VOL. 5 (2), DECEMBER, 2025
ISSN 2756-4444
E-ISSN 2756-4452

NUTRIENT CONTENTAND AND YIELD PERFORMANCE OF OKRA (Abelmoschus esculentus) AS INFLUECED BY ORGANIC FERTILIZER (WOODASH OF GLYRICIDIA) AND NPK 15;15;15 AT DIFFERENT LEVELS

BY

[1]A. S. Kareem, [2]M.E. Ishola, [3]Y. R. Adeniyi, [4]Olatunde A. O & [5]I. K. Ajiboye
[1,2,3,4]School of Agricultural Technology, Federal Polytechnic Ayede, Ogbomosho, Oyo State, Nigeria.
[5]School of Science and Technology, Federal Polytechnic Ayede, Ogbomosho, Oyo State, Nigeria.
Email: kareemsaheed99@gmail.com

Abstract

The experiment was conducted at the Department of Agricultural Technology, Federal Polytechnic Ayede, Ogbomosho, to study nutrient content and and yield performance of okra (abelmoschus esculentus) as influenced by organic fertilizer (woodash of glyricidia) and npk 15;15;15 at different levels. The treatments consisted of 3 gliricidia wood ash levels ((0 tonnes/ha, 15 tonnes/ha, and 30 tonnes/ha)) and 2 NPK (15:15:15) fertilizer levels (100 kg N/ha and 200 kg N/ha), factorially arranged in a randomized complete block design (RCBD) replicated four times in a pot experiment and data was analyzed by phyton, visualized and Anova. Okra plant height, number of leaves, number of branches, number of pods, pod length and pod weight were recorded and nutrient content of the yield were tested laboratory. Results showed that okra number of leaves, number of pods, pod length and plant branches were not significantly affected by the treatments while combined treatment A2B2 (Wood ash at 30 t/ha + NPK at 200 kg N/ha) recorded the highest cumulative plant height of 491.4 cm. Pod length and pod number were highest under A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha). The highest pod weight of 131.8 g was significantly recorded under A1B2. However, A1B1 (Wood ash at 15 t/ha + NPK at 100 kg N/ha) A1B2 while Notably, A1B1 (Wood ash at 15 t/ha + NPK at 100 kg N/ha) accounted for the highest proportional share of the total multi-nutrient pool at 12.9%. This study concludes that the combined application represents the most agronomically efficient and nutrient-effective strategy for okra production, and its adoption should be encouraged among smallholder farmers seeking to improve both crop yield and nutritional quality.
Keyword: Nutrient, Okra, Weight Organic Fertilizer, Performance

Introduction

Okra is a source of major nutrients including: calcium, protein, carbohydrates and vitamins, which makes it a common part of most Nigerian diets. Its capability to grow in a wide range of agro-ecological zones including the forest-savanna transition zone and derived savanna zones of Nigeria has been an advantage to smallholder farmers to boost food security and revenue production (Aboyeji et al., 2021). Nonetheless, the problem of growing okra on the same soil, specifically in the soils of the tropical region of Nigeria, has brought a lot of problems due to continuous cultivation, especially the loss of soil fertility, imbalance in nutrients, and acidity of soils. The excessive use of synthetic fertilizers, including NPK (nitrogen, phosphorus, potassium) also illustrates these problems, as in the short-term, this approach increases crop yields, but in the long-term, these substances lead to soil degradation (Adekiya et al., 2020). The tropical soils, especially Alfisols and Ultisols dominant in southwest and southeast Nigeria, have low organic matter, nitrogen, and phosphorus levels that require sustainable soil fertility management strategies in order to continue being productive. One of the solutions to these challenges has been suggested as integrating organic and inorganic fertilizers as a way of providing a balanced solution to a healthy soil and crops. In the Nigerian agriculture, the NPK fertilizers have taken the center stage in providing the necessary macronutrients needed to grow the plants (Agbede et al., 2021).

Nitrogen, phosphorus, and potassium are essential macronutrients that play distinct but complementary roles in plant growth and development. Nitrogen primarily promotes vigorous vegetative growth by supporting the formation of leaves and stems. Phosphorus is critical for root development, energy transfer, and the initiation of flowering, while potassium enhances overall plant health by improving fruit quality, strengthening resistance to pests and diseases, and increasing tolerance to environmental stress (Omotoso et al., 2024). Because of these benefits, NPK fertilizers are widely used in modern agriculture to boost crop productivity and ensure rapid nutrient availability. However, the continuous and exclusive use of inorganic NPK fertilizers, without the addition of organic amendments, has been associated with several negative consequences for soil health. Over time, such practices can lead to increased soil acidity, a decline in beneficial microbial populations, and nutrient imbalances. These changes reduce soil fertility and ultimately have adverse effects on crop yields (Adekiya et al., 2020).

The degradation of soil structure and biological activity further limits the soil's capacity to sustain long-term agricultural productivity, making reliance on chemical fertilizers alone unsustainable. In response to these challenges, attention has shifted toward integrating organic materials into soil management practices. One promising option is the use of *Gliricidia sepium*, a fast-growing, nitrogen-fixing leguminous tree commonly found in agroforestry systems in Nigeria. This plant not only contributes to soil fertility through biological nitrogen fixation but also produces biomass that can be converted into wood ash. Gliricidia wood ash is rich in essential nutrients such as potassium, calcium, magnesium, and various micronutrients. These elements are important for improving soil fertility and can help neutralize soil acidity, thereby enhancing nutrient availability for crops (Reuben et al., 2024). When Gliricidia wood ash is applied in combination with NPK fertilizers, it supports a more balanced and sustainable approach to soil management. The ash complements the nutrient supply from inorganic fertilizers while also improving soil physical, chemical, and biological properties. For instance, it can enhance soil structure, increase pH to more favorable levels, and stimulate microbial activity. Additionally, the use of such organic amendments can reduce the environmental risks associated with excessive chemical fertilizer application, such as nutrient leaching and pollution (Agbede et al., 2020). Beyond nutrient supply, organic materials like Gliricidia ash may also contribute to suppressing certain soil-borne pathogens and improving overall soil health. Despite these advantages, many farmers have gradually moved away from traditional organic manures and soil amendments. This shift has largely been driven by the convenience, quick results, and ease of application associated with inorganic fertilizers. Unlike organic inputs, which may require more labor and time to decompose and release nutrients, chemical fertilizers provide immediate effects, making them more appealing in intensive farming systems.

Methodology

The experiment was conducted in pots in the experimental field of the Teaching and Research Farm, Federal Polytechnic Ayede, Ogbomoso, Oyo state which lies on 7° 14' N and Longitude 40 10' E with elevation of 390 m above sea level. It has an average annual rainfall of 1000 – 1250 mm per annum with one mode from March to July and the second from September to November. The textural class of the soil used in this study was sandy loam. The treatments consisted of 3 wood ash levels (0 t/ ha, 15 t/ ha and 30 t/ ha) and 2 NPK (15:15:15) fertilizer levels (100kg/ ha NPK and 200kg/ haNPK. These were factorially combined and arranged in a Randomized Complete BlockDesign (RCBD) replicated four times. The factorial combined treatments are; A_1:90 g wood ash /12 kg of soil equivalent 15 tonnes of wood ash per ha.A_2:180gash/12kgofsoil,equivalent to 30 tonnes of woodash per ha. B_1:4 g

ISSN 2756-4444
E-ISSN 2756-4452

fertilizer/12 kg Soil, equivalent to 100 kg of NPK Fertilizer per hectare. B_2:8g fertilizer/12 kgSoil, equivalent to 200kg of NPK fertilizer per hectare.

The Okra seeds (Cultivar of NHAe-47-4), an improved variety sourced from the National Institute for Horticultural Research (NIHORT) was used for the experiment. Three seeds were sown per plot and two stands per pot were maintained for the study after thinning. Two weeks after sowing, inorganic fertilizer N P K 15:15;15 at the different levels were applied by side placement method at the base of the okra seedling. Glyricidia wood ash was applied three days before sowing by side placement 2 -3 inches away from the base of each plant to compare akra growth performance. Soil was collected inside the pot around the premises of the school premises (FEDPA), Each pot was 10 liters in size. These parameters were measured and recorded, number of leaves plant height and number of branches, finger length, number of fingers and pod weight. Plant height was measured regularly at weekly intervals by using a meter ruler. Number of leaves were obtained by counting any emergence from the 3^{rd} week up till 12 weeks after sowing on weekly basis. Number of branches was taken by counting the number branches on each of the two stands per pot. Weight of fresh Pods was obtained by weekly harvesting the Okra pods and weighing them, starting from 8weeks after sowing. Okra finger length was also measured by using a ruler. The length of every pod harvested per pot were measured and the average was recorded in centimetres. The number of fruits per pot were counted and recorded after which their weights were taken. Harvesting was carried out when the fruit was fully grown but still succulent. The organic manure (glyricidia woodash), soil composite sampled and the nutrient contents of the yields were air-dried for a week and pounded using porcelain-capped pestle and mortal to avoid contamination of the samples. After which they were sieved using a 2mm plastic sieve. The glyricidia wood ash sources and soil used were analyzed for Nitrogen, Phosphorus and Potassium content. Total Nitrogen was determined using modified micro Kjeldahl method; Total available phosphorus was determined using Bray II method and exchangeable K was extracted using 1Neutral, Ammonium acetate solution measured using a flame photometer. The data obtained were subjected to analysis by Python and visualised while level of significance were tested with Anova.

Results

Influence of Wood Ash of glyricidia and NPK Fertilizer on the Okra number of Leaves.

Figure 1 shows the statistical analysis of the effect of various levels of wood ash of glyricidia and NPK fertilizer (15:15:15) on the number of leaves of okra. It showed that the different treatment combinations did not significantly differ in their impact on the number of okra leaves in the experimental replicates(R1,R2,R3,R4). The nine treatment categories were also fairly similar between the four replicates with the lowest (41.0) and the highest (59.0) being observed in R1 and R4, respectively, under treatment B2 (NPK at 200kgN/ha). The minimum-maximum chart (Figure 1, bottom-left) further reveals that Replicate 2 (R 2) had the broadest distribution with the lowest value of 46.0 and the highest of 56.0, whereas R1, R3 and R4 exhibited somewhat narrow ones. As shown in the pie chart (Figure 1, top-right), the four replicates provided almost equal counts to the total number of leaves with R2 recording the highest number of 26.1% with others recording 24.7, 24.0, and 24.0 respectively, which indicates that the number of replicates responded to the question of plant growth the same way.

Influence of Wood Ash of Glyricidia and NPK Fertilizer on Height of Okra plant.

The cumulative sum of the okra plant height in all the four replicates (R1-R4) as indicated in the sorted bar chart (Figure 2) indicated that treatment A2B2 (Glyricidia wood ash.A at 30 t/ha + NPK at 200 kgN/ha) had the highest cumulative sum of 491.4 which took 13.0% of the total distribution as indicated in the pie chart (Figure 2). Treatment B1 was followed by cumulative total of 481.3, treatment A1B1, B2, A1B2, A2, A1 and Ctr were treated with cumulative total of 464.0, 459.4, 409.7, 400.4, 387.2, 367.5 and 333.0 respectively. However, despite the suppressive effect of sole wood ash on early plant height, the cumulative plant height data across all harvest periods showed that A2B2 (Wood ash at 30 t/ha + NPK at 200 kg N/ha) recorded the highest overall total of 491.4 cm, suggesting that the combination of wood ash with adequate inorganic nitrogen ultimately compensates for any early growth suppression associated with high wood ash rates over the full production period.

Influence of Wood Ash of glyricidia and NPK Fertilizer on Okra Number of Branches

Figures 3 showed the outcome of the influence of various amounts of the wood ash and NPK fertilizer on the quantity of branches of the okra. The results showed that treatment B1 (NPK at 200kg/ha) had the largest total count of branches with an overall total of 54.5, and A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha) had the greatest total of 52.5 and A1B1 (Wood ash at 15 t/ha + NPK at 100 kg N/ha) had the lowest total of 32.0 (Figure 3). This trend was also established by the pie chart, which showed that B1 had the highest individual percentage of distribution at 13.8 out of the total distribution of the treatments at 11.6 of A2, 11.0 of Ctr and 11.3 of A1 and A1B1 had the lowest percentage distribution at 8.1%. The ability of B1 (NPK at 200 kg N/ha)

Effect of Wood Ash and NPK Fertilizer Levels on Pod Length of Okra

Figure 4 showed the findings of the influence of varying concentrations of wood ash (Glyricidia) and NPK fertilizer on the length of okra pods (cm). The statistical test revealed that there were no significant differences existed in the influence of the varying level of fertilizer and wood ash in okra pod length. The highest response resulting in the maximum pod length over the entire production period was A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha) which recorded a total pod length of 82.9 cm, while B1 (NPK at 200 kg N/ha) with a total pod length of 58.5 cm and at 45.3 cm was A2 (Wood ash at 30 t/ha) (Figure 4). The pie chart distribution also revealed that A1B2 took the biggest portion of 22.1% of the total treatment, followed by B1 (15.6%), A1B1 (12.1%), A2B2 (9.9%), Ctr (9.6%), A2B (8.6%), A1 (7.9%), B2 (7.1%), and A2 (7.0%). Significant performance of A1B2 (Glyricidia Wood ash at 15 t/ha + NPK at 200 kg N/ha) in capturing the highest total pod length of 82.9 cm among all replicates indicates the possibility of a positive combined effect of the wood ash and inorganic nitrogen on the growth of pods.

Influence of the Wood Ash (glyricidia) and the NPK Fertilizer levels on the Number of Okra pods.

The findings of the influence of varying concentrations of Glyricidia wood ash and NPK fertilizer on the quantity of okra pods are shown in Figures 5. indicated that A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha) and A2B2 (Wood ash at 30 t/ha + NPK at 200 kg N/ha) had the highest single replicate value of 3.0 pods with A1B2 realizing the peak in R1 and A2B2 recording the peak in R1 and R2 respectively. Treatment B1 (NPK 100kg/ha) also achieved highest value of 3.0pods on R3, whereas A2B2 and A1B2 always obtained the value of 2.5 or more in several replicates. Conversely, treatment A1 (Wood ash at 15 t/ha) had the lowest figure of 0.0 pods in R3 and A2 (Wood ash at 30 t/ha) had the lowest minimum of 0.5 in R1. The bar chart analysis of all treatments replicates R1 to R4 ensured that A1B2 and A2B2 showed the highest remaining number of pods replicate after replicate despite the remaining treatments A1 and A2 (wood ash treatments alone without NPK) normally yielding lower number of pods. Although this is not statistically significant, the numerically better performance of A2B2 (Wood ash at 30 t/ha + NPK at 200 kg N/ha) and A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha) in registering the highest number of pods per replication indicates that there is a positive synergistic effect of wood ash and high rate of nitrogen on okra fruiting.

Effect of Wood Ash and NPK Fertilizer Levels on Pod Weight of Okra

Figures 6 show the output of the effect of the various amounts of Glyricidia wood ash and NPK fertilizer on the weight of okra pods (g). The statistical test revealed that the weight of the okra pod varied significantly in reaction to the type and amount of treatments. Figure 6 (horizontal bar chart of overall totals of treatments) revealed that A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha) was highest in overall total pod weight of 131.8 g, then A2B2 (Wood ash at 30 t/ha + NPK at 200 kg N/ha) 106.8 g and B1 (NPK at 200 kg N/ha) 101.3 g. A1B1 (Wood ash at 15 t/ha + NPK at 100 kg N/ha) recorded 71.7 g, Ctr (Control) recorded 57.3 g and A1 (Wood ash at 15 t/ha) recorded 54.0 g. The minimum weight of the total pod was found in A2 (Wood ash at 30 t/ha sole application) of 30.9 g, which has been indicated in red and is the worst treatment in all replicates. A2B1 (Wood ash at 30 t/ha + NPK at 100 kg N/ha) and B2 (NPK at 100 kg N/ha) treatment had 49.2 g and 52.1 g respectively (Figure 6).The fact that A1B2 (Wood ash at 15 t/ha + NPK at 200 kg N/ha) recorded the highest overall pod weight 131.8 g proves the advantage of combining moderate levels of wood ash with high levels of inorganic nitrogen levels to the development of okra pods.

Nutrient Content of Okra (Abelmoschus esculentus L.) as Influenced by Wood Ash of Gliricidia and NPK 15:15:15

The mineral composition of the okra (Abelmoschus esculentus L.) fruit was measured at eight levels of treatment, starting with the control (CTR - no fertilizer) to that with the highest ratios and levels of two inputs (A2B2 high Gliricidia wood ash + high NPK 15:15:15). The mineral parameters that are analyzed are calcium (Ca), magnesium (Mg), potassium (K), sodium (Na) and phosphorus (P). General tendency can be seen in all parameters of the minerals, higher production of minerals in the okra fruits was achieved by combining both Gliricidia wood ash and NPK 15:15:15, and the lowest value of most minerals was obtained in the control (CTR). The trend is a cumulative and synergistic impact of the organic and inorganic nutrient input on soil fertility, nutrient supply and mineral uptake into plant tissue. This general tendency is in line with the results of Adekiya et al. (2020), who organized a two-year field experiment comparing various organic manures and NPK 15:15:15 fertilizer in terms of the mineral content of okra. Their experiment found that organic manures and NPK fertilizer significantly enhanced soil organic matter (OM), N, P, K, Ca and Mg with organic manures yielding significantly higher levels of mineral in okra fruits than the sole NPK and the unfertilized control.

Discussion

The effect on number of leaves, this is in contrast to Adekiya et al. (2020) reported that when both the organic and inorganic amendments were used, there was a significant growth parameter such as plant height and leaf area and yield parameter such as pod weight and the number of pods per plant in okra. Influence of Wood Ash of Glyricidia and NPK Fertilizer on Height of Okra plant result is in line with Tan et al. (2023) research on fertilizer production under salty soils on the coast, it was discovered that the NPK + organic matter (NPK +OM) application produced the most favourable results in terms of okra agronomic characteristics, with plant height growing by up to 11.97 percent relative to the control (unfertilized soil). While Akintoye et al. (2021) also reported that plant height of okra at early growth stages was significantly higher under inorganic nitrogen application compared to organic amendment treatments, attributing the response to the faster availability of mineral nitrogen to the crop root zone. The result of influence on number of branches is consistent with the findings of Agede and Adeyinka (2012), who reported that the combined application of organic amendments and NPK fertilizer significantly. Nitrogen is a very vital macronutrient, which activates cell division and elongation hence increasing the growth and branching of the axillary buds (Marschner, 2012). This observation is similar to Adebayo et al. (2022), who had found that the use of inorganic nitrogen fertilizer in high rates, alone, increased the vegetative parameters, such as the count of branches in okra (Abelmoschus esculentus L.), considerably. The large number of branches counted in the B1 might be due to the easy supply of nitrogen in the inorganic fertilizer which is quickly mineralised and readily available to the plant to carry out metabolic functions (Fageria and Baligar, 2005).

Morphological features of pods (length) are more determined by genetic make-up of the variety, and are not as sensitive to either environmental or nutritional manipulation as other traits of yield such as pod weight or fruit count (Adeniji & Peter, 2019). The result of influence on okra pod length does contradict Akintoye et al. (2021), who indicated that the growth of okra in terms of pod length did not change greatly with various fertilizer treatments but was largely influenced by the cultivar applied and not the nutrient quantity applied. On the same note, Nwosu et al. (2020) noted that pod yield and weight responded significantly to different rates of inorganic and organic fertilizers but not the pod length, implying that pod length is stable to nutrient management regimes. The lack of meaningful treatment effects on the count of okra pods is allied with prior findings that indicate that pod count in okra, similarly to pod length, is very much affected by the genetic composition of the used variety and the general physiological health of the plant as opposed to the amount of fertilizer applied to it (Adeniji & Peter, 2019). Even though differences in the numbers were noted among the treatments, the statistical non-significance could be partially explained by the small size of plots and the large within-treatment variation that is inherent in short-term trials that involve vegetable crops and are conducted in the field (Odedina et al., 2021). This result of influence on the Number of Okra pods partly agrees with Akintoye et al. (2021), who found no statistically significant difference in the number of okra pods at the various levels of nitrogen fertilizer in a derived savanna context, which is explained by the buffer capacity of the reproductive physiology of the crop in response to moderate levels of nutrient fluctuations. The result influence on okra pod weight in line with Omisore et al., (2023) who reported that Wood ash at 15 t/ha contains potassium, calcium, and phosphorus and at the same time increases the soil pH to levels that promote the increase of nutrient bioavailability, without causing toxic impact of pH typical of excessive wood ash levels. This observation also agrees with Folorunso and Ojeniyi (1999), who observed that application of NPK 200 kg N/ha and amended growth of plant residues in 6 t/ha produced a lot of soil organic matter, N, P, Ca and Mg levels and pod weight of okra. In the same study, the wood ash recorded the highest pod weight of all the amendments tested with a mean weight of 449.3 kg/ha on the NPK treated plots and 145.2 kg/ha on the wood ash treated plots in line with the integrated treatment yielding better results compared to the sole amendments that had been made in the current study.

Nutrient Content of Okra (Abelmoschus esculentus L.) as Influenced by Wood Ash of Gliricidia and NPK 15:15:15 ; Resource Management Inc. (2020) has made the calculation that calcium is the most available element in wood ash, which makes it a similar element to the agricultural lime; calcium carbonate makes up about 25 percent of the wood ash dry matter.). Pottasium was more effectively nutritionally by B1 than by A1 (4-5 and 3.5% respectively), indicating that G. sepium green manure was comparatively better than low rate wood ash in K nutrition at the applied rates. This correlates with Akanbi et al. (2021) who found that okra plants sprouted on 5 t ha-1 G. sepium leaves (T1) exhibited the same level of K uptake as NPK-fertilized plots. Potassium is a direct constituent of NPK 15: 15:15 and a dominant mineral in Gliricidia wood ash. According to Saunders (2021), wood ash contains a good amount of K (approximately 5 percent) and crops have been positively reported to respond to both the K and P provided in wood ash. Greenway Biotech (2024) confirmed magnesium is an essential element of chlorophyll that participates in photosynthesis and nutrient uptake and its deficiency causes interveinal chlorosis and retarded growth. The growth in Mg level of okra fruit during Gliricidia wood ash treatment is an indication of the direct supply of Mg by wood ash which was reported by Saunders (2021) to have an average of 1 % Mg. The mechanism of action of the Gliricidia sepium green manure in Mg nutrition is complementary: Mg is released by the breakdown of the leguminous biomass as part of the mineral fraction, and the organic acids that are formed during the process of its mineralization enhance Mg mobility in the soil (Wulandari et al., 2023).

An extensive examination by Wulandari et al. (2023) established that G. sepium trees and leaves used as mulch, biochar or intercrop encourage total soil carbon and nitrogen, phosphorus, available phosphorus, pH, cation exchange capacity and soil organic matter in a broad range of agricultural systems. In a study undertaken by Reuben et al. (2024) utilizing degraded Ultisol in Abakaliki, southeast Nigeria, there was a significant improvement in the dry pod yield of okra when G. sepium green manure (6-8 t ha-1) was applied, which was due to the development of better N availability, related to the rapid mineralization of G. sepium. These findings are consistent with the marginally higher values of Nitrogen in treatment of A1B1- and A2B2 -containing in the present bar chart. Therefore, the proportions of each treatment to the total multi-nutrient pool can be measured with the help of the pie chart (Chart 2). The best contributor was A1B1 with 12.9 and B1 (12.2%), A2 (11.2%), A1B2 (11.1%), A2B2 (10.7%), A1 (9.9%), and A1B1 (9.6%). Such distribution results in a number of important agronomic interpretations. Saunders (2021) recorded that wood ash is a reliable source of K (approximately 5 percent) and crops have been found to react favorably to the presence of K and P originating in wood ash. The effect of Gliricidia sepium green manure on K nutrition is well known. The review conducted by Wulandari et al. (2023) found an extensive amount of evidence indicating that G. sepium leaves and litterings provide substantial amounts of K, Ca, Mg, and S as well as N and P and that its application can always increase K availability in the soil. This is in line with the study by Akanbi et al. (2021) who indicated that 5 t ha-1 G. sepium leaves (T1) generated okra plants that had K uptake that was comparable to NPK-fertilized plots.

Conclusion and Recommendations

From the result of the experiment the application of gliricidia Wood ash at 15 t/ha + NPK at 100 kg N/ha) most productive and accounted for the highest proportional share of the total multi-nutrient pool at 12.9%. Soil amendment like gliricidia wood ash can be used as an alternative to increase okra growth and yield than NPK 15:15:15 fertilizer that is expensive, causes environmental hazard, not readily available and quickly utilized by the soil. Therefore, this study concludes that the combined application of Gliricidia wood ash and NPK fertilizer at moderate rates represents the most agronomically efficient and nutrient-effective strategy for okra production, and its adoption should be encouraged among smallholder farmers seeking to improve both crop yield and nutritional quality. It was recommended that levels of wood ash should be used as soil amendment with NPK 15:15:15. Further research on different type of leguminous trees burnt to wood ash as soil amendment should be carried out.

References

Aboyeji, C. M., et al. (2021). Okra production in agro-ecological zones of Nigeria: Implications for smallholder farming. *Journal of Agricultural Science*, *13*(4), 45–58.

Adebayo, O., et al. (2022). Effects of inorganic nitrogen fertilizer on vegetative parameters of okra (*Abelmoschus esculentus* L.). *Nigerian Journal of Agronomy*, *18*(2), 112–120.

Adekiya, A. O., et al. (2020). Effect of organic manures and NPK 15:15:15 fertilizer on soil properties, growth, yield and mineral content of okra. *Scientia Horticulturae*, *261*, 108930.

Adeniji, O. T., & Peter, O. A. (2019). Morphological and yield traits of okra (*Abelmoschus esculentus* L.) as influenced by genotype and environment. *African Journal of Plant Science*, *13*(7), 178–185.

Agbede, T. M., & Adekiya, A. O. (2012). Tillage effects on soil properties and performance of okra (*Abelmoschus esculentus*) in a tropical Alfisol. *American-Eurasian Journal of Sustainable Agriculture*, *6*(2), 82–91.

Agbede, T. M., et al. (2021). Soil fertility management in tropical Alfisols and Ultisols of southwest and southeast Nigeria: Challenges and strategies. *Soil and Tillage Research*, *210*, 104980.

Agede, S. A., & Adeyinka, A. (2012). Combined application of organic amendments and NPK fertilizer on crop growth and soil fertility in southwest Nigeria. *Journal of Soil Science and Environmental Management*, *3*(5), 130–1

Akanbi, W. B., et al. (2021). Gliricidia sepium leaf application and potassium uptake in okra compared to NPK-fertilized plots. *Journal of Organic Agriculture and Environment*, *9*(1), 22–31.

Akintoye, H. A., et al. (2021). Okra plant growth and pod length response to nitrogen fertilizer levels in a derived savanna environment. *Horticultural Science and Technology*, *39*(3), 301–312.

Fageria, N. K., & Baligar, V. C. (2005). Enhancing nitrogen use efficiency in crop plants. *Advances in Agronomy*, *88*, 97–185.

Folorunso, O. A., & Ojeniyi, S. O. (1999). Effects of NPK fertilizer and plant residue amendment on soil fertility and pod weight of okra in southwest Nigeria. *Nigerian Journal of Soil Science*, *10*(1), 55–62.

Greenway Biotech. (2024). *The role of magnesium in plant nutrition and photosynthesis*. Greenway Biotech Inc. https://www.greenwaybiotech.com

Marschner, H. (2012). *Marschner's mineral nutrition of higher plants* (3rd ed.). Academic Press.

Nwosu, F. O., et al. (2020). Pod yield and weight response of okra to organic and inorganic fertilizer rates. *International Journal of Vegetable Science*, *26*(4), 389–398.

Odedina, J. N., et al. (2021). Within-treatment variation in short-term field trials involving vegetable crops: Implications for statistical interpretation. *Experimental Agriculture*, *57*(2), 210–221.

Omisore, A. G., et al. (2023). Soil pH and nutrient bioavailability as influenced by varying rates of wood ash application in tropical soils. *Journal of Soil Science and Plant Nutrition*, *23*(1), 88–97.

Omotoso, S. O., et al. (2024). Role of NPK fertilizers in macronutrient supply for sustainable crop production in Nigeria. *Nigerian Agricultural Journal*, *55*(1), 10–19.

Resource Management Inc. (2020). *Wood ash as a soil amendment: Composition and agronomic value*. Resource Management Inc.

Reuben, O. C., et al. (2024). Dry pod yield of okra as influenced by Gliricidia sepium green manure in a degraded Ultisol in Abakaliki, southeast Nigeria. *Journal of Plant Nutrition*, *47*(2), 305–315.

Saunders, M. (2021). *Wood ash as a fertilizer: Potassium, phosphorus and soil amendment properties*. Organic Research Centre.

Tan, X., et al. (2023). NPK and organic matter application on okra agronomic characteristics under saline coastal soils. *Agricultural Water Management*, *280*, 108230.

Wulandari, D., et al. (2023). Gliricidia sepium as a green manure, mulch and biochar: Effects on soil carbon, nitrogen, phosphorus, and cation exchange capacity across farming systems — A review. *Agroforestry Systems*, *97*(3), 541–558.

Figure1(NUMBER OF LEAVES)

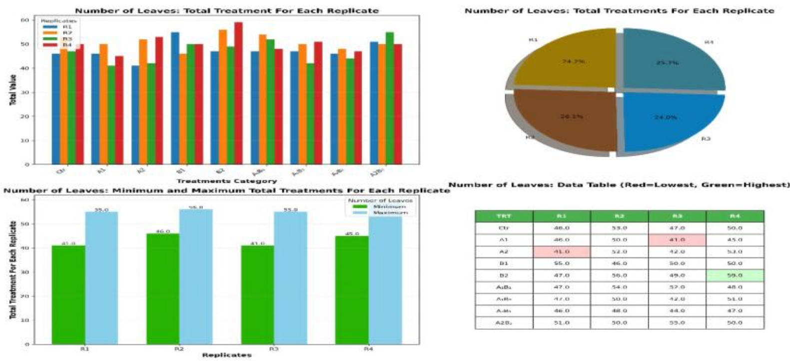


Figure 2(OKRA PLANT HEIGHT IN CM

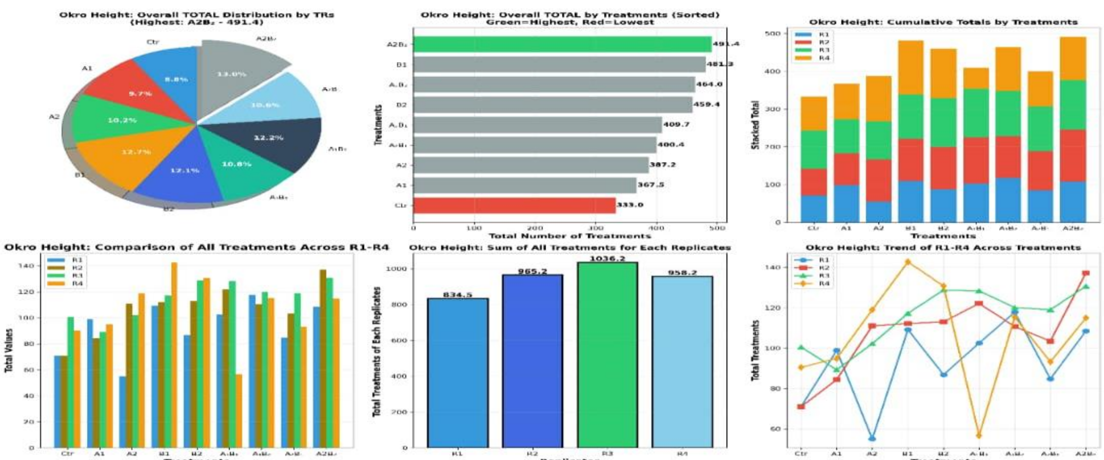


Figure 3 (Okra branches)

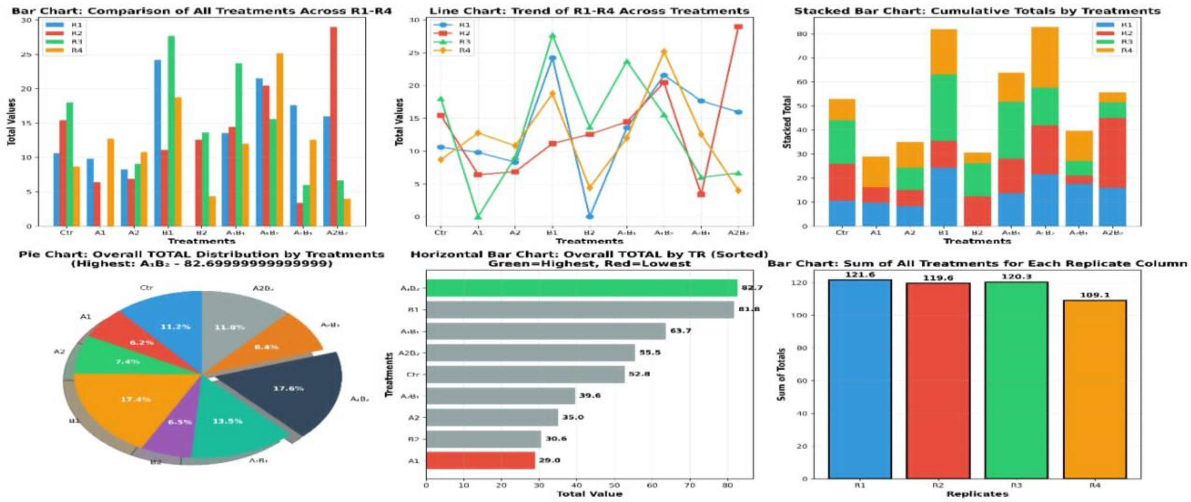


FIGURE 4 (OKRA POD LENGTH CM)

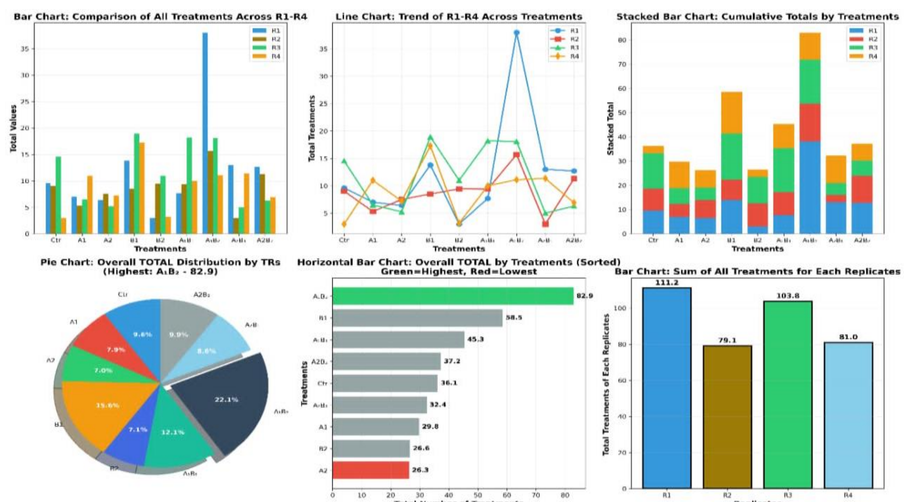
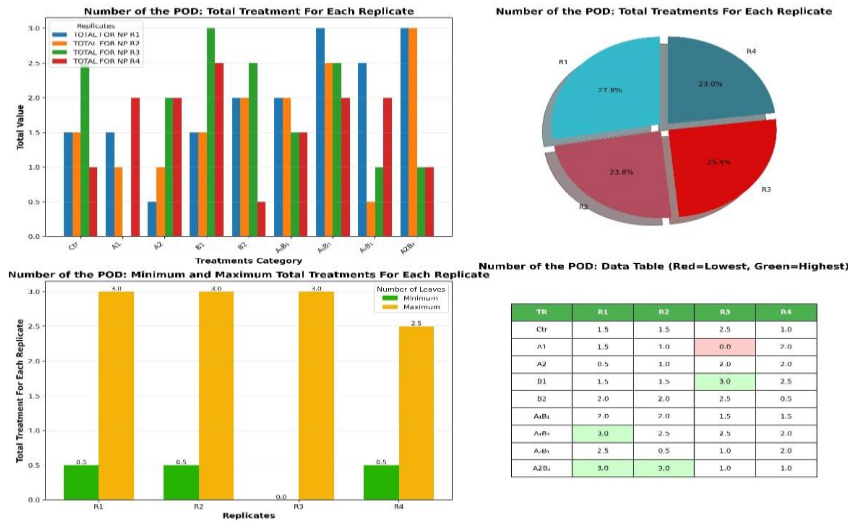
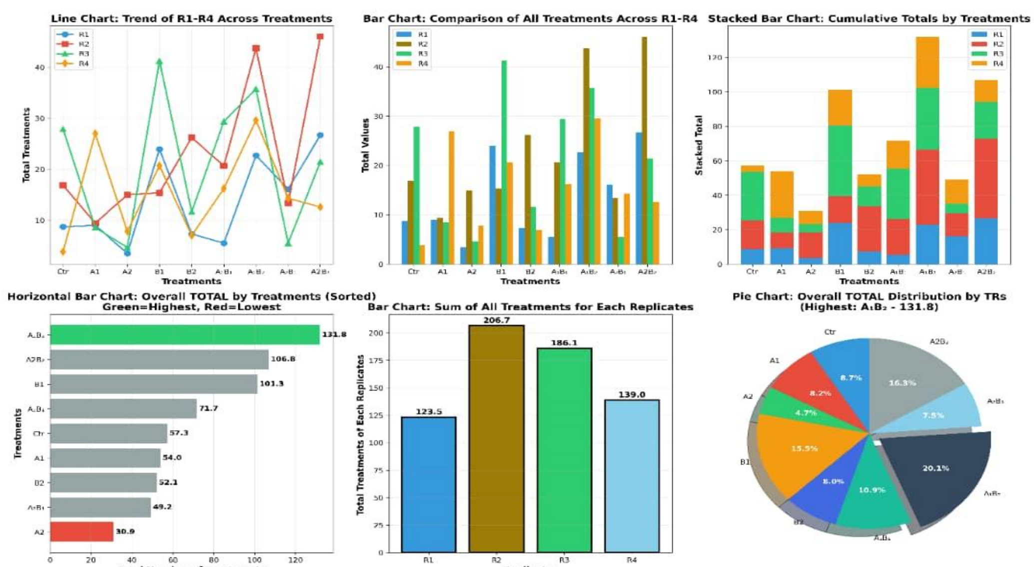


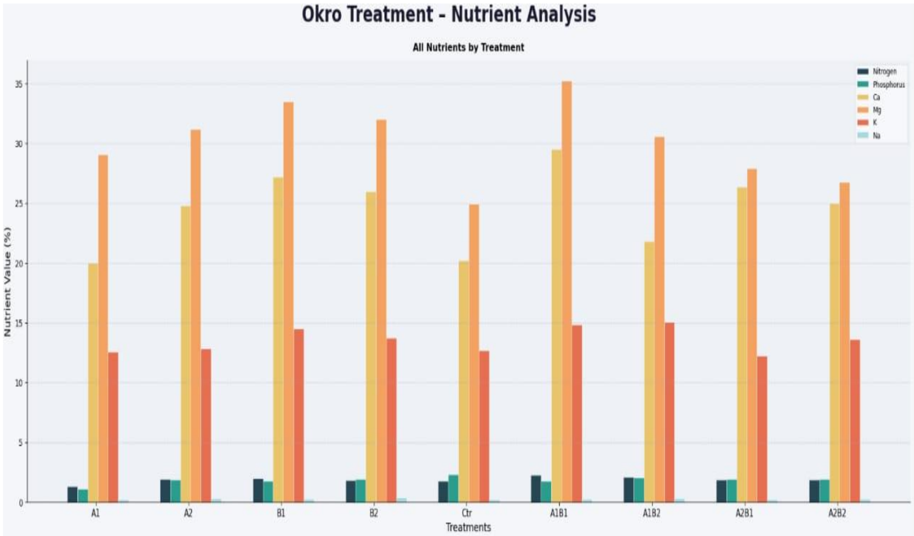
FIGURE 5(OKRA NUMBER OF PODS)

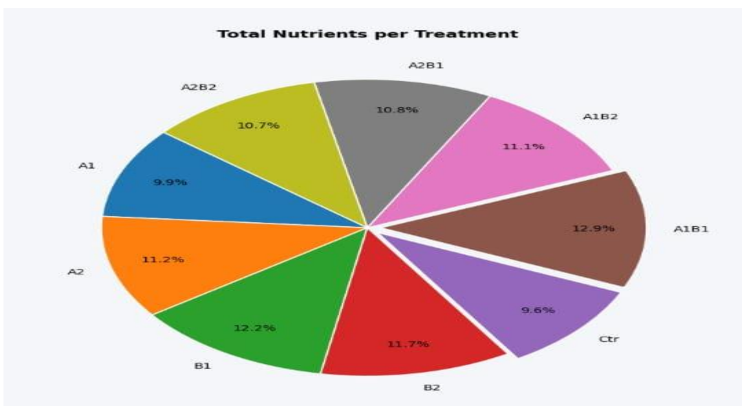


TR	R1	R2	R3	R4
Ctr	1.5	1.5	2.5	1.0
A1	1.5	1.0	0.0	2.0
A2	0.5	1.0	2.0	2.0
B1	1.5	1.5	3.0	2.5
B2	2.0	2.0	2.5	0.5
A_1B_1	2.0	2.0	1.5	1.5
A_1B_2	3.0	2.5	2.5	2.0
A_2B_1	2.5	0.5	1.0	2.0
A2B_2	3.0	3.0	1.0	1.0

FIGURE 6 (POD WEIGHT)




Okro Treatment - Nutrient Analysis
All Nutrients by Treatment
Nitrogen
Phosphorus
Ca
Mg
K
Na
Nutrient Value (%)
0
5
10
15
20
25
30
35
A1
A2
B1
B2
Ctr
A1B1
A1B2
A2B1
A2B2
Treatments


Total Nutrients per Treatment
A2B1
10.8%
A2B2
10.7%
A1B2
11.1%
A1
9.9%
A1B1
12.9%
A2
11.2%
Ctr
9.6%
B1
12.2%
B2
11.7%