**Colloquia SSSN 44 (2020) 243-248**

Colloquia Series

Available online at www.publishingrealtime.com

Publishing Real Time

Colloquia SSSN 44 (2020)

Proceedings of the 44th Conference of Soil Science Society of Nigeria on Climate-smart soil management, soil health/quality and land management: synergies for sustainable ecosystem services

# Effect of different combinations of organic and inorganic nitrogen sources on growth and pod yield of Okra (*Abelmoschus esculentus*) in Minna, Niger State.

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## Abstract

A study was carried out at the Federal University of Technology Minna during the 2019 cropping season to evaluate different combinations of organic and inorganic nitrogen sources on growth and pod yield of Okra (*Abelmoschus esculentus*) in Minna, Niger State. Two varieties of Okra (NHAe47-4 and LD88) were treated to two different combination ratios (75:25 and 50:50) of inorganic and organic N sources, respectively, 100 % inorganic and control (No fertilizer). Nitrogen was sourced from urea (46 % N) and Cow dung. The nitrogen was applied at the rate of 80 kg ha$^{-1}$ while Phosphorus and Potassium were applied as basal at 45 kg ha$^{-1}$ each using Single Super Phosphate (18 % $P_2O_5$) and Muriate of Potash (60 % $K_2O$) as sources. The experiment was laid out in a Randomized Complete Block Design with three replications, and data were subjected to Analysis of Variance using Minitab Version 17.0. Results showed that there were significant differences ($P < 0.05$) among the treatments applied. The application of 75 % N from Urea + 25 % N from Cow dung produced the tallest okra plants of NHAe47-4 variety (103.27 cm) and LD88 (154.87 cm); highest number of leaves per plant, highest leaf area and stem girth per plant were also recorded with 75 % N +25% N (inorganic and organic sources respectively) as compared to other fertilizer plans. However, the two varieties' response to 100 % N from urea attained reproductive stage (days to first flower bud sight, first flower bud opening and 50% flowering) earlier than the other treatments. Application of 75 % N (Inorganic) + 25% N (Organic) produced the highest yield of 10 pods per plant with NHAe47-4 and 16 pods per plant with LD88. However, NHAe47-4 attained reproductive stage earlier than LD88, but best vegetative growth traits such as heights, leaf number/plant, leaf area and higher pod yield were recorded with LD88. Thus, it can be concluded from this study that the complementary application of 75 % N from Urea + 25 % N from cow dung resulted in significantly better performance and yield of the two okra varieties.

**Keywords**: Integrated nitrogen management, urea, cow dung, Okra, growth, pod yield

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https://doi.org/10.36265/colsssn.2020.4435

Peer-review under responsibility of 44th SSSN Conference LoC2020.

## 1.0 Introduction

Okra[*Abelmoschus esculentus* L. Moench] is a member of the hibiscus family, Malvaceae and has the typical floral characteristics of that family (Atijegbe *et al.*, 2014). It is reported to have originated from tropical Africa and was first cultivated in Egypt in 12thcentury (Maurya *et al.*, 2013), and it is widely distributed in the tropics, including Nigeria. The okra plant requires warm temperatures and cannot withstand low temperature for long or tolerate any threat of frost. Optimum temperature is in the range of 21 to 30 degrees Celsius, with minimum and maximum temperatures of 18 degrees Celsius and a maximum 35 degrees Celsius (Adhikari *et al.*).

Okra is a common ingredient of soups and sauces (Muhammad *et al.*, 2018). It is widely cultivated for its immature edible green fruits consumed as a vegetable (AG, 2013). Okra is a vegetable of national importance in Nigeria as it is rich in vitamins and minerals. It is produced and consumed all over the country for the mucilaginous or "draw" property of the fruit that aids easy consumption of the staple food products (Muhammad et al., 2018). The tender green pods of Okra are important sources of vitamins and minerals such as vitamins A, B1, B3, B6, C and K, folic acid, potassium, magnesium, calcium and trace elements such as copper, manganese, iron, zinc, nickel, and iodine (Lee *et al.*, 1990). These nutrients are often lacking in the diet of people in most developing countries (Muhammad et al., 2018). The fruits can be conserved by drying or pickling. The crop leaves are sometimes used as a substitute for spinach (Singh *et al.*, 2014). On the average, young green pod contains 86.1% moisture, 9.7% carbohydrate, 2.2% protein, 0.2% fat, 1.0% fiber and 0.8% ash [6]. The major producing countries include India (5,507,000 tons), Nigeria (1,978,286 tons), Sudan (287,000 tons), Mali (241,033), Pakistan (117,961 tons), Cote d'Ivoire (112,966 tons), Ghana (66,360 tons), Egypt (55,166 tons), Iraq (123,583 tons), and Malaysia (55,856 tons) [5]. Globally, okra production approximately stands at 8,900,434 million tons grown on 2,157,961 hectares (FAOSTAT, 2016).

Most of the soils in Nigeria are strongly weathered and dominated by low-activity clay minerals with low nutrient status. This is because they are adversely affected by sub-optimal soil fertility even as erosion causes deterioration of nutrient status and changes in soil organism's population (Omotayo *et al.*, 2009). This type of problem is solved through the use of either organic or inorganic fertilizer. In inorganic fertilizers, nutrients content are relatively high, and they rapidly supply nutrients directly because they do not have to undergo decomposition processes like organic fertilizers. This made it possible to predict, to some extent, the level and timing of nutrient uptake by crop (Muhammad et al., 2018). However, persistent application of inorganic fertilizers has been reported to increase soil acidity and soil physical degradation, reducing crop yield (Ojeniyi *et al.*, 2007). On the other hand, organic fertilizers are known to provide nutrients and contribute to soil quality by improving the structure, chemistry, and biological activity in the soil. However, sole application of organic nutrient sources may not be able to maintain and synchronize the necessary supply of nutrients to the growing plants for optimum crop production, because of relatively less quantity of plant-available nutrients and more time needed for mineralization to release nutrients for effective plant uptake (Malhi *et al.*, 2013).

This is because the decomposition of organic material and release of nutrients from it is strongly affected by temperature and soil moisture content (Adekiya *et al.*, 2012). This makes it impossible to supply the adequate amount of nutrients required by plants at some critical points of need. Also, its bulky nature has rendered its use for large scale crop production less practicable. Hence, there is a need for an integrated organic and inorganic fertilizer application in okra production in Minna.

**2.0 Materials and Methods**

The research work was conducted at the Crop Production Landscaping farm and Soil Science Laboratory of Federal University of Technology Minna, located in the Southern Guinea Savannah agro-ecological zone of Nigeria. The experimental site lies on latitude $9^0$31'52.823" north and longitude $6^0$26'54.498" east. Surface soil samples (0-20 cm) using sterilized soil auger at an even interval in a "W" shaped pattern throughout the 580m$^2$ experimental site on August 5, 2019. Samples were bulked, air-dried and passed through 2 mm sieve. The manure used for the experiment was cow dung which was shade dried, crushed and analysed for its chemical properties. The soil and manure's physical/chemical properties were analysed at the Federal University of Technology Minna, Niger State. The soil and manure's Total Nitrogen content was determined using the Kjeldahl Method of Nitrogen Determination (Kjeldahl, 1883).

Seeds of the okra variety NHAe47-4 and LD88 used for this experimental study were sourced from National Horticultural Research Institute (NIHORT) Ibadan, Oyo State, Nigeria. The existing secondary vegetation on the field was cleared manually with local tools such as cutlasses, and the debris was raked from the field. The plot was partitioned into unit plots with a meter tape according to the experimental design, demarcated with pegs and straightened with rope after which the ridges were made with hoes. Okra seeds were sown at the rate of three seeds per hole and an inter and intra row spacing of 80 cm x 50 cm, resulting in 8 holes per ridge and 32 holes per plot. A basal dose of $P_2O_5$ and $K_2O$ was applied to all plots at a recommended rate of 45 kg $P_2O_5ha^{-1}$and 45 kg $K_2Oha^{-1}$. The nutrients were sourced from Single Super Phosphate (SSP) and Muriate of Potash (MOP). Nitrogen which is the nutrient of interest, was applied to all the plots as necessary except for 0% N at a recommended rate of 80 kg N ha$^{-1}$. Nitrogen was sourced from cow dung as organic matter and from urea as inorganic fertilizer. Weeds were removed manually using hoes at 3 weeks after sowing and subsequently at an interval of two weeks to maintain weed-free experimental plots. The seedlings were thinned manually with hand to 1 seedling per stand at three weeks after sowing to uproot the less vigorous plants, reduce plant population per stand, and reduce competition for nutrients, water and sunlight.

The treatments consisted of four (4) organic and inorganic fertilizer combination (Control – No fertilizer, 100 % N from Urea, 75 % N from Urea + 25 % N from Cow dung, 50 % N from Urea + 50 % N from Cow dung) and two (2) okra variety (NHAe47-4 and LD88). This translated to a 4 × 2 Factorial Combination with a total of eight (8) treatments replicated three (3) times.

**3.0 Result**

Table 1 shows the effect of nitrogen source and variety on the plant height of Okra. Plant height recorded in variety LD88 was significantly higher than that of variety NHAe47-4 through the periods reading was taken. The application of 75% NI + 25% NO resulted in taller plants which were significantly taller than plants fertilized with other treatment combinations except at maturity where the 129.40cm recorded in plants fertilized with 75% NI + 25% NO was statistically similar to 118.59cm recorded in plants fertilized with 100% NI.

At 3WAS, there was no significant ($P \leq 0.05$) difference between nitrogen source except for control which had a significantly lower number of leaves (7.22). The treatment 75% NI + 25% NO had a significantly higher leaf number at FFBS, FFBO and M than other treatments. At F-50%, the values recorded in plants fertilized with 75% NI + 25% NO and 100% NI were statistically similar but significantly higher than the values recorded in other treatments.

Table 3 shows the effect of variety and nitrogen source on the leaf area of Okra. All through the periods at which readings were taken, the NHAe47-4 had a significantly wider leaf area than LD88. Also, applying 75% NI + 25%, NO resulted in a significantly wider leaf area than other treatments.

The earliest days to first flower bud sight (39.75), first flower bud opening (47.17) and 50% flowering (55.50) was noticed in variety NHAe47-4 plants. Okra plants treated as control had the highest number of days to first flower bud sight (47.17) and days to 50% flowering (63.67) which was significantly ($P \leq 0.05$) longer than those in another nitrogen source except 50% NI + 50% NO (46.67 and 62.67 respectively). Plants supplied with 75% NI + 25% NO produced the lowest number of flower abortion incidence (1.58), which was significantly lower than those of other treatments.

Plants of LD88 had significantly (P ≤ 0.05) higher number of productive branches per plant (4.61), the number of pod per plant (11.93) and weight of pod per plant (138.20g) while the variety NHAe47-4 had longer pod length (10.77cm) significantly. There is no significant difference between the pod diameter of the two varieties. The nitrogen source 75% NI + 25% NO produced okra plants with the highest number of productive branches per plant (5.02), number of pod per plant (13.05), the weight of pod per plant (194.61g) and pod length (12.47cm) which was significantly (P ≤ 0.05) than other nitrogen sources. The pod diameter of okra seed supplied with 75% NI + 25% NO was the highest (11.60cm) which was statistically similar to 100% NI (11.05cm) but significantly greater than 50% NI + 50% NO (9.05cm) and control which produced pod with the lowest diameter (7.88cm).

Table 1: Effect of Nitrogen Source and Variety on the Plant Height (cm) of Okra

| TREATMENTS | 3WAS | FFBS | FFBO | F-50% | M |
|---|---|---|---|---|---|
| Variety(V) | | | | | |
| NHAe47-4 | 25.93b | 37.84b | 58.43b | 73.37b | 84.44b |
| LD88 | 27.76a | 40.27a | 86.42a | 96.92a | 138.24a |
| SE ± | 0.12 | 0.34 | 0.81 | 0.76 | 2.47 |
| | | | | | |
| Nitrogen Source (N) | | | | | |
| Control | 24.48d | 26.32d | 48.21d | 54.71d | 87.07c |
| 100 % NI | 27.64b | 44.72b | 80.08b | 90.06b | 118.59ab |
| 75 % NI + 25 % NO | 28.92a | 53.78a | 90.95a | 107.30a | 129.40a |
| 50 % NI + 50 % NO | 26.34c | 31.39c | 70.48c | 85.51c | 114.30b |
| SE ± | 0.16 | 0.48 | 1.15 | 1.07 | 3.50 |
| V*N | * | * | * | * | * |

Means with the same letter are not significantly different at P ≤ 0.05 of probability according to Tukey Test

Table 2: Effect of Nitrogen Source and Variety on the Leaf Number of Okra

| TREATMENTS | 3WAS | FFBS | FFBO | F-50% | M |
|---|---|---|---|---|---|
| Variety(V) | | | | | |
| NHAe47-4 | 8.34a | 15.43a | 25.59a | 28.86b | 4.57a |
| LD88 | 7.98a | 15.36a | 24.46b | 34.49a | 4.70a |
| SE ± | 0.12 | 0.30 | 0.26 | 0.67 | 0.26 |
| | | | | | |
| Nitrogen Source (N) | | | | | |
| Control | 7.22b | 10.76d | 15.63d | 19.75c | 2.36c |
| 100 % NI | 8.22a | 16.56b | 28.02b | 36.62a | 4.92b |
| 75 % NI + 25 % NO | 8.78a | 19.62a | 31.92a | 39.40a | 7.23a |
| 50 % NI + 50 % NO | 8.43a | 14.64c | 24.53c | 30.93b | 4.04b |
| SE ± | 0.17 | 0.43 | 0.36 | 0.94 | 0.36 |
| V*N | * | * | * | * | * |

Table 3: Effect of Variety and Nitrogen Source on Leaf Area of Okra

| TREATMENTS | 3WAS | FFBS | FFBO | F-50% | M |
|---|---|---|---|---|---|
| Variety(V) | | | | | |
| NHAe47-4 | 180.08a | 511.48a | 815.86a | 926.40a | 160.37a |
| LD88 | 88.07b | 295.66b | 480.81b | 556.38b | 94.43b |
| SE ± | 0.88 | 5.50 | 11.50 | 13.10 | 5.08 |
| | | | | | |
| Nitrogen Source (N) | | | | | |
| Control | 111.30d | 256.45c | 402.38d | 463.54d | 49.80d |
| 100 % NI | 138.30b | 431.02b | 717.83b | 798.02b | 161.18b |
| 75 % NI + 25 % NO | 154.80a | 426.21a | 867.72a | 1033.81a | 199.88a |
| 50 % NI + 50 % NO | 131.91c | 400.60b | 605.40c | 670.18c | 98.74c |
| SE ± | 1.24 | 7.78 | 16.30 | 18.60 | 7.19 |

Means with the same letter are not significantly different at P ≤ 0.05 of probability according to Tukey Test

Table 4: Effect of Nitrogen Source and Variety on Flowering of Okra

| TREATMENTS | Days to First Flower Bud Sight | Days to First Flower Bud Opening | Days to 50% Flowering | Flower Abortion Incidence |
|---|---|---|---|---|
| Variety(V) | | | | |
| NHAe47-4 | 39.75b | 47.17b | 55.50b | 0.93a |
| LD88 | 49.25a | 59.00a | 66.17a | 0.81a |
| SE ± | 0.49 | 0.81 | 0.62 | 0.05 |
| Nitrogen Source (N) | | | | |
| Control | 47.17a | 53.50a | 63.67a | 1.58a |
| 100 % NI | 41.33b | 50.00a | 57.50c | 0.60bc |
| 75 % NI + 25 % NO | 42.83b | 54.33a | 59.50bc | 0.45c |
| 50 % NI + 50 % NO | 46.67a | 54.50a | 62.67ab | 0.83b |
| SE ± | 0.69 | 1.15 | 0.87 | 0.07 |
| V*N | * | * | * | * |

Means with the same letter are not significantly different at $P \leq 0.05$ of probability according to Tukey Test

Table 5: Effect of Variety and Nitrogen source on Productive Branches and yield of Okra

| TREATMENTS | Number of productive branches | Number of pod per plant | Weight of pod per plant (g) | Pod length (cm) | Pod diameter (cm) |
|---|---|---|---|---|---|
| Variety(V) | | | | | |
| NHAe47-4 | 3.00b | 7.74b | 91.82b | 10.77a | 10.18a |
| LD88 | 4.61a | 11.93a | 138.20a | 9.53b | 9.61a |
| SE ± | 0.09 | 0.24 | 3.86 | 0.11 | 0.31 |
| Nitrogen Source (N) | | | | | |
| Control | 2.22d | 5.98d | 51.19d | 7.54d | 7.88b |
| 100 % NI | 4.32b | 11.12b | 125.74b | 10.71b | 11.05a |
| 75 % NI + 25 % NO | 5.02a | 13.05a | 194.61a | 12.47a | 11.60a |
| 50 % NI + 50 % NO | 3.67c | 9.20c | 88.51c | 9.88c | 9.05b |
| SE ± | 0.13 | 0.34 | 5.46 | 0.15 | 0.44 |
| V*N | * | * | * | * | * |

Means with the same letter are not significantly different at $P \leq 0.05$ of probability according to Tukey Test

WAS : Weeks after sowing

FFBS : First flower bud sight

FFBO : First flower bud opening

F-50%: 50 percent flowering

M: Maturity

SE ±: Standard Error of Mean

% NI : Percentage of Nitrogen from Inorganic source (Urea)

% NO: Percentage of Nitrogen from Organic source (cow dung)

* : Significant ($P \leq 0.05$)

## 4.0 Discussion

In this study, significant variations were recorded between the two varieties (NHAe47-4 and LD88) with regards to some vegetative as well as reproductive parameters (plant height, leaf area, days to first flower bud sight, days to first flower bud opening and days to 50% flowering, number of productive branches per plant, number of pod per plant, the weight of pod per plant and pod length). These variations could be attributed to differences in genetic make-up concerning those traits. Elhag *et al.* (2014) had earlier affirmed that the differential growth of crops under similar environmental conditions is normally the result of differences in their genetic make-up. Similar to what was obtained in this study, Muhammad et al. (2018) have also attributed the differences observed among the three varieties (LD88, NHAE47-4 and Dogo variety) in their genetic make-up. Variability in performance among varieties has also been recorded in other vegetables like tomato, all of which were also attributed to genetic make-up differences (Ilupeju *et al.*, 2015; Umar *et al.*, 2018; Vallejo *et al.*, 2002).

Plants fertilized with 75% NI + 25% NO had higher values of plant height, leaf area and number of leaves this could be attributed to the availability of nutrient, especially nitrogen throughout growth. It could be that the exhaustion of N from urea due to its volatile nature has been taken care of by the slow nutrient release nature of cow dung, thereby making N available to the plants at every stage of growth. This assertion agrees with Bairwa et al. (2009) that, mineralization of manures aids in soil nutrient build-up that leads to improved nutrient availability to the growing Okra. This enhancement in vegetative growth could also be due to nitrogen's role in the synthesis of chlorophyll, enzymes and proteins as opined by Kauthar (2014).

Muhammad *et al*. (2018) also reported that NPK and Poultry Manure's combined application resulted in taller, though the application was in equal proportion. The positive effect of combined application of organic and inorganic fertilizers has also been reported in other vegetable species. Islam *et al.* (2017) reported that combined application of urea with cow dung showed a significant increase in number of leaves per plant, leaf area, Root/ canopy, plant fresh weight, number of branches in sweet pepper. Also, Baishya *et al.* (2013) reported that the application of 75% recommended dose of chemical fertilizers and 25% recommended dose of nitrogen through farmyard manure (FYM) recorded higher values plant height, stem number and stem girth. In tomato, higher values of plant height and number of leaves have been obtained with integrated organic manure and inorganic fertilize (Ogundare *et al.*, 2015; Rodge *et al.*, 2009).

The yield parameters such as the number of pod per plant, weight of pod per plant and pod length were highest in plants fertilized with 75% NI + 25% NO. This shows a positive correlation between flowering and fruiting as the flowering performance was also highest in plants given this same treatment. This could have resulted from the cumulative stimulating effect of nitrogen from both sources on vegetative growth characters that form the basis for flowering and fruiting and translocation of assimilates from source to sink as reported by Dass *et al.* (2008). As earlier by Kauthar (2014)), the increase recorded on the number of fruits per stand and fresh fruit yield in their study might result from the increased flowering process, leading to more significant fruit formation. The mineralization of cow dung could have released additional P and K and other micro-nutrients, all of which might have enhanced both vegetative and reproductive performance of the plants. Higher performance regarding yield parameter was also recorded in Muhammad *et al*. (2018) from the combined application of NPK and poultry manure. The enhancement in yield recorded by Nweke *et al.* (2015) cucumber from the combination of cow dung and urea has also proved that the integration of organic and inorganic nutrition sources yields a better performance over a sole application from either of the sources.

**5.0 Conclusion**

It is concluded from this study that the application of 75 % N from Urea + 25 % N from cow dung resulted in significantly better performance of the two okra varieties compared to other treatment combinations.

**References**

Adekiya, A., Ojeniyi, S., & Agbede, T. (2012). Poultry manure effects on soil properties, leaf nutrient status, growth and yield of cocoyam in a tropical Alfisol. *Nigerian Journal of Soil Science, 22*(2), 30-39.

Adhikari, A., & Piya, A. Effect of Different Sources of Nutrient on Growth and Yield of Okra (*Abelmoschus esculentus* L. Monech).

AG, O. (2013). Growth and yield response of Okra (*Abelmoschus esulentus* (L.) Moench) to NPK fertilizer rates and weed interference in South-Eastern Nigeria.

Atijegbe, S. R., Nuga, B. O., Lale, N. E., & Osayi, R. N. (2014). Effect of organic and inorganic fertilizers on Okra (*Abelmoschus esculentus* L. Moench) production and incidence of insect pests in the humid tropics. *J. Agri. Vet. Sci, 7*, 25-30.

Bairwa, H., Shukla, A., Mahawer, L., Kaushik, R., Shukla, K., & Ameta, K. (2009). Response of integrated nutrient management on yield, quality and physico-chemical characteristics of okra cv. Arka Anamika. *Indian Journal of Horticulture, 66*(3), 310-314.

Baishya, L., Kumar, M., Ghosh, M., & Ghosh, D. (2013). Effect of integrated nutrient management on growth, productivity and economics of rainfed potato in Meghalaya hills. *International Journal of Agriculture, Environment and Biotechnology, 6*(1), 69-77.

Dass, A., Lenka, N., Patnaik, U., & Sudhishri, S. (2008). Integrated nutrient management for production, economics, and soil improvement in winter vegetables. *International journal of vegetable science, 14*(2), 104-120.

Elhag, A. Z., & Ahmed, A. A. (2014). Effect of cultivar and sowing date on Okra (Abelmoschus esculentus L. Moench.) seed yield. *Universal Journal of Applied Science, 2*(3), 64-67.

FAOSTAT, F. (2016). URL: http://www. fao. org/faostat/ en/-data/QC. *Food and agriculture organization of the United Nations (FAO)*.

Ilupeju, E., Akanbi, W., Olaniyi, J., Lawal, B., Ojo, M., & Akintokun, P. (2015). Impact of organic and inorganic fertilizers on growth, fruit yield, nutritional and lycopene contents of three varieties of tomato (Lycopersicon esculentum (L.) Mill) in Ogbomoso, Nigeria. *African Journal of Biotechnology, 14*(31), 2424-2433.

Islam, M. M., Islam, M. K., Proshad, R., Islam, M. S., Islam, M. S., Kormoker, T., & Billah, K. M. (2017). Effect of inorganic and organic fertilizers on soil properties with vegetative growth and yield quality of sweet pepper (Capsicum annuum L.) in Bangladesh.

Kauthar (2014). Performance of sweet pepper (Capsicum annum L.) varieties as influenced by nitrogen and poultry manure fertilization in the Sudan savanna. Masters Thesis, postgraduate studies, Ahmad bello university, Zaria in partial fulfilment of the master of science requirements in agronomy.

Kjeldahl, C. (1883). A new method for the determination of nitrogen in organic matter. *Z Anal Chem, 22*, 366.

Lee, K., Cho, C., Yoon, S., & Park, S. (1990). The effect of nitrogen fertilizer, planting density and sowing date on the yield of Okra. *Korean Journal of Crop Science, 35*(8), 179-183.

Malhi, S., Vera, C., & Brandt, S. (2013). Relative effectiveness of organic and inorganic nutrient sources in improving yield, seed quality and nutrient uptake of canola. *Agricultural Sciences, 2013*.

Maurya, R. P., Bailey, J. A., & Chandler, J. S. A. (2013). Impact of plant spacing and picking interval on the growth, fruit quality and yield of Okra (Abelmoschus esculentus (L.) Moench). *American Journal of Agriculture and forestry, 1*(4), 48-54.

Muhammad, A., Sanda, H. Y ., Aliyu, U., & A., I. B. (2018). Response of Okra (Abelmoschusesculentus L. Moench) Varieties to Sole and Combined Organic and Inorganic Fertilization in the Sudan Savanna Ecological. *Journal of Agriculture and Horticulture Research*.

Nweke, I., & Nsoanya, L. (2015). Effect of Cow Dung and Urea Fertilization on Soil Properties, Growth, and Yield of Cucumber (*Cucumis sativus* L). *Journal of Agriculture and Ecology Research International*, 81-88.

Ogundare, S., Babalola, T., Hinmikaiye, A., & Oloniruha, J. (2015). Growth and fruit yield of tomato as influenced by organic and inorganic fertilizer in Kabba, Nigeria. *European Journal of Agriculture and Forestry Research, 3*(3), 48-56.

Ojeniyi, S., Awodun, M., & Odedina, S. (2007). Effect of animal manure amended spent grain and cocoa husk on nutrient status, growth, and tomato yield. *Middle-East Journal of scientific research, 2*(1), 33-36.

Omotayo, O., & Chukwuka, K. (2009). Soil fertility restoration techniques in sub-Saharan Africa using organic resources. *African Journal of Agricultural Research, 4* (3), 144-150.

Rodge, B., & Yadlod, S. (2009). Effect of organic and inorganic fertilizers on growth, yield and quality of tomato (Lycopersicon esculentum Mill.). *Asian Journal of Horticulture, 4*(1), 221-224.

Singh, B., & Aakansha, G. (2014). Correlation and path coefficient analysis in Okra (Abelmoschus esculentus). *Indian Journal of Agricultural Sciences, 84*(10), 1262-1266.

Umar, R., Yusuf, S. T., Tsado, E. K., Ibrahim, H., & Adewumi, O. A. (2018). Influence of sources and rates of organic fertilizers on growth and yield of tomato (*Lycopersicum esculentum* Mill) in Minna, Nigeria. In: Fabunmi, T. O., Olowe, V. L. O., Sakariyawo, O. S. (eds). . *Proceeding of the 14th Annual Conference of Organic Agriculture in Tertiary Institution in Nigeria "Abeokuta 2018*.

Vallejo, F., Tomás-Barberán, F. A., & García-Viguera, C. (2002). Potential bioactive compounds in health promotion from broccoli cultivars grown in Spain. *Journal of the Science of Food and Agriculture, 82*(11), 1293-1297.