INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

Comparative Analysis of Maize and Sorghum Yields under Different Fertilizer Application in Oke Ose, Kwara State, Nigeria

Adeniyi Adedapo[1], Ajadi B. S[2]., and Banjoko, I. K.[3]

[1,2] Department of Geography, Kwara State Polytechnic, Ilorin

[3]Department of Agricultural Technology, Kwara State Polytechnic, Ilorin

***Corresponding Author**

DOI : https://doi.org/10.51583/IJLTEMAS.2025.1411000078

Received: 15 November 2025; Accepted: 22 November 2025; Published: 17 December 2025

ABSTRACT

This paper examines the comparative analysis of maize and sorghum yields under different fertilizer application. Maize and sorghum were planted on a land area of 50m^2 each. The 50m^2 of land for maize and sorghum was further divided into two. NPK fertilizer was applied to one half while urea fertilizer was applied to the other half of land for maize and sorghum. The yields of maize and sorghum were calculated. The Physicochemical characteristics of the soil were analyzed using Association of Official Analytical Chemists (AOAC) Methods. Descriptive statistic, mean, Analysis of variance (ANOVA) and t- test statistic were used in data analysis. The result of the Laboratory analysis of the soil reveals that the soil is sandy and slightly acidic with low Nitrogen, Organic carbon, Organic Matter, and Potassium. The result of the Analysis of variance (ANOVA) shows that there is no significant difference in the values of the physicochemical parameters selected. This implies that the soil in the study area is relatively the same in term of physicochemical characteristics. In term of crop yield, the result of the study reveals that the average yield of maize under NPK and urea fertilizer is 1.69t/ha and 1.30t/ha respectively. Similarly, the yields of sorghum under NPK and urea fertilizer is 1.58t/h and 1.22t/h respectively. This implies that, in term of yields, maize and sorghum performed best when treated with NPK fertilizer than urea fertilizer. However, the result of t-test statistic shows that there is a significant difference in yields of maize and sorghum under NPK and Urea fertilizers because the p values for maize and sorghum, 0.0319 and 0.0222 respectively, are less than 0.05. Therefore, the study recommend application of NPK fertilizer for both maize and sorghum crops for better productivity.

Keywords: Maize, NPK fertilizer, Sorghum, Urea fertilizer, Yield

INTRODUCTION

There are several factors that affect crop yield. Some of these factors include climate variability, changes in farming techniques, soil fertility and agricultural inputs like fertilizer. Variations in rainfall, temperature and other climatic parameters affects crop yields. Generally, changes in climatic elements affect crop productivity. According to Adeniyi, (2013), climate is so fundamental that it affects virtually all aspects of crop production. The type of crop grown, crop yield, time of planting and harvesting of crops in an area are climate determined. According to Ziska, et. al. (2016) changes in the occurrence and severity of droughts and floods could pose challenges for farmers and threaten food safety. Furthermore, soil fertility is an important factor in determining crop yield. According to Hatfield, (2006) the capability of a soil to produce crop yield depend on its fertility. Therefore, variations in the fertility of soil in an area or over a period of time will cause variations in crop yield. The mineral composition of the soil in term of quality and quantity influence crop productivity. Hence, in order to increase the amount of agricultural production harvested per unit of land area, fertilizer application is required. Application of fertilizer, as an artificial measure of improving soil fertility to ensure steady improvement of crop yield and sustainable crop production, is critical in modern agricultural production. Fertilizer application is needed because deficiencies of nutrients like nitrogen, potassium, phosphorus, calcium, Sulphur, magnesium, boron, manganese, iron, zinc, and copper often occur in the soil due to nutrient uptakes by crops, crop

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

management techniques and other environmental conditions**.** Soil nutrient deficiency, mostly nitrogen (N), phosphorus (P), and potassium (K), has been identified as one of the important challenges in grain production Ning Wang, et. al. (2024). Therefore, fertilizers are needed to replace and improve nutrients balance in the soil. Fertilizers are often added to the soil to supply the necessary nutrients required for plant growth and productivity According to Adeyeye, et. al. (2018) adequate fertilizer is the prerequisite way to combat declining in crop yield. Jiang, et al. (2024) also reported that rational fertilization can improve the soil nutrient content and increase maize yield. In Nigeria, NPK (Nitrogen, Phosphorous and Potassium) and Urea fertilizers are the most common fertilizers types used for grain crops.

There have been several studies on the impacts of NPK on soil nutrient conditions and crop yield. According to Liu,et al (2020) fertilizer application accountable for up to 50% of the total increase in crop yields in contemporary agricultural production. Similarly, Alvarez, et. al. (2017) opined that most studies have revealed that the application of nitrogen, phosphorus and potassium fertilizers has a major impact on soil fertility. Musa, et al. (2022) in the study of performance evaluation of maize (Zea mays L.) varieties for growth and yield as influenced by Urea and NPK fertilizers reported that application of NPK 20:10:10 fertilizer at 120kg/ha significantly influence maize yield. Ning Wang, et. al. (2024) also reported that the application of N and P fertilizers significantly improved maize yield by increasing SOC, N, and P concentrations, and advancing the reproductive stage. Maize yield and growth parameters increased with increased application of NPK fertilizer. Mello, et al, (2018) reported that Potassium plays a significant role in photosynthesis process by enhancing the translocation of photosynthesis, increasing enzyme activities, and contributing to the synthesis of proteins, carbohydrates, and fats, thus significantly increasing total crop productivity. According to Naumann, (2020) Potassium helps plants endure various biotic and abiotic stresses like pathogens, drought, and extreme temperatures. Jones et al. (1991) also opined that potassium is the crucial foremost element involved in maintaining plant water status and cell pressure, which is responsible for regulating stomata opening and closing. Phosphorus also play a significant role in the photosynthesis process.

According to Samar, (2023) Urea has served as the primary nitrogenous fertilizer worldwide since the early 1950s and its generally acknowledged as the most concentrated nitrogen source, containing approximately 46% nitrogen. Similarly, Sina et all, (2014) reported that the effect of urea fertilizer on the number of grain rows, number of grains per row, the number of grains per ear, grain weight, grain yield, biological yield and harvest index were significant. NPK and Urea fertilizer enhance crop yield by providing the essential nutrients to crop in a balanced and easily absorbed form. Most studies have shown that the application of nitrogen, phosphorus and potassium fertilizers and urea fertilizer have a significant impact on both the yield and quality of maize and sorghum.

The review of past literatures therefore, revealed separate studies on the impact of the fertilizer on crop yield. However, this study intends to compare the impact of the two fertilizers identified, NPK and Urea, on maize and sorghum yield with the view to ascertain which of the fertilizers is best suitable for the crops.

Crop yield estimation is essential for enhancing agricultural practices and maximizing crop outputs. It guides famers in decision-making. Therefore, understanding the effect of specific fertilizer on crop yield is fundamental for improving farm techniques and ensuring food sustainability. There is the need to investigate the impact of different fertilizer on Maize and Sorghum yield to ensure optimum crop productivity. In this study, maize and Sorghum were selected because they are the commonly grown and staple cereal crops in Nigeria and also common source of income for many farmers. The production and consumption of Maize and Sorghum have increased tremendously. According to Rotili et al., (2021) Maize is one of the universally foremost staple cereals, standing as the second most planted crops in the world. Similarly, Dillon et al., (2007) stated that Sorghum is an important staple food for millions of poor rural farmers in the Semi-arid, Asia and Africa regions. Nigeria is the largest producer of sorghum in West Africa accounting for 71% of the total regional sorghum output (Gourichon, 2013). Similarly, NPK and urea fertilizer were selected because they are widely available and used by farmers in the area. In addition, Hauck, (1984) reported that both NPK and urea fertilizers can be easily manufactured, stored, transported, distributed and handled. Furthermore, farmers especially in Nigeria applied NPK fertilizer because nitrogen (N), phosphorus (P), and potassium (K) are essential for plant growth. According to Umeri, et al. (2022) Nitrogen (N) is a macro-element required for plant growth and it is essential for chlorophyll synthesis

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

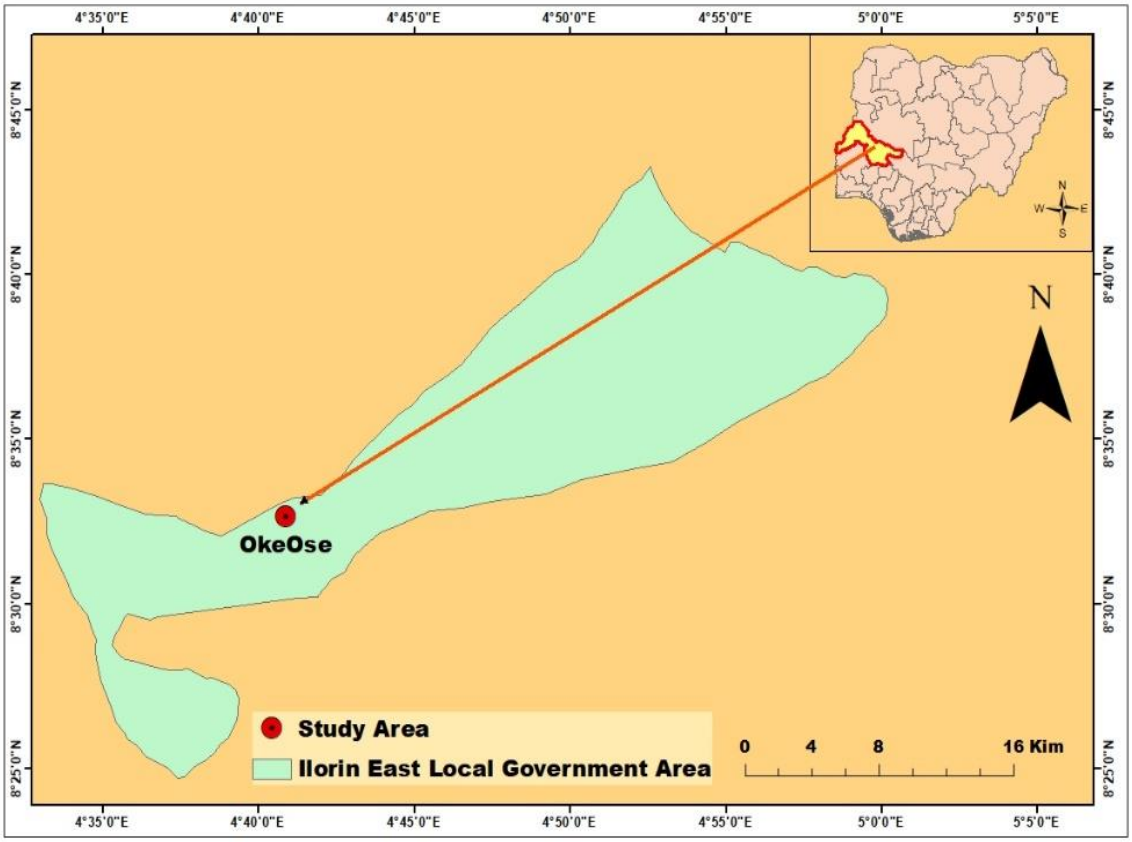
while Oyedeji, et al (2014) reported that enough nitrogen is needed in the soil to for plant to grow well. Similarity, Akanbi et al. (2009) reported that crops display a considerable positive reaction to nitrogen application. In addition, according to Abdullahi, et al. (2022) majority of studies have mostly concentrated on the response of maize to nitrogen especially in the savannas of Nigeria where production of maize is high. Therefore, the main objective of this study is to compare the impact of NPK and urea fertilizers on maize and Sorghum yields in Oke Ose, Kwara State.

Study area

The study was conducted in Oke Ose which is located on latitude 8^0 55'N and Longitude 4^0 65'. Oke Ose is one of the towns in Ilorin East Local Government Area of Kwara State. Ilorin East Local Government Area which was created in 1991, has its headquarters in Oke-Oyi and an area of 486 km^2. The population census 2006 population census put the population of the local Government at 204,310 which was projected to be 311,500 in 2022. Ilorin East Local Government Area share boundaries with Ilorin South Local Government Area to the south, Ilorin West Local Government Area to the West, Moro Local Government Area to the north and Ifelodun Local Government Area to the east (Adeniyi, et. al. 2025). Figure 1 shows the map of Ilorin East Local Government Area and the study area.

The climate of Oke Ose exhibits both wet and dry seasons. The rainy season which last for about 7 months begins towards the end of April and last till October while the dry season begins in November and ends in April. The temperature of the area ranges from 33^0 to 35^0 from November to January while from February to April from 34^0 to 37^0. Total annual rainfall ranges from 990.3mm to 1318mm. The rainfall exhibits double maximal pattern. The relative humidity ranges from 35% to 88%. In term of geology, the area is made up of Precambrian basement complex rock. These rocks are mostly igneous and metamorphic rocks. The soils are made up of loamy soil with medium fertility. Farming is the predominant activities in the area. Some of the common cereal and tuber crops grown in the area are maize, Sorghum, cassava and yam (Adeniyi, et. al. 2025).

Figure 1: Map of Ilorin East Local Government Area and the study area.



ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

MATERIALS AND METHOD

Field Experiment

The experiment was conducted at Oke Ose in Ilorin East Local Government Area, Kwara State. An experimental land area of $100m^2$ was divided into two, $50m^2$ each, and Maize was planted on one half while Sorghum was planted on the other half. The $50m^2$ of land for maize was further divided into two. NPK 15-15-15 fertilizer was applied to one half of land while urea 46-0-0 fertilizer was applied to the other half of land. The NPK fertilizer contain 15% of Nitrogen, 15% of Phosphorous in the form of phosphate and 15% of Potassium while urea fertilizer contains 46% of Nitrogen and zero Phosphorous and Potassium. Similarly, the $50m^2$ of land for Sorghum was further divided into two. NPK fertilizer was applied to one half of land while urea fertilizer was applied to the other half of land. The same quantity, 2.5kg, of NPK fertilizer and Urea fertilizer were applied to the crops at the same time. The yield of maize under the NPK fertilizer and Urea fertilizer were estimated. Similarly, the yield of Sorghum under the NPK fertilizer and Urea fertilizer were estimated. The yield of maize under NPK fertilizer was compared with that under the urea fertilizer while the yield of sorghum under NPK fertilizer was also compared with that under urea fertilizer.

Grain Yield

An area of $1m^2$ from the experimental area was measured using measuring tape. From the area, the number of heads or cobs of crop were counted and the number of grains per heads or cobs were also counted. This was done five times each for maize under NPK fertilizer and urea and sorghum under NPK fertilizer and urea fertilizer. Estimation of crop yield always involves estimation of crop area and quantity of harvested products. So, for this study, the average number of heads or cobs, the average number of grains per heads and the grain weight of the crop was used to estimate the yield of the crops. Therefore, the crop yield in tones per hectare was calculated as:

$$\text{Yield in t/ha} = (A \times B \times C) / 10{,}000$$

Where

A = the average number of heads or pods in an area of $1m^2$

B = the average number of grains per heads/cobs

C= the grain weight of the crop

To calculate C, the grain weight, the grains are measured in the scale pan and weight recorded. The volume is also measured in a graduated cylinder. Then divide the weight of the grains by the volume of the grains.

Though there are many methods to estimate crop yield, some of which are direct and easy while some are more complex. However, in this study, the above method was adopted because it can be carry out relatively quickly and easily.

Pre Planting Soil analysis

Pre-Planting soil analysis was carried out to determine the pyhsico chemical characteristics of the experimental soil. Twenty soil samples were randomly collected with an auger at the depth of 0 – 20 cm from the experimental area. The soil samples were taken to laboratory analysis where they were air-dried and analyzed using Association of Official Analytical Chemists (AOAC) methods for analyzing physico-chemical properties of soil. The parameters analyzed were Potassium, pH, Sodium, Electric Conductivity, Organic matter, Organic carbon, Nitrogen, Phosphorous, Calcium, Magnesium, Exchangeable acidity, and Effective Cation Exchange Capacity (ECEC) and soil texture.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

RESULTS AND DISCUSSION

Physicochemical Characteristics of the Experimental Soil

Physicochemical characteristics are measurable physical and chemical properties of soil which are essential for soil fertility, effectiveness of fertilizer, suitability for various crops and dictate the ability of soil to support crop. The laboratory results of the physicochemical characteristics of the pre-planting soil were presented in table 1. The result reveals that the mean values of pH, Nitrogen and Organic Matter are 6.77, 0.12 and 1.00 respectively while the mean values of Potassium and Organic Carbon are 0.38 and 0.58 respectively. The percentage of sand, silt and clay in the soil are 89.0, 7.0 and 4.0 respectively. The result therefore, reveals that, in term of textural class, the soil is sandy. The result also reveals that the soil is slightly acidic with low Nitrogen, Organic carbon, Organic Matter, and Potassium. This Implies that there is need for replacement and improvement of nutrients balance, especially Nitrogen, Potassium and Organic Matter, in the soil. The result also reveals that to increase crop yields, application of fertilizer, as an artificial measure of improving soil fertility, is required. Therefore, it is necessary to apply fertilizer especially NPK and urea, for optimum plant growth and improved yields.

Table 1. Pre-planting soil physicochemical parameters of the experimental Area

Soil Parameters	**Mean**
pH (H_2O)	6.77
Electrical Conductivity (dS/cm)	11.90
Organic carbon (%)	0.58
Organic matter (%)	1.00
Nitrogen (%)	0.12
Available Phosphorous (ppm)	72.72
Potassium (cmol/kg)	0.38
Sodium (cmol/kg)	0.10
Calcium (cmol/kg)	1.15
Magnesium (cmol/kg)	1.45
Exchangeable acidity (cmol/kg)	0.32
ECEC (cmol/kg)	3.40
Sand %	89.0
Silt %	7.0
Clay %	4.0

Source: Authors' Computation, 2025

Crop Yield Under NPK and Urea Fertilizers

Crop yield is the quantity of harvested agricultural crop, for example, grains, from a definite unit of land area and it is usually expressed as weight per unit area. The average amount of maize and sorghum harvested per unit

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

area of 50 m^2 under NPK fertilizer and urea fertilizer is presented in table 2. The table reveals that the average yield of maize and sorghum when NPK fertilizer was used was 1.69t/ha and 1.58t/ha respectively. Similarly, the average yield of maize and sorghum under NPK fertilizer and urea fertilizers was 1.30t/h and 1.22t/h respectively. Comparatively, the result shows that there are increase in yield in both maize and sorghum with the application of NPK fertilizer. In other word, in term of yields, maize and sorghum performed best when treated with NPK fertilizer than urea fertilizer. This implies that the two additional nutrients, Phosphorous and Potassium, provided by the NPK fertilizer which are not present in the Urea fertilizer have significant influence on the yield of the crops. Increased maize and sorghum yields required nutrient balance especially Nitrogen, Phosphorous and Potassium. The NPK fertilizer provided a complete nutritional values needed for improved yield. Hence, NPK fertilizer is more suitable for better maize and sorghum yields. The result agreed with the submission of Ning Wang, et. al. 2024 which states that a balanced NPK fertilizer regime effectively managed soil nutrient balance which eventually brings increase productivity.

Table 2: Maize Yield under NPK and Urea Fertilizers

Crop	**Yield**	
	NPK Fertilizer (t/ha)	Urea Fertilizer (t/ha)
Maize	1.69	1.30
Sorghum	1.58	1.22

Source: Authors' Computation, 2025

T- test Statistics

T-Test is a statistics test used to determine if there is a significance difference between means of two set of data. In this study, T-Test statistics was used to compare the means between maize and sorghum yield under NPK fertilizer and urea fertilizer. The result of the test shows that the p value for the maize yield under NPK fertilizer and urea fertilizer is 0.0319 while the p value for sorghum yield under NPK fertilizer and urea fertilizer is 0.0222. This shows that the different between the means is statistically significant because the p values are less than 0.05. Therefore, this implies that there is a significant difference in yields of maize and sorghum under NPK fertilizer and Urea fertilizer. The difference could be as a result of the additional nutrients, phosphorous and potassium, provided by NPK fertilizer. This therefore, suggest that a balanced nutrient contents is required for high productivity for both maize and sorghum.

CONCLUSION AND RECOMMENDATION

The study examines the impacts of different fertilization application, that is NPK and urea fertilizer, on maize and sorghum yield. The result reveals that Maize and sorghum performed best when treated with NPK fertilizer than urea fertilizer in Oke-Ose, Ilorin East Local Government of Kwara State. The average yield of maize and sorghum were higher with the application of NPK fertilizer than the average yield when urea fertilizer was used. The increase in yields could be because NPK fertilizer reduce soil bulk density and also increase soil porosity which eventually increases the rate at which plant absorb nutrient. Therefore, comparatively, NPK fertilizer produces more yield of maize and sorghum than urea fertilizer. So, in term of increase in yield for maize and sorghum NPK fertilizer will be the most preferred fertilizer for better yield. Based on this finding, the study therefore recommend application of NPK fertilizer for both maize and sorghum crops for better productivity in the study area.

ACKNOWLEDGEMENT

The authors extend their appreciation to Tertiary Education Trust Fund, TETFUND, in Nigeria and the Management, Kwara State Polytechnic, Ilorin, for funding this research and providing enabling platform respectively.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

REFERENCES

1. Abdullahi, I. T., Alpha Y. K., Bashir, A. B., Kamaluddin, T. A., Temitope, D. A., & Jenneh, F. B. (2022). Maize yield as affected by the interaction of fertilizer nitrogen and phosphorous in Guinea savanna of Nigeria. Heliyon 8 11: 11587
2. Adeniyi A., Ajadi B. S. & Banjoko, A. L. (2025) Soil Fertility Status and its Implications on Agricultural Productivity in OkeOse, Ilorin East Local Government Area, Kwara State. Geo-Studies Forum, 11, (1&2) 114-122
3. Adeniyi, A. (2013) Impact of Climate on Productivity of Selected Crops in Ilorin, Kwarar State, Nigeria Ilorin Journal of Social Sciences 15 (1): 59-66
4. Adeyeye, A. S., Olalekan, K. K., Lamidi, W. A., Aji, P. O., Othman, H. J., & Ishaku, M. A. (2018) Comparative Effect of Organic and Inorganic Fertilizer Sources on the Growth and Fruits Yield of Tomato (Lycoperscicum esculentum mill). International Journal of Agricultural Policy and Research, 6, 122-126
5. Akanbi, W. B., Adeyeye, A. S., Ogunrinde, J. O., Babajide, P. A., Ajibola, A. T., Ilupeju, E. A. O., & Akinfasoye, J. A. (2009). Effects of Organic Fertilizer and Cutting Height on Growth, Shoot Yield and Nutrient Uptakes of Amaranth (Amaranthus cruentus). Research Journal of Life and Physical Sciences, 3(1), 7-14.
6. Alvarez, R. and Steinbach, H. S. (2017) Modeling soil test phosphorus changes under fertilized and unfertilized managements using artificial neural networks. Agron. Journal. (109): 2278–2290.
7. Dillion, S. L., Frances, M. S., Robert, J. H., Giovanni C., Liz, L., & Lee, L.S. (2007) Domestication of Crop Improvement: Genetic Resources for Sorghum and Saccharum (Andropogoneate). Ann. Bot. 1; 100 (5): 975-989.
8. FAO (2009b). "New Challenges: Climate Change and Bio-energy." FAO WSFS Issues Paper, FAO.
9. FAO (2009c). "The Technology Challenge: How to Feed the World 2050," High-Level Export Forum, October 12–13, FAO, United Nations.
10. Gourichon, H. (2013) Analysis of Incentives and Disincentives for Sorghum in Nigeria. Technical Notes Series, MAFAP, FAO, Rome.
11. Hatfield, J.L. (2006). Erosion: On-Site and Off-Site Impacts In Lal, R. (2006). Encyclopedia of Soil Science, 2nd Ed.
12. Jiang, M, Dong, C., Bian, W., Zhang, W. & Wang, Y. (2024) Effects of Different Fertilizer Practices on Maize yield, soil Nutrients, soil Moisture, and water Use efficiency in Northern China Based on a meta-analysis. Sci. Rep. 18, 14 (1) 6480. DOI: 10.1038/s41598-024-57031-z.
13. Jones, J.B., Wolf, J. B. & Mills, F. L. A. (1991) Plant Analysis Handbook (Micro-Macro Pub. Inc., USA,), pp. 2l3
14. Liu, Y., Zou, L. & Wang, Y. (2020) Spatial-temporal characteristics and influencing factors of agricultural eco-efficiency in China in recent 40 years. Land Use Policy. https://doi.org/10.1016/j.landusepol.2020.104794 (2020).
15. Mello, S. da C., Pierce, F.J., Tonhati, R., Almeida, G.S., Neto, D.D., & Pavuluri, K. (2018) Potato response to Polyhalite as a potassium source fertilizer in Brazil: yield and quality Hortscience, 53 (2018), pp. 373-379, 10.21273/HORTSCI12738-17
16. Sina, M. A., Farhood, Y., Bijan, K., and Edris, S. (2014) Effect of Different Urea Levels on Yield and Yield Components of Corn 704. International journal of Advanced Biological and Biomedical Research. 2, (2): 300-305
17. Musa, D.D. Mohammad, F.T. & Bala, A. S. (2022). Growth and Yield Response of Common Beans (Phaseolus Vulgaris L.) To Sodom Apple (Calotropis Procera Aiton.) Leaf, Stem and Root Aqueous Extracts. International Journal of Science & Engineering Technology 30 (2)
18. Naumann, M., Koch, M., Thiel, H., Gransee, A., & Pawelzik, E. (2020) The importance of nutrient management for potato production Part II: plant nutrition and tuber quality. Potato Res., 63, 121-137
19. Ning Wang, Jin, Z., Keyun, F., & Hongyu, N. (2024) Higher Sustainability and Soil Quality by Reducing Chemical Fertilizer with Organic Fertilizer Application Under a Single-cotton Cropping System. Frontiers in Plant Science 15 DOI: 10.3389/fpls.2024.1494667
20. Oyedeji, S., Animasaun, D. A., Bello, A. A., & Agboola, O. O. (2014). Effects of NPK and Poultry manure on growth, yield and proximate composition of three amaranthus. Journal of Botany, Article ID:828750.https://doi.org/10.1155/2014/828750

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

21. Rotili, D. H., Adeledo, L. G., devoil, P., Rodriguez, D., & Maddonni, G. A. (2021) Exploring the Effect of Tillers on the water economy plant growth and Kernel set of low-density maize crops Agricultural Water Management. Elsevier 243 (C).
22. Samar, S. Romas, M. Jonas, B. Donata, D. & Karolina, B. (2023) Review: Modified Urea Fertilizers and Their Effects on Improving Nitrogen Use Efficiency (NUE) Journals Sustainability. 16 (1) 10.3390/su16010188.
23. Umeri, C., Nwajei, S.E, and Akporherhe, H. (2022) Effect of urea fertilizer on the growth and yield of African spinach (Amaranthus hybridus L.) in derived- savanna zone of Delta State, Nigeria. J. Current Opinion Crop Sci. 3(1): 28-33
24. Ziska, L., A. Crimmins, A. Auclair, S. DeGrasse, J.F. Garofalo, A.S. Khan, I. Loladze, A.A. Pérez de León, A. Showler, J. Thurston, and I. Walls, (2016). The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 189–216.