# CORRELATION ANALYSIS BETWEEN YIELD AND GROWTH OF CUCUMBER (*Cucumis sativus* L.) TO TIME AND RATE OF NPK FERTILIZER APPLICATION IN SUDAN SAVANNA, NIGERIA

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***ABSTRACT***

*Two locational trials were conducted during 2021/2022 dry season at Makera irrigation farm Dutsin-Ma Local Government Area and in Ajiwa, Batagarawa Local Government Area of Katsina State. The study was aimed at determining the correlation between growth and yield of cucumber (Cucumis sativus L.) to time and rate of NPK (20:10:10) fertilizer application in the Sudan savanna. The treatments consisted of factorial combinations of five NPK application times (at Planting (P); 3 WAP; P+3WAP; P+6WAP and 3WAP+6WAP) and five rates of NPK (20:10:10) fertilizer (0, 30, 60, 90 and 120 kg NPK ha$^{-1}$). These were laid out in randomized complete block design (RCBD) and replicated three times. The results showed that time of application of NPK (20:10:10) significantly increased the growth and yield parameters of cucumber measured on number of leaves, vine length (cm), stem diameter (mm), leaf area (cm$^2$), number of fruit per plant and per hectare, fruit diameter (mm), fruit length (cm), fruit weight per plant (g), fruit weight per plot (kg), and fruit yield per hectare (kg ha$^{-1}$). The correlation analysis of the above measure parameters are showed in table 2 and 3. Based on research findings of the experiments it can be concluded that for optimum cucumber yield; fruit yield parameters should be positively correlated with growth parameters. Therefore, it can be recommended that for good cucumber production yield and growth parameters has to be positively correlated with each other so that farmers within the study area can maximize benefits of cucumber production.*

**Keywords:** *Cucumis sativus,* correlation, growth, yield, rate of NPK fertilizer, Sudan and savanna

## INTRODUCTION

Cucumber (*Cucumis sativus* L.) belongs to the family *cucurbitaceae* and is one of the important fruit vegetable crops grown in Nigeria. It is grown in commercial quantity in Northern Nigeria, eaten largely in different parts of the country and enjoyed across different ethnic groups (Iyagba and Isirima, 2017). It is noted to be the fourth most cultivated vegetable worldwide (Wehner, 2007). In Nigeria however, its place has not been ranked because of underutilization and lack of its knowledge (Eifediyi and Remison, 2009). Climatic factors are very important factors that affect crop production. Each crop has specialized environmental requirements (such as temperature, rainfall, soil type, soil pH, wind speed and velocity, etc.) which must be met for good growth, development and production. Cucumber for instance requires a warm climate

with optimum temperature for growth at about 30°C. The optimum night temperature is 18-21 °C while the minimum temperature for its development is15°C. At temperature less than n 10°C, growth stops while at 0 °C all plants perish. (Khurana *et al*., 2001)

Cucumber production is fast becoming popular in most part of Nigeria probably because of its high nutritional and economic value (Nweke *et al.,* 2013). In spite of its nutrient content and values, cucumber production is still mainly done by very few farmers in Nigeria especially in urban and peri-urban areas. This is due to lack of awareness and agronomic response of the crop to a number of factors involved in producing good quality marketable fruits sizes (Nweke *et al*., 2013). Cucumber production in Southeastern Nigeria is constrained by a lot of factors. In the course of reviewing this work, five major factors militating against cucumber production in Southeastern Nigeria were identified as follows: storage problem, high cost of improved seed, inadequate capital, inadequate enlightenment on climatic factors, and limited access to credit. Solutions to improve cucumber production in southeastern Nigeria include: creating awareness, organizing seminars and workshops, avoiding post-harvest losses and provision of improved seeds. (Okpani et al., 2023)

Cucumber has a very good source of vitamins A, C, K, B6; some important minerals such as potassium, magnesium and phosphorus. It also provides dietary fiber and pantothenic acid (Olaniyi *et al*., 2009). The potential uses of cucumber have made the crop to gain popularity in Nigeria. It is used for various culinary purposes and plays important role in maintaining good health because of its minerals and vitamins (Yamaguchi, 2000). It is eaten raw, cooked and used as a salad. It has been reported that minerals and vitamins present in cucumber assists in building up bones, teeth, protects the human body and promotes major metabolic processes in the body that enhances vitality and good health (Iyagba and Isirima, 2017). Despite the important of cucumber as a major source of minerals and vitamins, the production is still low as result of various factors which include nutrient/water deficiency (Ayotamuno *et al*., 2007). The objective of this research was to determine the correlation between yield and growth parameters for an increased productivity of cucumber in the Sudan savanna.

## Materials and Methods

A two location trials was conducted at the Makera irrigation farm in Dutsin-Ma Local Government Area (Latitude $12^{0}$27'18" N and Longitude $7^{0}$29'29" E) and at Ajiwa in Batagarawa Local Government Area (Latitude $12^{0}$ 59'0" N and Longitude 7045'0" E) in Katsina State. The two experiments were conducted during 2021/2022 dry season. The treatment consists of factorial combinations of five (5) times of fertilizer application at (Planting (P); 3 WAP; P +WAP; P+6WAP and 3WAP+6WAP) and five (5) rates of NPK fertilizer (20:10:10) application (0, 30, 60, 90 and 120kg NPK $ha^{-1}$) This was laid out in randomized complete block design (RCBD) and replicated three times. Each plot was measured 2m×3m ($6m^2$) with space of 0.5m between the plots and 1m between the replications. The inter and intra rows spacing of 50 cm× 50 cm was used. The gross plot measured 2 m × 3 m = ($6 m^2$) while net plot measured 2.5 m × 2 mm = ($5 m^2$) and the total research area was 682 $m^2$. Composite soil samples were randomly collected using soil auger at the depth of 15-30 cm depth for physical and chemical analysis. POINSETT cucumber variety was used for the experiment. It is an early variety that matures in 60-65 days. Both experimental sites (Makera and Ajiwa fadama) were harrowed and levelled. Irrigation basins and water canals were constructed. The experimental sites (Makera and Ajiwa fadama) were harrowed and levelled. Irrigation basins and water canals were constructed. Manual weeding using hoe and hand pulling was carried out at 3 and 6 weeks after sowing (WAS). Appropriate dose of

insecticide was used to control the incidence of insect pest infestation at growth, flowering and fruiting. Samplings on number of leaves per plant, plant length (cm), stem girth (mm), leaf area ($cm^2$) and days to 50% flowering were obtained at 4, 6, and 8WAP from three tagged plants. Harvesting was carried out by hand picking the fruits at maturity. Data collected from the experiment were subjected to statistical analysis of variance (ANOVA) as described by Gomez and Gomez (1984) using SAS package version 9.0 (SAS institute, 2002). The differences among treatment means were separated using Duncan's Multiple Range Test. Effects were considered statistically significant at 5% level of probability (Duncan, 1955).

**Results and Discussion**

The results of the soil physical and chemical properties of the experimental sites (Table 1) showed that, the soils were as very low in major nutrient elements. Soils were sandy and sandy loam at Ajiwa and Makera. The soil was low in organic carbon, nitrogen and phosphorous more especially at Ajiwa experimental site. This implied that cropping the soil without application of fertilizer or soil amendment would make attaining the maximum yield difficult. The pH value (7.80) in Ajiwa was slightly alkaline while in Makera slightly acidic (6.09). The implication of slightly acidic soil in Makera could be because plant nutrients are likely to be available for crop uptake. This was in conformity with the findings of Odunze *et al*. (2006) in which they noted that pH fell within 5.5-6.5 are optimun for release of plant nutrients or cucumber production. The organic carbon rated as low in Ajiwa (1.233 g/kg) and moderate at Makera (14.65 g/kg), which means both soils need to be incorporated with organic materials such as crop residues, or animal manure to improve their low organic matter content. The soil at Ajiwa was low in total nitrogen (0.09 g/kg) but moderate in available Phosphorous (P) (16.64 g/kg). In Makera however, available P is low (4.51 g/kg) and high in total Nitrogen (1.70 g/kg). Cation exchange capacity of both locations were low (4.20 and 4.06) respectively. This might be as a result of low amount of organic carbon from soils of both locations which may have an influence on cation content. Similar observations were made by Ibrahim *et al*., 2016, Sharu *et al*., 2013, and Shehu *et al*., 2015.The findings also indicated that both soils of the experimental sites were moderate in Exchangeable Bases, which means the soils had reasonable but not in excess supply of essential nutrients like calcium, magnesium, sodium and potassium.

The correlation coefficient between yield and growth characters of cucumber at Ajiwa and Makera during 2021/2022 dry season is indicated in Table 2 and 3 respectively. Fruit yield per hectare of cucumber was found to significantly and positively correlate with number of leaves, vine length, stem girth, leaf area, days to 50% flowering, number of fruits per plant, fruit length, fruit girth, fruit weight per plant, fruit weight per plot and number of fruits per hectare. The positive and significant response might be because, timing and rate of application of NPK aligned with the nutrient demand of Cucumber, thus balancing both vegetative and reproductive growth. This was in agreement with the findings of (Tasisa *et al*., 2012 and Meseret *et al*., 2012) in which they separately reported that positive and significant correlation existed between number of leaves, leaf area, average fruit yield, and fruit per plant of tomato. Furthermore, it might be because of the stimulating effects of nutrients on growth characters like leaf area, leaf area index which intercept light for better photosynthesis leading to production of assimilate from source to sink. In other words, assimilates thus produced might have been fully translocated to sink resulting in a significant response. This result was in agreement with the findings of Feng *et al*. (2019) who reported that plants with larger leaf area and its index captured sunlight for photosynthesis with fuel plant growth and fruit production.

**Table 1: Analysis of physical and chemical characteristics of the soil at Ajiwa and Makera experimental sites during 2021/2022 dry season**

| | LOCATION | |
|---|---|---|
| **Soil Characteristics** | **AJIWA** | **MAKERA** |
| **Particle Size Distribution (g)** | | |
| Sand (g) | 900.0 | 580.0 |
| Silt (g) | 20.0 | 270.4 |
| Clay (g) | 80.0 | 140.6 |
| Textural Class | Sand | Sandy Loam |
| **Chemical Composition** | | |
| pH in $H_2O$ (1:2.5) | 7.80 | 6.09 |
| Organic Carbon (g $kg^{-1}$) | 1.23 | 14.65 |
| Total Nitrogen (g $kg^{-1}$) | 0.09 | 1.70 |
| Available Phosphorous (g $kg^{-1}$) | 16.64 | 4.51 |
| **Exchangeable Bases (Cmol $kg^{-1}$)** | | |
| Calcium (Ca) | 2.80 | 2.65 |
| Magnesium (Mg) | 0.27 | 0.46 |
| Potassium (K) | 0.17 | 0.19 |
| Sodium (Na) | 0.17 | 0.26 |
| CEC (Cmol $kg^{-1}$) | 4.20 | 4.06 |

Source: Soil Science Laboratory, Ahmadu Bello University, Zaria in the year 2022.

Table: 2: Correlation matrix between yield and growth characters of cucumber at Ajiwa during 2021/2022

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | 1.000 |
| 2 | | | | | | | | | | | 1.000 | 0.412* |
| 3 | | | | | | | | | | 1.000 | 0.573* | 0.414* |
| 4 | | | | | | | | | 1.000 | 0.535** | 0.281 | 0.427* |
| 5 | | | | | | | | 1.000 | -0.515** | -0.475** | -0.218 | -0.247* |
| 6 | | | | | | | 1.000 | -0.463** | 0.358* | 0.461** | 0.261* | 0.276 |
| 7 | | | | | | 1.000 | 0.551** | -0.410* | 0.372* | 0.455** | 0.201 | 0.059 |
| 8 | | | | | 1.000 | 0.663** | 0.415* | -0.331* | 0.240 | 0.475** | 0.264* | 0.074 |
| 9 | | | | 1.000 | 0.649** | 0.551** | 0.458** | -0.414* | 0.320 | 0.589** | 0.298 | 0.183 |
| 10 | | | 1.000 | 0.653** | 0.582** | 0.645** | 0.637** | -0.431* | 0.410 | 0.660** | 0.410* | 0.443** |
| 11 | | 1.000 | 0.670** | 0.540** | 0.448** | 0.537** | 0.451** | -0.439** | 0.528** | 0.615** | 0.339* | 0.349* |
| 12 | 1.000 | 0.464** | 0.650** | 0.477** | 0.385** | 0.527** | 0.909** | -0.539** | 0.400** | 0.503** | 0.283* | 0.336* |

*: Significant at 5%, **: significant at 1 %, NS: Not significance.

1-Fruit yield per hectare
2- Number of fruits per hectare
3- Fruit weight per plot
4- Fruit weight per plant
5-Fruit diameter
6-Fruit length
7- Number of fruits per plant
8- Days to 50% flowering
9-Leaf area
10-Stem diameter
11-Vine length
12-Number of leaves



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Table: 3: Correlation matrix between yield and growth characters of cucumber at Makera during 2021/2022

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | 1.000 |
| 2 | | | | | | | | | | | 1.000 | 0.640** |
| 3 | | | | | | | | | | 1.000 | 0.576** | 0.517** |
| 4 | | | | | | | | | 1.000 | 0.535** | 0.683** | 0.686** |
| 5 | | | | | | | | 1.000 | -0.673** | -0.496** | -0.638** | -0.619** |
| 6 | | | | | | | 1.000 | -0.485** | 0.320 | 0.481** | 0.567** | 0.313 |
| 7 | | | | | | 1.000 | 0.551** | -0.380 | 0.341* | 0.491** | 0.486** | 0.277 |
| 8 | | | | | 1.000 | 0.590* | 0.410* | -0.343* | 0.354* | 0.361* | 0.342* | 0.287 |
| 9 | | | | 1.000 | 0.392* | -0.576** | 0.515** | -0.576** | 0.392* | 0.526** | 0.489** | 0.472** |
| 10 | | | 1.000 | 0.584** | 0.268* | 0.518** | 0.647** | -0.416* | 0.315 | 0.429* | 0.411* | 0.359** |
| 11 | | 1.000 | 0.413 | 0.551** | 0.369* | 0.475** | 0.289 | -0.560** | 0.581** | 0.519* | 0.649** | 0.669** |
| 12 | 1.0000 | 0.390** | 0.652** | 0.545** | 0.413* | 0.554** | 0.937** | -0.562** | 0.412* | 0.563** | 0.638** | 0.429** |

*: Significant at 5% level of probability. **: significant at 1 % level of probability. NS: Not significance.

1-Fruit yield per hectare
2- Number of fruits per hectare
3-Fruit weight per plot
4-Fruit weight per plant
5-Fruit diameter
6-Fruit length
7- Number of fruits per plant
8- Days to 50% flowering
9-Leaf area
10-Stem diameter
11-Vine length
12-Number of leaves



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## Conclusion and Recommendation

Based on research findings of the experiments it can be concluded that for optimum cucumber yield, application time of NPK (20:10:10) at 3WAP at 90kg/ha$^{-1}$ is best for growth and yield. Therefore, it can be recommended that for good cucumber yield, appropriate time of application of NPK (20:10:10) fertilizer at 3WAP at 90kg/ha$^{-1}$ is therefore recommended.

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## REFERENCES


Ayotamuno JM, Zoufa K, Ofori SA, & Kogbara RB (2007). Response of maize and cucumber intercrop to soil moisture control through irrigation and mulching during the dry season in Nigeria. *African J. Biotechnol.* 6 (5):509.

Duncan, D.B., (1995). Multiple and multiple F tests. Biometrics, 11:1-42

Eifediyi, E. K & Remison, S.U. (2009). The effects of inorganic fertilizer on the yield of two varieties of cucumber (*Cucumis sativus* L.) Department of Crop Science, Ambrose Alli University, Ekpoma, *Nigeria. Report and Opinion,* 1(5). 74-77.

Feng, L., Raza, M.A., Li, Z., Chen, Y., Khalid, M. H. B., Du, J., Liu, W., Wu, X., Song, C., Yu L., Zhang, Z., Yuan, S., Yang, W., & Yang, F. (2019). The Influence of Light Intensity and Leaf Movement on Photosynthesis Characteristics and Carbon Balance of Soybean. Frontiers in Plant Science, 9. DOI:https://www.frontiersin.org/journals/plantscience/articles/10.3389/fpls.2018.01952

Gomez, K.A. and Gomez, A.A. (1984) Statistical Procedures for Agricultural Research. 2nd Edition, John Wiley and Sons, New York, 680 p.

Khurana, A.J. & Singh, M.B. (2001). Optimum temperature for the germination of seed. *Journal of Applied Ecology,* 6: 71-78.34.

Ibrahim J., Aliyu J., & Shobayo, B. (2016). Characterization, Classification and Agricultural Potentials of Soil of Gabari District, Zaria. Northern Guinea Savanna Zone Potentials of Soils of Gabari District, Northern. *Biological and Environmental Science Journals for the Tropics.* 13(2): 102-113.

Iyagba, A. G. & C. B. Isirima, C. B., (2017). Studies on effects of rates of poultry droppings on growth and yield of cucumber (*Cucumis sativus*) in Niger Delta region of Nigeria. 18(4):1-7.

Meseret, D.R., Ali, M. & Bantte, K. (2012). Evaluation of tomato (*Lycopersicon esculentum* Mill.). Genotypes for yield and yield components. *The African Journal of Plant Science and Biotechnology,* 6(1): 4549.

Nweke IA, Orji EC, & Ijearu SI (2013). Effect of Staking and Plant Spacing on the Growth and Yield of Cucumber. *IOSR Journal of Environmental Science, Toxicology and Food Technol.* 3(4):26-31.

Odunze, A.C, Yusuf, D.M & Aishatu, A., (2006) Soil properties and Management strategies for some humid savanna zone Alfisols in Kaduna state Nigeria. *Samaru journal of Agriculture Research,* 22, 3-14.

Okpani, F.M., Orji, K.O., & Umekwe, P.N. (2023) A review on the benefits, techniques, constraints and solutions to cucumber production in southeastern Nigeria. *Nigerian Journal of Scientific Research,* 22: 2023; journal.abu.edu.ng; ISSN-0794-0378.

Olaniyi, J.O., Ogunbiyi, E. M and Alagbe, D. D. (2009). Effects of organo-mineral fertilizers on growth, yield and mineral nutrients uptake in cucumber. *Journal*

*of Animal & Plant Sciences,* 5(1): 437 - 442.

SAS (2002). Statistical Analysis system (SAS) users guide (version 9.0) SAS Institute Inc., Carry, NC., USA.

Sharu M. Yakubu, M., Yakubu, M., Noma S., & Tsafe, A. (2013). Characterization and Classification of Soils on an Agricultural landscape in Dingyadi District, Sokoto State, Nigeria. *Nigerian journal of Basic and Applied Sciences* 21(2), 137-147, https://doi.org/10.3923/ijss.2015,74,83.

Shehu, B. M., Jibrin, J,-. M., & Samadi, A. M. (2015). Fertility status of selected soils in the Sudan savanna biome of northern Nigeria. *International Journal of Soil Science*, 10(2), 74-83. https://doi.org/10.3923/ijss.2015,74,83.

Tasisa, J., Belew, D., & Bantte, K. (2012). Genetic association analysis among some traits of tomato (*Lycopersicon esculentum* Mill) genotypes in west Showa, Ethiopia. *International Journal of plant Breeding and Genetics,* 6: 129-139.

Wehner, T. C. (2007). Cucumbers, watermelon, squash and other cucurbits. In: Encylopedia of food culture, pp 474-479.

Yamaguchi, M. (2000). Cucurbits in world vegetable: Principles, production and nutritive values. AVI Publishing Company Inc. West Port, Connecticut. 317-322.