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# GROWTH AND YIELD RESPONSE OF CUCUMBER TO ORGANIC MANURES IN SAMARU NORTHERN GUINEA SAVANNA OF NIGERIA

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## ABSTRACT

This research was carried out at Institute for Agricultural Research Farm, Zaria during the 2018 and 2019 rainy season to evaluate the effect of four application rates (0, 2, 4 and 6 t $ha^{-1}$) of poultry manure and three application rates (0, 10 and 20 t $ha^{-1}$) of cow dung on cucumber production. This experiment was laid out in 4 x 3 factorial arrangement fitted into randomized complete block design with three replications. Data were collected on number of leaves, leaf area index, vine length, fruit length and yield. Results obtained showed significant increase with poultry manure application on all parameters taken except leaf area index in 2019, fruit length in 2018 and fruit yield in 2019. While significant increase with cow dung application was recorded only in 2018 on yield at 20 t $ha^{-1}$ which was higher than the control but comparable to 10 t $ha^{-1}$. Combined analysis showed significant differences only with poultry manure application at 2 t $ha^{-1}$ beyond which non-significant differences were recorded. Correlation analysis showed fruit length and leaf area index to be significantly positively correlated with yield. Based on the result obtained in the trial, 2 t $ha^{-1}$ of poultry manure can be recommended for the production of cucumber in Samaru Northern Guinea Savanna of Nigeria.

**Keywords:** Cucumber; poultry manure; cow dung; yield; soil

## INTRODUCTION

Cucumber, a member of the *Cucurbitaceae* is a vegetable mostly consumed fresh as a snack, or in salads, soups, smoothies, boats, roll ups, dips, dressings, and ice pops (Noelle and Brittany, 2020). Cucumbers are nutrients rich crops popularly used as culinary vegetables and in cosmetic industries globally. It contains remarkably high quantities of vitamins, minerals and about 96% of water thus aids hydration, weight loss, lower blood sugar, enhance bowel movement among other uses (Rachael, 2017). Despite the enormous benefits in the consumption of cucumber, a number of famers do not have the knowledge of improved agronomic practices regarding fertilizer usage that would boost cucumber production. In an attempt to increase its awareness and production, it is needful to adopt production practices that would be safe to man, higher animals and environmentally friendly. One of such safe production techniques is organic agriculture where ecologically based pest control, biological fertilizers(derived from plant and animal waste), use of nitrogen fixing cover crops among

other practices devoid of chemicals and with rapid decomposing characteristics are employed (Roland and Adamchak, 2008).The use of organic sources of nutrients for plants production has been proven to promote plant growth, improve / preserve soil quality, poses little or no harm to the environment and human health when applied to the soil and consumed by humans or animals. Given the highlighted benefits of cucumber and organic manures, there is the need for increasing cucumber production while ensuring the maintenance of healthy soil, environment and food for human consumption. This trial was therefore conducted to determine the effect of organic manures on cucumber production in the northern guinea savanna of Nigeria.

## MATERIALS AND METHODS

### Study Area

The trial was carried out at the research farm of the Institute for Agricultural Research, Samaru (latitude 11°18' 16"N, longitude 07°62' 34"E and 686m above sea level) during the 2018 and 2019 rainy season. Samaru is located in the Northern Guinea Savanna ecological zone of Nigeria. The rainfall regime in this zone is unimodal and peaks in the month of August and often terminates in the first or middle of October (Kowal and Knabe, 1972). Meteorological data is given on the appendices (i and ii) and soil of the experimental site was sandy loam.

### Field Layout and Experimental Design

The land was sprayed with glyphosate at the rate of 1.5 kg a.i $ha^{-1}$ prior to land preparation to control already emerged weeds. After fourteen days, the land was harrowed twice and ridged at 0.75 intra row spacing. Experimental site was marked out where gross plot size was $12m^2$ while net plot was $6m^2$. Treatments consisted of four application rates (0, 2, 4 and 6 t $ha^{-1}$) of poultry manure and three rates (0, 10 and 20 t $ha^{-1}$) of cow dung laid out in a 4 x 3 factorial arrangement fitted into randomized complete block design with 3 replications. Cucumber variety used was the slicing market more.

### Data Collection and Analysis

Five plants were tagged on each net plot and data were collected on number of leaves, leaf area index, vine length, fruit length and yield. The number of leaves on the tagged plants was counted and mean computed and recorded as number of leaves per plant. Leaf Area Index (LAI) was taken using a ceptometer, while the vine length and fruit length were taken using a tape and meter rule, respectively. The fruit yield measured at each harvest was bulked and computed as yield per hectare. The data collected were then analyzed using analysis of variance as described by Snedecor and Cochran (1967), using the general linear model (GLM) procedure of the statistical analysis system (SAS) package (SAS, 1990) version 9.1. Means were separated using Duncan Multiple Range Test (Duncan, 1955).

## RESULTS

Number of leaves and LAI were significantly increased by application of poultry manure at the sampling period and in both years, except in 2019 where leaf area index was not significant (Table 1). Number of leaves and leaf area index in 2018 were increased with application of up to 2 t $ha^{-1}$ of poultry manure and further increase to higher rates resulted in non-significant differences. In 2019, application of 6 t $ha^{-1}$ of poultry manure resulted in higher number of leaves only when compared to the control. The incorporation of cow dung however resulted in non-significant differences in the parameters measured. The combined analysis for number of leaves and leaf area index showed that application of 2 t $ha^{-1}$ poultry manure resulted in significant increase than the control but similar at higher poultry manure rates. No significant interactions were recorded between the treatments on number of leaves and leaf area index of cucumber.

Table 1: Effect of organic manures on number of leaves and leaf area index of cucumber

| Treatments | Number of Leaves at 6WAS | | | Leaf Area Index at 6WAS | | |
|---|---|---|---|---|---|---|
| | 2018 | 2019 | Combined | 2018 | 2019 | Combined |
| Poultry Manure (M)($tha^{-1}$) | | | | | | |
| 0 | 8.00b | 11.00b | 9.36b | 0.49b | 1.33 | 0.91b |
| 2 | 11.00a | 13.00ab | 12.07a | 0.79a | 1.75 | 1.27a |
| 4 | 13.00a | 13.00ab | 12.89a | 0.97a | 1.45 | 1.21ab |
| 6 | 14.00a | 14.00a | 14.04a | 0.84a | 1.22 | 1.03ab |
| SE± | 0.970 | 1.013 | 0.701 | 0.095 | 0.210 | 0.115 |
| Cow Dung (D)($tha^{-1}$) | | | | | | |
| 0 | 11.00 | 14.00 | 12.03 | 0.66 | 1.47 | 1.07 |
| 10 | 13.00 | 12.00 | 12.42 | 0.82 | 1.94 | 1.01 |
| 20 | 11.00 | 12.00 | 11.83 | 0.83 | 1.65 | 1.24 |
| SE± | 0.840 | 0.877 | 0.607 | 0.082 | 0.182 | 0.100 |
| Interactions | | | | | | |
| M x D | NS | NS | NS | NS | NS | NS |

Means followed by the same letter(s) within a treatment group and year are not significantly different at 0.05 level of probability using DMRT. NS= Not significant, WAS= Weeks after sowing

There was significant increase in vine length in both years and fruit length in 2019 with poultry manure application (Table 2). In 2018, increase in poultry manure from 0 – 4 t $ha^{-1}$ resulted in a corresponding increase in the vine length but further increase to 6 t $ha^{-1}$ resulted in statistically similar mean. Application of 4 t $ha^{-1}$ of poultry manure resulted in longer vine and fruit in 2019 when compared to the control. Application of cow dung had no significant effect on the cucumber vine and fruit length. Likewise, neither was the interaction between the treatments significant in the two years. The combined analysis showed significant differences only on vine length where, increase in poultry manure from 0 – 4 t $ha^{-1}$ significantly increased vine length. Further increase in poultry manure to 6 t $ha^{-1}$ resulted in non-significant differences in vine length of cucumber.

Table 2: Effect of organic manures on vine length and fruit length of cucumber

| Treatments | Vine length (cm) at 6WAS | | | Fruit length(cm) | | |
|---|---|---|---|---|---|---|
| | 2018 | 2019 | Combined | 2018 | 2019 | Combined |
| Poultry Manure(M)(tha$^{-1}$) | | | | | | |
| 0 | 38.07c | 72.30b | 55.19c | 14.59 | 16.01b | 15.30 |
| 2 | 60.11b | 86.74ab | 73.43b | 15.23 | 17.16ab | 16.19 |
| 4 | 75.16a | 99.25a | 87.20a | 14.34 | 17.51a | 15.92 |
| 6 | 80.80a | 108.70a | 94.75a | 14.52 | 17.10ab | 15.81 |
| SE± | 4.432 | 8.461 | 4.860 | 0.708 | 0.452 | 0.420 |
| Cow Dung (D)(tha$^{-1}$) | | | | | | |
| 0 | 62.27 | 97.62 | 79.94 | 14.67 | 16.99 | 15.83 |
| 10 | 68.53 | 91.49 | 80.01 | 14.51 | 17.08 | 15.79 |
| 20 | 59.80 | 86.14 | 72.97 | 14.82 | 16.77 | 15.79 |
| SE± | 3.838 | 7.327 | 4.136 | 0.613 | 0.392 | 0.364 |
| Interactions | | | | | | |
| M x D | NS | NS | NS | NS | NS | NS |

Means followed by the same letter(s) within a treatment group and year are not significantly different at 0.05 level of probability using DMRT. NS= Not significant, WAS= Weeks after sowing

Cucumber yield (Table 3) was significantly affected by poultry manure and cow dung rates only in 2018. Poultry manure applied at 2 t ha$^{-1}$ significantly increased yield but further increase to higher rates resulted in statistically similar means. Application of cow dung significantly increased yield at 20 t ha$^{-1}$ than the control but similar to 10 t ha$^{-1}$. The combined analysis showed significant increases only with application of poultry manure where 2 t ha$^{-1}$ significantly increased yield, but application of higher poultry manure rates resulted in no significant yield differences. No significant interaction was recorded between the treatments on yield of cucumber.

Table 3: Effect of organic manures on yield (kg ha$^{-1}$) of cucumber

| Treatments | 2018 | 2019 | Combined |
|---|---|---|---|
| Poultry Manure (M)(tha$^{-1}$) | | | |
| 0 | 1140b | 1895 | 1517.7b |
| 2 | 2424a | 2827 | 2625.8a |
| 4 | 2977a | 3176 | 3076.4a |
| 6 | 3009a | 3037 | 3023.1a |
| SE± | 294.1 | 431.6 | 261.11 |
| Cow Dung (D)(tha$^{-1}$) | | | |
| 0 | 1933b | 2931 | 2431.7 |
| 10 | 2262ab | 2424 | 2342.6 |
| 20 | 2969a | 2847 | 2908.0 |
| SE± | 254.7 | 373.8 | 226.14 |
| Interactions | | | |
| M x D | NS | NS | 226.14 |

Means followed by the same letter(s) within a treatment group and year are not significantly different at 0.05 level of probability using DMRT. NS= Not significant, WAS= Weeks after sowing

The correlation matrix on Table 4 showed that fruit length and leaf area index were highly significant and positively correlated with the cucumber yield. The vine length was not significantly correlated with the yield and fruit length. While leaf area index was negative and not significantly correlated with fruit length.

Table 4: Correlation among parameters measured at Samaru in 2019 rainy season

| | Yield | Fruit Length | Vine Length | Leaf Area Index |
|---|---|---|---|---|
| Yield | 1 | | | |
| Fruit Length | 0.53053** | 1 | | |
| Vine Length | 0.23776$^{NS}$ | 0.8499 $^{NS}$ | 1 | |
| Leaf Area Index | 0.41663* | -0.07373 $^{NS}$ | 0.11993 | 1 |

## DISCUSSION

There were significant increases recorded on number of leaves, leaf area index, vine length, fruit length and yield when poultry manure was applied. This could be due to improvement in nutrient status of the soil as savanna soils are poor in inherent fertility arisen from leached, low in organic matter content, low CEC and have a poor buffering capacity (Lombin, 1987). This observation is in agreement with the findings of Henry (2000) who noted that the beneficial effects of organic matter in unfertile soils consist of supplying lots of nitrogen and sulphur which improves plant growth. Increases as a result of manure applied could also be attributed to the nutrients released from mineralization of the organic matter (Aduloju *et al*., 2010; Dada and Fayinminnu, 2010; Sodimu, 2020). The incorporation of poultry manure into the soil builds up soil organic matter which consequently raises the humus content of the soil as well as compensate for the continuous humus mineralization which in turn improves the soil's nutrient storage capacity and availability to plants (Luka *et al*., 2019 and Johannes, 2013). A similar research carried out on cucumber by Sodimu (2020), also reported significant increases in number of leaves, leaf diameter, vine length, number of flowers per plant and yield with application of poultry manure. Year 2019 was significantly better than 2018 which could probably be because animal waste increases soil organic matter, nitrogen and cation exchange significantly (Mbah and Mbagwu, 2006). This agrees with the findings of Ewulo *et al*. (2007) who stated that application of cow dung between 0 to 10tha$^{-1}$ increased the availability of N, P, K and Ca to the soil leading to increase pH.

Year 2019 showed significantly better results than in the first (2018). This could be associated with the slow-release nature of the organic manures as nutrients are released to crops only after been broken down by microbial activity. Additionally, the duration of nutrient release may take a long time as microbial activity may be driven by soil moisture availability, temperature among other factors (Guodong *et al.,* 2018). Longer fruits and higher yield recorded in the second year could be associated with increase in leaf area index which increased the surface area for solar radiation interception which consequently increased production of assimilates and the overall crop yield.

No significant interaction was recorded between the treatments throughout the trial, and this could mean that the two manures (Poultry and cow dung) are independent and not influenced by each other (Murray, 2018).

## CONCLUSION

Cucumber responded significantly to poultry manure application while cow dung manure however resulted in non-significant differences between the control and higher rates applied. It can therefore be concluded that cucumber production in Samaru Northern Guinea Savanna of Nigeria can be done using 2 t $ha^{-1}$ of poultry manure.

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Appendix i: Meteorological data showing mean monthly rainfall temperature and relative humidity at Samaru during 2018 rainy season

| Month | Rainfall (mm) | Temperature ($^0$C) | | Relative humidity (%) |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| July | 182.1 | 20.6 | 28.8 | 76.6 |
| August | 259.7 | 20.1 | 27.8 | 79.8 |
| September | 108.5 | 20.1 | 31.2 | 73.6 |
| October | 22.0 | 19.3 | 33 | 65.5 |

Source: Meteorological Unit, Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria

Appendix ii: Meteorological data showing mean monthly rainfall temperature and relative humidity at Samaru during 2019 rainy season

| Month | Rainfall | Temperature | | Relative humidity |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| July | 314.2 | 22.8 | 28.8 | 78.1 |
| August | 243.2 | 22.2 | 28.3 | 81.2 |
| September | 237.4 | 23.0 | 30.4 | 73.4 |
| October | 217.4 | 22.5 | 29.8 | 76.4 |

Source: Meteorological Unit, Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria