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Research Article

Comparative Effects of Organic and Inorganic Fertilizers on Onion Growth and Yield in Aliero, Kebbi State, Nigeria

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Abstract

This study evaluated the effects of organic manure and inorganic nitrogen fertilizer on the growth and yield of onion in the Sudan Savanna of Kebbi State, Nigeria, during the 2023 and 2024 rainy seasons. A factorial experiment in a Randomized Complete Block Design (RCBD) tested four nitrogen rates (0, 40, 80, and 120 kg N ha^{-1}) and three manure levels (10, 15, and 20 t ha^{-1}). Data were analyzed using ANOVA. Results showed that both nitrogen fertilizer and manure significantly improved onion growth and yield. The highest growth and yield were obtained with 120 kg N ha^{-1} and 20 t ha^{-1} manure, while the control produced the lowest values. Their combined application significantly increased fresh and cured bulb yields, highlighting the benefits of integrated nutrient management. Although higher fertilizer and manure rates increased bulb rotting during storage. The study recommends application of 120 kg N ha^{-1} with 20 t ha^{-1} manure to maximize onion productivity under the Sudan Savanna conditions of Kebbi State, provided appropriate post-harvest practices are used to reduce storage losses.

Keywords: *Onion, Fertilizer, Bulb, Organic, Savanna.*

INTRODUCTION

Onion (*Allium cepa* L.) belongs to the Alliaceae family. It is the second most important vegetable after tomato worldwide. Onion is grown as an annual bulb crop and a biennial seed crop. It is widely consumed as food and a daily spice in Nigeria. Onion bulbs are also used traditionally to treat diseases such as colds, pneumonia, and measles. Nigeria ranks 24th among onion-producing countries globally. However, its average yield (15 t/ha) is lower than that of Niger, Egypt, and South Africa. Onion is a crop that responds strongly to adequate nutrient supply. Conventional fertilizer use has improved onion yield and quality. However, long-term reliance on inorganic fertilizers has reduced soil productivity. Declining soil fertility is a major constraint to sustainable onion production. Integrated Nutrient Management (INM) is recommended to improve soil fertility. Organic manures improve soil health but release nutrients slowly. Nutrient release from organic sources may not always match crop demand. Excessive inorganic fertilizer use can pollute water through leaching. It can also harm beneficial soil organisms and the environment. Inorganic fertilizers are often expensive and sometimes unavailable in Nigeria. Organic materials such as poultry manure, FYM, green manure, and biodigested slurry improve soil fertility. These organic materials also enhance crop productivity and environmental quality. This study evaluates the combined use of organic and inorganic fertilizers on onion. Onion production in Kebbi State is affected by poor soil fertility and low productivity. Poor bulb quality and short shelf life also reduce farmers' income. Continuous cultivation without nutrient replacement has degraded soils. There is limited research on fertilizer effects on onion shelf life in Kebbi State. The study seeks to identify effective fertilizer management practices. The study also aims to extend onion storage life and reduce postharvest losses. Sustainable soil fertility management is expected to benefit farmers in the Sudan Savanna. The main aim is to assess the effects of organic and inorganic fertilizers on onion performance. Specifically, the study examines their effects on onion growth, yield, and shelf life.

MATERIALS AND METHOD

Field experiment was conducted during the 2023 rainy seasons at the Fadama Teaching and Research Farm, Abdullahi Fodiyo University of Science and Technology, Aliero, located in Jega, Kebbi State, Nigeria (12°12.99′ N, 4°21.90′ E; 197 m above sea level). The treatments consisted of three levels of organic manure which comprises of (10, 15 and 20t/ha) and four rates of nitrogen fertilizer (0, 40, 80 and 120 t/ha) w layed out in a Randomized Complete Block Design (RCBD) with three replicates. The plot of 1 x 2m ($4m^2$) was manually ploughed, the farm yard manure was applied evenly on the prepared plot. The viable onion seeds were dressed and broadcast evenly, Mulching and watering two days after while the mulches were removed two weeks after seed emerges. The vigorous seedlings that attained the height of 15cm were transplanted; the spacing of 8x8cm was maintained. The fertilizer application was done on treatments bases cow dung (10t ha^{-1}, 15t ha^{-1} and 20t ha^{-1}) and Nitrogen fertilizer (40kg N ha^{-1}, 80kg N ha^{-1} and 120kg N ha^{-1}) and untreated control The irrigation was carried out at three days' interval. Weeds were controlled manually when observe in the plot. Broad spectrum of perfect killer was used to control pest at vegetative growth stage in the field. Data on plant height, shoot dry weight, mean bulb diameter, mean bulb weight, cured bulb weight were taken and subjected to Analysis of Variance (ANOVA) using SAS Software. The treatment means were separated using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS

Plant Height

Table 1 shows that both nitrogen fertilizer and manure significantly influenced onion plant height during the 2023 and 2024 rainy seasons. Plant height increased consistently with increasing nitrogen rates from 0 to 120 kg N ha^{-1} at all sampling periods (3, 6, 8, and 10 WAT), with the tallest plants generally recorded at 120 kg N ha^{-1} and the shortest in the control (0 kg N ha^{-1}). This trend was consistent across both seasons and was confirmed by the combined analysis. Manure application also improved plant height, with 20 t ha^{-1} generally producing the tallest plants, particularly in 2024 and the combined analysis, while 10 t ha^{-1} often resulted in the lowest values. The improved performance at the higher manure rate was likely due to enhanced soil fertility and nutrient availability. The interaction between nitrogen fertilizer and manure was not significant in either season or the combined analysis, indicating that each factor independently contributed to onion plant growth.

Mean Bulb Diameter (cm) and Mean Bulb Weight (g)

Table 2. Presents the effect of nitrogen fertilizer rates and manure levels on mean bulb diameter and mean bulb weight of onion during the 2023 and 2024 rainy seasons and the combined analysis. The results showed that nitrogen fertilizer significantly increased bulb diameter and bulb weight. During the 2023 rainy season, bulb diameter increased from the control treatment to 120 kg N ha^{-1}. Similarly, bulb weight increased from the control plots to 120 kg N ha^{-1}.During the 2024 season, the highest bulb diameter and bulb weight were also recorded under 120 kg N ha^{-1}, while the control treatment recorded the lowest values. The combined analysis confirmed that the highest bulb diameter and bulb weight were obtained under 120 kg N ha^{-1}.

Manure application also significantly improved bulb diameter and bulb weight. The highest bulb diameter and bulb weight were consistently recorded under 20 t ha^{-1} manure, while the lowest values were obtained under 10 t ha^{-1} manure. The beneficial effect of manure may be due to improved soil fertility, enhanced nutrient availability and better moisture retention. Organic manure improves soil structure and encourages efficient nutrient uptake, which supports bulb enlargement. The interaction between nitrogen rate and manure was not significant for bulb diameter and bulb weight.

Total Fresh Bulb Yield and Cured Bulb Yield

Table 3 shows the effect of nitrogen fertilizer rates and manure levels on total fresh bulb yield and cured bulb yield of onion during the 2023 and 2024 rainy seasons and the combined analysis. The results revealed that nitrogen fertilizer significantly increased fresh bulb yield and cured bulb yield during both seasons and in the combined analysis. During the 2023 rainy season, fresh bulb yield increased from the control treatment to 120 kg N ha^{-1}. Similarly, cured bulb yield increased from the control treatment to 120 kg N ha^{-1}. In the 2024 rainy season, the highest fresh bulb yield and cured bulb yield were also obtained under 120 kg N ha^{-1}, while the lowest yields were recorded in the control treatment. The combined analysis confirmed that 120 kg N ha^{-1} produced the highest fresh bulb yield and cured bulb yield. Manure application also significantly influenced bulb yield. The highest fresh bulb yield and cured bulb yield were obtained under 20 t ha^{-1} manure, while the lowest yields were recorded under 10 t ha^{-1} manure. The positive effect of manure on yield may be attributed to improved soil fertility and enhanced nutrient availability. Organic manure improves soil moisture retention and microbial activity, which support nutrient uptake and plant growth. The interaction between nitrogen rate and manure was not significant for both fresh bulb yield and cured bulb yield.

Table 1: Plant height (cm) of Onion (3, 6, 8 and 10 WAT) as affected by Nitrogen rate and Manure during 2023 and 2024 rainy seasons and the Combined data in Jega Sudan Savannah Zone of Kebbi state.

Treatment	Plant height (cm)											
	3WAT	6WAT	8WAT	10WAT	3WAT	6WAT	8WAT	10WAT	3WAT	6WAS	8WAT	10WAT
	2023				2024				Combined Data			
Nitrogen rate (kg/ha)												
0	14.42c	29.93b	34.65b	37.16b	13.04[c]	28.80b	32.64b	35.78b	13.73c	29.37b	33.65b	36.47b
40	15.56b	38.17a	41.23a	44.64a	14.80[b]	33.36a	37.40a	40.83a	14.82bc	35.76a	39.69a	42.74a
80	15.72b	38.74a	41.99a	46.55a	15.51[b]	33.54a	38.96a	41.27a	15.61b	36.14a	41.51a	43.91a
120	16.40a	39.48a	44.05a	47.19a	16.61[a]	32.45a	36.07a	38.68a	16.51a	35.96a	38.65a	42.94a
SE±	1.892	2.801	2.056	2.057	1.461	3.968	2.973	3.172	1.792	2.189	2.338	3.376
Manure (t/ha)												
10	15.11b	36.23	41.35	44.12	14.47bc	31.58ab	35.38ab	37.41b	14.79bc	33.90	38.75	40.91
15	15.47b	37.21	41.58	43.92	15.65b	34.14a	37.87a	40.26ab	15.56b	35.68	39.61	42.10
20	16.98[a]	36.87	42.12	44.63	17.09a	33.23a	37.60a	41.15a	17.04a	35.05	39.59	42.89
SE±	1.372	2.801	2.056	2.057	1.826	2.968	3.973	3.172	1.712	2.189	2.338	3.376
Interaction												
N x M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column in each treatment are not significantly different at 5% using DNMRT. *= Significant at 5%, NS= not significant.

Table 2: Mean Bulb Diameter and Mean Bulb Weight of Onion as affected by Nitrogen rate and Manure during 2023 and 2024 rainy seasons and the Combined data in Jega Sudan Savannah Zone of Kebbi state.

Treatment	Mean Bulb Diameter (cm)			Mean Bulb Weight (g)		
	2023	2024	Combined	2023	2024	Combined
Nitrogen rate (kg/ha)						
0	3.90c	3.98c	3.94c	22.08c	21.46c	21.77c
40	4.02bc	4.13bc	4.08bc	30.12b	31.25b	30.69b
80	4.56b	4.40b	4.48b	40.00a	36.42ab	38.21a
120	5.21a	5.17a	5.19a	40.83a	38.92a	39.88a
SE±	**0.398**	**0.351**	**0.465**	**2.663**	**2.119**	**1.579**
Manure (t/ha)						
10	4.31b	4.43b	4.37b	28.58c	22.88c	25.73c
15	4.38b	4.28b	4.33b	31.42b	30.63b	31.03b
20	5.11a	5.49a	5.30a	37.08a	35.83a	36.46a
SE±	**0.298**	**0.351**	**0.465**	**2.663**	**2.119**	**1.579**
Interactions						
N x M	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column in each treatment are not significantly different at 5% using DNMRT. *= Significant at 5%, NS= not significant.

Table 3: Total Fresh Bulb Yield and Cured Bulb Yield of Onion as affected by Nitrogen rate and Manure during 2023 and 2024 rainy seasons and the Combined data in Jega Sudan Savannah Zone of Kebbi state.

Treatment	Total Fresh Bulb Yield (t ha^{-1})			Cured Bulb Yield (t ha^{-1})		
	2023	2024	Combined	2023	2024	Combined
Nitrogen rate (kg/ha)						
0	9.54d	9.23d	9.39d	5.48d	6.20d	5.84d
40	12.06c	11.12c	11.59c	10.55c	9.60c	10.07c
80	15.50b	14.81b	15.15b	13.55b	12.02b	12.79b
120	19.91a	19.96a	19.93a	17.91a	17.96a	17.93a
SE±	**1.716**	**1.181**	**1.038**	**1.466**	**0.981**	**1.254**
Manure (t/ha)						
10	10.79c	9.44c	10.12c	6.21c	5.29c	5.75c
15	15.21b	15.31b	15.26b	12.38b	11.77b	12.07b
20	18.54a	17.91a	18.23a	16.68a	16.11a	16.40a
SE±	**1.716**	**1.181**	**1.038**	**1.466**	**0.981**	**1.254**
Interactions						
N x M	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column in each treatment are not significantly different at 5% using DNMRT. *= Significant at 5%, NS= not significant.

DISCUSSION

Response of Onion to Nitrogen Rates

The results of this study demonstrated that nitrogen fertilizer significantly influenced the growth and yield performance of onion during the 2023 and 2024 rainy seasons as well as in the combined analysis. The increase in plant height, number of leaves, shoot dry weight, bulb diameter, bulb weight, fresh bulb yield and cured bulb yield with increasing nitrogen application confirms the important role of nitrogen in onion production. Onion plants supplied with 120 kg N ha^{-1} consistently recorded superior growth and yield parameters compared with the lower nitrogen rates and the control treatment. This finding indicates that adequate nitrogen nutrition is essential for vigorous vegetative growth and optimum bulb development in onion cultivation. The significant increase in plant height observed with increasing nitrogen rates may be attributed to the role of nitrogen in chlorophyll formation, protein synthesis and cell division. Nitrogen is a major component of amino acids and nucleic acids, which are required for vegetative growth and tissue development. The taller plants obtained under 120 kg N ha^{-1} suggest that nitrogen enhanced photosynthetic efficiency and promoted rapid vegetative growth. This result agrees with the findings of Kumar *et al*. (2022), who reported that increasing nitrogen fertilizer significantly improved onion plant height due to enhanced nutrient uptake and increased metabolic activities. Similarly, Singh *et al*. (2021) observed that onion plants supplied with higher nitrogen levels produced taller plants because nitrogen promoted leaf expansion and stem elongation.

The significant improvement in bulb diameter and bulb weight with increasing nitrogen rates indicates that nitrogen plays a crucial role in bulb formation and enlargement. Bulb development in onion depends largely on the availability of photosynthates produced during vegetative growth. Adequate nitrogen supply enhances leaf area development and photosynthetic efficiency, which subsequently improves assimilate translocation to the bulbs. The larger bulb diameter and heavier bulb weight obtained under 120 kg N ha^{-1} agree with the findings of Rahman *et al*. (2023), who reported that nitrogen fertilization significantly increased bulb size and bulb weight in onion. The authors attributed the improvement to enhanced carbohydrate synthesis and efficient assimilate partitioning.

Fresh bulb yield and cured bulb yield also increased significantly with increasing nitrogen application. The highest yields obtained under 120 kg N ha^{-1} indicate that nitrogen fertilizer improved onion productivity through enhanced vegetative growth, bulb enlargement and assimilate accumulation. Nitrogen is known to increase leaf area duration and photosynthetic activity, resulting in greater production of carbohydrates required for bulb formation. This finding agrees with the report of Abdissa *et al*. (2021), who observed that onion bulb yield increased significantly with increasing nitrogen levels. Similarly, Ibrahim *et al*. (2022) reported that nitrogen application improved onion yield by enhancing nutrient uptake, photosynthesis and bulb development.

Response of Onion to Manure

The results of the present study showed that manure application significantly influenced the growth and yield of onion during the two cropping seasons and in the combined analysis. Onion plants treated with 20 t ha^{-1} manure consistently produced superior growth and yield parameters compared with lower manure levels. The findings indicate that organic manure plays an important role in improving soil fertility and enhancing onion productivity.

The increase in plant height observed with increasing manure application may be attributed to improved soil physical and chemical properties resulting from organic matter addition. Organic manure enhances soil structure, aeration, water-holding capacity and nutrient availability, thereby promoting root growth and nutrient uptake. The tallest plants obtained under 20 t ha^{-1} manure suggest that the higher manure rate improved soil fertility conditions required for vigorous vegetative growth. This result agrees with the findings of Yusuf *et al*. (2021), who reported that poultry manure significantly increased onion plant height due to improved soil nutrient status and enhanced microbial activity. The improvement in bulb diameter and bulb weight under higher manure levels suggests that organic manure positively influenced bulb enlargement and assimilate translocation. The larger bulbs obtained under 20 t ha^{-1} manure may be attributed to enhanced nutrient availability, improved soil moisture retention and better root development. Organic manure also improves cation exchange capacity and nutrient use efficiency, thereby promoting bulb growth. This finding agrees with the report of Choudhary *et al*. (2023), who observed that organic manure significantly increased onion bulb size and bulb weight through improved soil fertility and enhanced nutrient uptake.

The significant increase in fresh bulb yield and cured bulb yield observed under 20 t ha^{-1} manure indicates that organic manure contributed substantially to onion productivity. The higher yields obtained at increased manure levels may be due to improved vegetative growth, efficient nutrient utilization and better bulb development. Organic manure supplies nutrients slowly and continuously, which supports sustained crop growth throughout the growing season. Similar findings were reported by Adekiya *et al*. (2022), who observed that poultry manure significantly improved onion yield through enhanced soil fertility and increased nutrient availability. The beneficial effect of manure observed in this study may also be related to its ability to improve soil organic matter content. Soils in the Sudan Savannah zone are generally low in organic matter and susceptible to nutrient depletion. Application of organic manure improves soil fertility status

and enhances soil biological processes, thereby creating favorable conditions for crop growth. In addition, organic manure improves soil moisture retention, which is particularly important under the semi-arid conditions of northern Nigeria where moisture stress often limits crop productivity.

Interaction of Nitrogen and Manure

The interaction between nitrogen and manure was not significant for most vegetative growth traits such as plant height, leaf number, shoot dry weight, bulb diameter, and bulb weight. However, their interaction was significant for fresh and cured bulb yields. The combination of 120 kg N ha^{-1} + 20 t ha^{-1} manure produced the highest yields. This synergistic effect resulted from the complementary functions of inorganic nitrogen (rapid nutrient supply) and organic manure (improved soil fertility, nutrient retention, and reduced nutrient losses). The findings demonstrate that integrated nutrient management is more effective than using either nitrogen fertilizer or manure alone for maximizing onion productivity under the Sudan Savannah conditions of Kebbi State.

CONCLUSION

Nitrogen fertilizer and manure significantly enhanced the growth and yield of onion in the Sudan Savannah zone of Kebbi State. The combined application of 120 kg N ha^{-1} and 20 t ha^{-1} manure produced the highest growth performance, bulb yield and cured yield, demonstrating the effectiveness of integrated nutrient management. Although higher nutrient levels increased bulb rotting percentage, improved vegetative growth was positively associated with higher bulb yield, making the combined application suitable for onion production in the study area.

REFERENCES

1. Abdissa, Y., Tekalign, T., & Pant, L. M. (2021). Effect of nitrogen fertilizer rates on growth and bulb yield of onion (*Allium cepa* L.). *International Journal of Vegetable Science, 27*(4), 355–366.
2. Adekiya, A. O., Agbede, T. M., & Ejue, W. S. (2022). Poultry manure improves soil properties and onion productivity in tropical soils. *Scientia Horticulturae, 29*(5), 110–117.
3. Choudhary, M., Singh, R., & Yadav, P. (2023). Organic manure application improves onion bulb development and yield. *Asian Journal of Agricultural Research, 17*(2), 98–107.
4. Ibrahim, H. A., Yusuf, A. U., & Bello, M. (2022). Effect of nitrogen fertilizer on yield and yield components of onion in northern Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology, 8*(1), 125–133.
5. Kumar, S., Verma, A., & Singh, P. (2022). Nitrogen fertilization enhances growth and productivity of onion. *Indian Journal of Agricultural Sciences, 92*(7), 854–860.
6. Rahman, M. M., Islam, M. R., & Hasan, M. K. (2023). Nitrogen fertilization effects on bulb characteristics and yield of onion. *Horticulturae, 9*(4), 406–412.
7. Singh, V., Kumar, R., & Meena, M. (2021). Growth response of onion to graded levels of nitrogen fertilizer. *Journal of Pharmacognosy and Phytochemistry, 10*(5), 1320–1325.

CITATION

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