Biological and Environmental Sciences Journal for the Tropics
Volume 21, Number 3, December 2024. Pp 258 - 264
https://dx.doi.org/10.4314/bestj.v21i3.25

Research article

Effects of Different Levels of Poultry Manure and Rice Straw Ash on Growth and Yield of Cucumber (*Cucumis sativus* .L)

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Submission: 05/10/2024
Accepted: 31/12/2024

Abstract
Poultry Manure and rice straw ash were used in an experiment whose aim was to determine their effect on the growth and yield of cucumber. The research was conducted during the 2021 dry season beside the insect net house of the Centre for Dryland Agriculture Bayero University Kano, (11^{o}58N,8^{o} 25E and 475m above sea level) in Sudan Savanna agro-ecological zone of Nigeria) The treatments consisted of one variety of cucumber (LIBERO F1) and four levels of poultry manure (0, 3, 6, 9 tons ha^{-1}) and rice straw ash (0, 3, 6, 9 tons ha^{-1}). The experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications. The treatments were applied before sowing during land preparation. Data were collected on plant height, number of leaves, number of branches, number of fruits, fruit length, fruits weight per plant and fruit yield. The data was subjected to analysis of variance (ANOVA) using Genstat software (2014) at 5% level of probability. The results showed that all the growth and yield parameters assessed significantly increased with increase in the application of both poultry manure and rice straw ash compared to the control in both cases. Application of poultry manure at 9 tons ha^{-1} is recommended for use in the study area for better growth and yield of cucumber. Similarly, where rice straw ash is to be used, application of 9 tons ha^{-1} is recommended for enhanced yield of cucumber.
Keywords: Poultry Manure, Rice Straw Ash, Cucumber, Growth, Yield

Introduction

Cucumber (*Cucumis sativus* L.) is an ancient annual vegetable belongs to the family Cucurbitaceae (Eifediyi and Remison 2010). Cucumber originated from an area in India between the Himalayas and the Bay of Bengal, and its cultivation started about 3000 years ago (Adetula and Denton, 2011),C and is the fourth important vegetable crop in Asia (Eifediyi and Remison 2010). The five highest producing states in Nigeria are; Plateau, Kaduna, Katsina, Kano and Benue (Bernard and Yaduma, 2021). Cucumber is naturally perishable and succulent and is eaten as a salad or when cooked (Anonymous 2013). It can also be put in vinegar; the crop serves as a major source of vitamins for people in developing countries. The cucumber controls hypertension in human body and also resolving kidney problems when eaten on regular basis (Vimala *et,al.*, 2014).

Fertile soils are used for the cultivation of cucumber; infertile soils result in bitter and misshapen fruits which are often rejected by consumers. Bush fallowing has been an efficient, balanced and sustainable agricultural system for soil productivity and fertility restoration) but as a reslt of increase in the population, the fallowing periods have decreased from ten years to three years and this has had an adverse effect on the fertility restoration leading to poor yields of crops. Therefore, the use of external input in the form of poultry litter-yard manures and other fertilizer has become imperative (Njoku *et al.*, 2017).

Ash is the substance that remains after any material has been burned. The application of ash to farm land after recycling has been one effective way to improve the physical, chemical and microbiological properties of soil (Njoku *et al.*, 2017). In Northern Nigeria, it is observed that the farmers engaged the practice of burning and applying burnt ash on their farms which they believe enhance the fertility of the soil for farming purposes since soil fertility maintenance is the major concern in the tropics (Enujeke *et al.*, 2013).

Organic fertilizers such as poultry manure can therefore be used to reduce the number of toxic compounds such as nitrate produced by conventional fertilizers. Hence improving the quality of vegetables as well as human health. Also, it will be possible to lessen the escalating effects of disease such as cancer. Preliminary study by (Alfred, 2017) has revealed that farmers adopt the practice of burning rice husk on the field after harvesting and use the ash as organic manure for soil treatment. Rice straw ash might further increase soil fertility. Optimum use of suitable soil, use of organic sources of fertilization and good agronomic management will ensure improved productivity and enhanced farmers' livelihoods (Bernard and Yaduma, 2021) Less use of inorganic fertilizer and pesticides will lessen the negative impact on soil fertility. Hence, the study was designed to determine the optimum levels of poultry manure and rice straw ash that will give higher productivity of cucumber in the study area.

Materials and methods

Field experiment was conducted during the 2021 dry season at the Centre for Dry Land Agriculture and Research Farm, Bayero University Kano, located at the latitude 11.59 N and longitude 08 25 E of the equator at 466 m above sea level in Sudan Savannah zone of Nigeria. The treatments consist of three levels of poultry manure at the rate of (0kg, 0.3 kg, 0.6kg, 0.9kg per plot respectively). The poultry manure was sourced from poultry unit of CDA farm. Rice straw was obtained from agricultural research centre, Bayero university and was burn down using a lighter to get the ash, and also three levels of rice straw ash at the rate of 0kg, 0.3kg, 0.6kg, 0.9kg per plot were prepared. Cucumber variety LIBERO F1 was obtained from Technisem Seeds Company at Kano. The experiment was laid out in a Randomized Complete Block Design with three replications. The plot size measured 1m x 1m ($1m^2$) giving 4 plots for poultry manure and 4 plots for rice straw ash. This gave a total of 8 plots per replication and a total of 24 plots for the whole treatments. A space of 1.5 m was allowed between the replications and 0.5 m between the treatment plots. Poultry manure and rice straw ash was applied during land preparation as per treatment. No pesticides or herbicide was used. Data were collected on plant height, number of leaves, number of branches, number of fruits, fruit length, fruits weight per plant and fruit yield per hectare. The data generated were subjected to analysis of variance (ANOVA) using Genstat software (2014) least significant difference (LSD) was used to compare treatment means at 5% level of significance.

Results and Discussion

Plant Height (cm)

The effect of poultry manure and rice straw ash on plant height indicated that rice straw and poultry manure significantly influenced the plant height of cucumber (Table 1). At 3 WAS no significant difference was observed but at 6 WAS poultry manure at 9 tons ha^{-1} recorded the tallest plants compared to other treatments and the control. This is consistent with the findings and reports of Adekiya and Ojeniyi (2002) and Ewulo *et al.,* (2008) which attributed increased growth of crop plants to the release of more nutrient elements through the moisture that has been made available by the manure. Poultry manure released essential elements which promoted high photosynthetic activities that enhanced growth and yield of watermelon (John *et al.,* 2004).

Number of Leaves per Plant

Poultry manure and rice straw ash significantly influenced the number of leaves per plant on both sampling periods (Table 2). At 3 WAS rice straw ash at 9 tons ha^{-1} recorded the higher number of leaves while poultry manure at 3 tons ha^{-1} was the least. At 6 WAS however, rice straw ash at 6 tons ha^{-1} were statistically at par and while poultry manure at 9 tons ha^{-1} recorded the higher number of leaves per plant compared to the other treatments and the control.

Similar observation made by (Henry 2000) that the beneficial effects of organic matter in unfertile soils consist of supplying lots of nitrogen and sulphur which improves the quality of leaves. The cause of maximum numbers of leaves plant per plant might be the organic manure; it made the soil more fertile and favourable for plant growth. Poultry manure contains nitrogen which boosts the growth of the plant. Mangila *et al.* (2017) and Enujeke *et al.* (2013) revealed that poultry manure contained more nutrients, which improved the physical condition of soil for plant growth and development. High concentration of nitrogen present in poultry manure leads to luxuriant plant growth compared to other treatments (Agbede *et al.,* 2008; Ewulo *et al.,* 2008).

Number of Branches per Plant

Table 3 shows the number of branches per plant and indicated that at 3 WAS there was no

significant differences, but at 6 WAS poultry manure at 3 tons ha^{-1} recorded higher number of branches per plant compared to other treatments and the control. The results corroborate the findings of Njoku *et al.l* (2017) who reported increased number of branches of cucumber treated different levels of poultry manure and Dauda *et al.* (2018), who also reported similar increase in number of branches in water melon treated with 20t of poultry manure.

Table 1. Effect of Poultry Manure and Rice Straw Ash on Plant Height (cm) of Cucumber at CDA-BUK in 2021

	Weeks After Sowing (WAS)	
Treatments	3WAS	6WAS
Poultry Manure (tons ha^{-1})		
0	10.03[a]	46.0[d]
3	10.10[a]	81.9[b]
6	9.97[a]	86.5[b]
9	10.10[a]	113.2[a]
Rice Straw Ash (tons ha^{-1})		
0	10.03[c]	46.0[d]
3	11.70[b]	51.6[c]
6	9.80[d]	63.2[b]
9	12.53[a.]	75.1[a]
SE+	2.641	6.831

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Table 2. Effect of Poultry Manure and Rice Straw Ash on Number of Leaves of Cucumber at CDA-BUK in 2021

	Weeks After Sowing (WAS)	
Treatments	3WAS	6WAS
Poultry Manure (tons ha^{-1})		
0	3.406[c]	22.80[c]
3	6.133[b]	22.30[c]
6	7.567[a]	32.77[b]
9	6.200[b]	44.00[a]
Rice Straw Ash (tons ha^{-1})		
0	6.567[c]	22.80[b]
3	6.767[b]	24.47[b]
6	7.100[a]	40.33[a]
9	7.600[a]	42.67[a]
SE+	0.612	3.090

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Table 3. Effect of Poultry Manure and Rice Straw Ash on Number of Branches of Cucumber at CDA-BUK in 2021

	Weeks After Sowing (WAS)	
Treatments	3WAS	6WAS
Poultry Manure (tons ha^{-1})		
0	3.000^{a}	13.52^{d}
3	3.100^{a}	39.13^{a}
6	4.200^{a}	26.50^{c}
9	3.133^{a}	36.33^{b}
Rice Straw Ash (tons ha^{-1})		
0	4.00^{a}	13.52^{c}
3	4.100^{a}	16.57^{c}
6	3.667^{a}	30.10^{b}
9	3.733^{a}	26.53^{b}
SE+	0.553	2.652

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Number of Fruit per Plant

The effect of rice straw ash and poultry manure on the number of fruits per plant is show in Table 4, where the number of fruits per plant was found to have significantly increased with the increases of Poultry manure and rice straw ash. The application of poultry manure at 9 tons ha^{-1} recorded the higher number of fruits per plant while control recorded the least. Similarly, application of rice straw ash at 9 tons ha^{-1} also recorded the higher number of fruits per plant compare to other treatments and the control. Enujeke *et al* (2013) revealed that higher level of poultry manure as a rich source of nutrients, significantly increased fruit number and fruit length. Similar findings was obtained by Khan *et al.* (2017) who reported increased number of fruits per plant of cucumber under different levels of poultry manure. Also, the findings of Oke *et al.* (2020) revealed significant increase in the number fruits per plant with application of different levels of poultry manure to cucumber.

Table 4. Effect of Poultry Manure and Rice Straw Ash on Number of Fruits per Plant of Cucumber at CDA-BUK in 2021

Treatments	Mean
Poultry Manure (tons ha^{-1})	
0	4.00^{c}
3	7.00^{c}
6	12.667^{ab}
9	13.000^{a}
Rice Straw Ash (tons ha^{-1})	
0	4.00^{d}
3	5.333^{c}
6.	6.000^{b}
9	9.000^{a}
SE+	1.622

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Fruit Length (cm)

The result in Table 5 showed the effects of poultry manure and rice straw ash on cucumber, where the application of poultry manure at 6 and 9 tons ha^{-1} were statistically at par and significantly higher than the control in cucumber fruit length. The control recorded the shortest fruit lengths among the treatments. Similar observation was made by Khan *et al.* (2017) who reported increased fruit diameter and fruit length of cucumber supplied with different levels of poultry manure. Also, Oke *et al.* (2020) discovered that cucumber fruit lengths increased significantly with increase in poultry manure application.

Table 5. Effect of Poultry Manure and Rice Straw Ash on Fruits Length (cm) of Cucumber at CDA-BUK in 2021.

Treatments	Mean
Poultry Manure (tons ha^{-1})	
0	27.13^{c}
3	28.33^{b}
6	30.27^{a}
9	29.10^{a}
Rice Straw Ash (tons ha^{-1})	
0	17.13^{c}
3	25.67^{b}
6	28.87^{a}
9	28.73^{a}
SE+	1.442

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Fruit Weight (g) per Plot

The fruit weight per plot as influence by poultry manure and rice straw ash indicated that poultry manure applied at 9 tons ha^{-1} was found to significantly influence the fruit weight per plot (Table 6), and also recorded the heaviest fruit per plant compared to the control. Dauda, *et al*. (2018) noted that high poultry manure level, which is a rich source of nitrogen, phosphorus, magnesium and calcium, increased the fertility of the soil and led to increased in the fruit weight. The increase in average fruit weight might be due to the high concentration of nutrients in poultry manure level which boost up the growth and yield.

Table 6. Effect of Poultry Manure and Rice Straw Ash on Fruits Weight (g) per Plot of Cucumber at CDA-BUK in 2021.

Treatments	Mean
Poultry Manure (tons ha^{-1})	
0	760^{d}
3	2278^{c}
6.	3533^{b}
9	4372^{a}
Rice Straw Ash (tons ha^{-1})	
0.	560^{d}
3	1227^{c}
6.	1780^{b}
9	3035^{a}
SE+	282.4

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Fruit Yield (kg ha^{-1})

Table 7 presents the effect of poultry manure and rice straw ash on fruit yield ha^{-1} where it was observed that it significantly increased the yield of cucumber. The application of poultry manure and rice straw ash at 3, 6, 9 tons ha^{-1} recorded significant higher fruit yield per hectare, compared with the control. Aliyu (2010) reported higher rates of poultry manure resulted in higher yield of eggplant. High rates of poultry manure improve moisture availability which results in improved nutrient release to plants for increased growth and yield (Adekiya Ojeniyi, 2014). Poultry manure increased plant N, P, K, Ca and Mg status in leaf of Sorghum (Agbede *et al*. 2008). According to the latter report, the manure was found to increase plant height, leaf area, stem diameter, number of roots, shoot weight and grain weight.

Improvement of soil properties as result of application of Rice straw ash resulted in increase in the yield of cucumber. Similarly, Mbah et al. (2017) observed higher yield of cucumber with increase of the hardwood bio char applied. Also this result agrees with the findings of Eifediyi and Remison (2010) who observed that ash waste can improve the growth and yield of cucumber.

Dauda *et al*. (2018) working on water melon, attributed the vigorous growth and increased fruit yield with increased application of poultry manure which led to increased supply of nutrient elements associated with high photosynthetic activities resulting in higher growth and increased yield. However, yield of cucumber as affected by bio char, wood ash and rice husk dust application in soil amendment improved soil chemical properties in Abakaliki South eastern Nigeria and that the application of wood ash recorded the highest cucumber yield when compared to the yield obtained in the application of bio char and rice husk dust (Njoku *et al*., 2017).

Table 7. Effect of Poultry Manure and Rice Straw Ash on Fruits Yield (kg) per Hectare of Cucumber at CDA-BUK in 2021.

Treatments	Mean
Poultry Manure (tons ha^{-1})	
0	7603^{e}
3	22783^{b}
6	35333^{b}
9	43717^{a}
Rice Straw Ash (tons ha^{-1})	
0	6603^{d}
3	12267^{c}
6	17800^{b}
9.	30350^{a}
SE+	2823.5

Mean in the same column, having the same letters are do not have significant difference at p=0.05 using student Newman Keuls test. WAS= weeks after sowing

Conclusion

Application of poultry manure and rice straw ash significantly increased the growth and yield indices of cucumber. The application of poultry manure at 9 tons ha^{-1} gave highest yield compared to other levels and the control. The higher the levels of poultry manure and rice straw ash applied, the greater the increases in plant height, erect stemming and good branching, as well as fruits yield of the crop. Fruit yield was however found to be significantly higher with application of poultry manure compared to the rice straw ash which in turn yielded higher than the control.

Recommendations

Based on the findings of this research, the following recommendations are made:

1. Application of 9 tons ha^{-1} of poultry manure is recommended for higher yield of cucumber in the study area.
2. Similarly, where rice straw ash is to be used, application of 9 tons ha^{-1} is also recommended for higher cucumber yield.
3. More research should be carried out with other levels of poultry manure and rice straw ash in order to determine their potential.

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