by the organic matter.

5.1 Conclusion

This study successfully demonstrated the beneficial effects of *Panicum maximum* leaf powder as an organic fertilizer on maize production. The decomposition of the leaf powder enriches the soil with nitrogen essential for plant growth. *Panicum maximum* leaf powder offers a sustainable and ecologically sound approach to maize cultivation.

5.2 Recommendation

Based on the findings of this study, farmers should be encouraged to utilize *Panicum maximum* to improve soil organic matter and achieve maximum benefits for establishment, maturity, and stover yield. Thereby ensuring long-term soil health and moisture retention, and minimizing resource use

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