Discovery Agriculture

Effects of organic amendment on growth and yield of onion (*Allium cepa* l.) in Bauchi State, Nigeria

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To Cite:
Muhammad SY, Abdulmumini BR, Sunday U. Effects of organic amendment on growth and yield of onion (*Allium cepa* l.) in Bauchi State, Nigeria. *Discovery Agriculture* 2026; 12: e6da3196 doi: https://doi.org/10.54905/disssi.v12i25.e6da3196

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Peer-Review History
Received: 29 October 2025
Reviewed & Revised: 12/November/2025 to 23/April/2026
Accepted: 30 April 2026
Published: 09 May 2026

Peer-Review Model
External peer-review was done through double-blind method.

Discovery Agriculture
pISSN 2347-3819; eISSN 2347-386X

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ABSTRACT

The research was conducted at Teaching and Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria during dry season of 2025 to determine the effects of various organic fertilizers on the performance of onions (*Allium cepa* L.). The treatments consisted of Poultry Manure, Cow Dung, Rice Husk, cowpea husk, Poultry Manure + cowpea husk, Poultry Manure + Cow Dung, Cow Dung + Rice Husk, Cow Dung + cowpea husk, and a control. These were arranged in a randomized complete block design (RCBD) replicated three times. Data on plant height, leaf number, plant diameter, bulb diameter, yield per plot, and yield per hectare were collected. Analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) were adopted for data analysis and mean separation. The result shows a significant ($P \leq 0.05$) effects of organic amendments on onion growth and yield parameters. The also revealed that, poultry manure application produced the tallest plants, highest number of leaves, thicker bulbs and higher yields (44.02 t/ha) than the other treatments and the control. Compost application improved plant girth, while integrated applications showed moderate benefits. This finding indicated that organic fertilizer, particularly poultry manure, improved the performance of onion and reduce dependence on synthetic fertilizers. Application of poultry manure as an effective, sustainable amendment for onion cultivation is recommended for the study area and similar agroecological conditions.

Keywords: Onion, Organic, Fertilizer, Growth, Yield.

1. INTRODUCTION

A globally important vegetable crop, onions (*Allium cepa L.*) are cultivated for their nutritional benefits (Sansan et al., 2024) and is crucial for both local economies and international trade. However, conventional onion farming depends heavily on synthetic fertilizers and pesticides, which often causes environmental menace, consisting of soil degradation, water pollution and biodiversity decline. Organic farming practices on the other hand, offers a sustainable alternative, improving soil health and biodiversity. One of the key components of organic farming is the application of organic fertilizers. Organic nutrients are materials derived from plant or animal sources that are added to the soil to improve its physical, chemical, and biological properties. Organic fertilizers include compost, farmyard and green

manure, cover crops and other organic residues. The use of organic fertilizers is a foundation of sustainable agriculture, due to their effects on soil fertility, improve water retention capacity and promoting healthy soil ecosystem. Increasing organic matter content of a soil provides essential nutrients, improve aggregate stability and beneficial microorganisms.

Apart from improvement of immediate soil conditions, organic amendments also contribute to the sustainably long-term agricultural systems. They help in carbon sequestration and mitigate climate change. Moreover, organic fertilizers enhance resistance to pests and diseases thereby reducing dependence on synthetic pesticides (Reddy & Rao, 2024). The application of organic fertilizers in the production of onion has shown a promising result. The crop thrive in soils with good structure, adequate nutrient availability, and a balanced microbial community (Wright, 2017). It has been reported that organic amendments can improve onion performance, enhance the nutritional benefits of the bulbs and reduce incidence of diseases. This study addresses the need for sustainable alternatives by investigating the impact of organic amendments on onion growth and yield. The problem is that the current practices may not be sustainable in the long term.

Despite importance of Onion (*Allium cepa* L.) in provision food and income to millions of households worldwide, its cultivation is constrained by low soil fertility and high costs of input (FAO, 2018). Over reliance on synthetic fertilizers can lead to environmental pollution, soil degradation and nutrient imbalance (Amos *et al*., 2015). Organic fertilizers such as poultry manure, cow dung, compost and green manures are the best alternative since they can improve soil structure, increase nutrient availability, improve microbial activity and sustainably long-term crop productivity. Organic amendments have been reported to improve onion performance, with poultry manure and compost taken the lead. However, effectiveness of organic fertilizers depends on type, rate of application, soil conditions and environmental factors. Therefore, there is a need to evaluate the effects of different organic amendments under local conditions to provide sustainable recommendations for farmers. This study was therefore aimed to evaluate how different organic fertilizers influence the performance of onions (*Allium cepa* L.).

2. MATERIALS AND METHODS

Location and Description of Experimental Site

A field trial was conducted during 2025 dry season at Abubakar Tafawa Balewa University Teaching and Research Farm, Bauchi state, Nigeria. The site is located at latitude 10°22 N; 9 °47 E and 1300 m. above sea level. The temperature fluctuates between 20° - 34.5°C. The soil type is sandy loam with a past cropping history of maize, sorghum, cowpea, millet, groundnut, soybeans etc. cropped in no particular order.

Treatments and Experimental Design

The treatments consisted of an onion variety (wape), and eight (8) different organic amendment (Poultry Manure, Cow Dung, Rice Husk, Cowpea husk, Poultry Manure + Cowpea husk, Poultry Manure + Cow Dung, Cow Dung + Rice Husk, Cow Dung + Cowpea husk) and a control. The treatments were combined and arranged in a randomized complete block design (RCBD) replicated three times. A plot size of 3 x 1.5m was adopted for the experiment, 0.5m was used as a boarder row between plots and 1m was left as a walk way between the replications. The plot was ploughed and harrowed before laying out of the experiment.

Cultural Practices

The land selected for raising seedlings was fine texture and well drained. The land was opened and dried. Large sized clods were broken into pieces and finally the soil was made loose, friable, until good tilth. All weeds and stubbles were removed and the soil was mixed with decomposed cow dung during final land preparation. The seedbed was 3 m × 1 m in size with a height of about 20 cm. Onion seeds were soaked overnight (twelve hours) in water. The onion seedlings were transplanted on the prepared plots, 1 seedling per hole with 15 cm intra-row spacing (between the plants) and 35cm inter-row spacing (between the rows). The plots were irrigated before transplanting and after transplanting at regular interval as required by the crop. Fertilizers were used in the experiment according to the treatment.

Weeding was done manually at two weeks' interval, in order to keep the experimental plot clean, to avoid competition with the crops. The onions were harvested at a maturity time, within the 125 – 140 days after sowing, as the plants tunned yellow wish with necrotic leaf tips couple in the neck of the onion and fall in more than 50% plants. The plants were up rooted from the net plot of each treatment separately and the yield parameters were taken from the ten randomly selected plants.

Data Collection

Data were collected from Ten (10) randomly tagged plants at bi-weekly interval at various growth stages of the plants on Plant height (cm), Number of leaves per plant, Plant Diameter, Bulb Diameter (mm), Bulb **yi**eld per plot (kg) and Bulb yield per hectare (Kg/ha).

Data Analysis

Analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) were adopted for data analysis and mean separation.

3. RESULTS & DISCUSSION

Plant Height

Effect of organic amendments on plant height is presented in Table 1. The results of the study indicated a significant (P≤0.05) difference among the treatments used with respect to plant height. The result further revealed that, application of Poultry Manure significantly (P≤0.05) produced the tallest plants at 8 and 10 WAT. The increase in plant height with the addition of poultry manure could be attributed to more availability of the nutrient which enhances protein synthesis which lead to increased accumulation of carbohydrates and this in turn, may have resulted in increased plant growth such as leaf number and leaf length (Rizk, 2012). The result of this finding is in line with the report of Nasreen *et al*. (2007) who reaffirmed that onion height increased in response to nitrogen fertilizer application. This result also aligns with that of Salami and Omotoso (2018), who observed that plants that received 20 tons/ha had the tallest plants compared to the control. Similarly, Mrema *et al*. (2022) reported a similar trend while studying effects of poultry manure on vegetables performance.

Table 1. Effect of Organic Amendments on Plant Height (cm) of Onions (*Allium cepa* L.)

	WAT			
Treatments	**4**	**6**	**8**	**10**
Control	25.10	35.50	39.73^{d}	45.53^{e}
Poultry Manure	27.30	34.87	57.07^{a}	59.90^{a}
Cow Dung	25.41	35.40	52.13^{b}	57.07^{ab}
Rice Husk	26.22	36.73	47.50^{bc}	48.17^{d}
Cowpea husk	25.00	35.00	44.57^{cd}	46.44^{de}
Poultry Manure + CH	25.22	34.21	45.33^{c}	45.00^{e}
Poultry Manure + Cow Dung	26.31	34.32	43.32^{cd}	47.65^{d}
Cow Dung + Rice Husk	25.02	35.20	53.44^{b}	56.63^{b}
Cow Dung + CH	26.00	36.11	48.32^{bc}	51.34^{c}
LS	NS	NS	**	**
SE (±)	17.28	3.741	4.270	3.479

Means followed by the same letter within the same column are not statistically different following DMRT. CH=Cowpea husk, LS= Level of Significance, SE=Standard Error, **= significance at 0.01, *=significance at 0.05 and NS= Not Significant

Number of Leaves

Effect of organic amendments on leaf number is presented in Table 2. The results revealed a significant (P≤0.05) difference among the treatments used with respect to leaf number. The result further revealed that, except at 10 WAT where significant difference exists, no significant difference was observed in respect to leaf number throughout the study period. The result also indicated that, poultry manure significantly (P≤0.05) produced higher leaf number than all other nutrient used. This indicated that manure application promotes luxuriant vegetative growth of crops. These findings corroborate the report of Khan *et al*. (2002), who reported a response of number of leaves to higher rates of poultry manure. Amos *et al*. (2015) also observed a similar response. This result is concordant with the findings of Kaushik (2017) who reported that highest leaf number per plant of onion was recorded with the highest addition of organic manure.

Table 2. Effect of Organic Amendments on Leaf Number of Onions (*Allium cepa* L.)

	WAT			
Treatments	**4**	**6**	**8**	**10**
Control	3.22	6.43	9.00	12.53[e]
Poultry Manure	3.03	6.34	9.37	17.23[a]
Cow Dung	3.64	6.01	9.37	15.07[ab]
Rice Husk	3.01	5.94	9.83	13.17[d]
Cowpea husk	3.45	6.00	9.57	14.44[de]
Poultry Manure + CH	3.22	6.21	9.33	14.00[e]
Poultry Manure + Cow Dung	3.04	6.32	9.32	13.65[d]
Cow Dung + Rice Husk	3.67	6.20	9.44	15.63[b]
Cow Dung + CH	3.45	6.11	9.32	13.34[c]
LS	NS	NS	NS	**
SE (±)	0.65	1.12	1.41	2.06

Means followed by the same letter within the same column are not statistically different following DMRT. CH=Cowpea, LS= Level of Significance, SE=Standard Error, **= significance at 0.01, *=significance at 0.05 and NS= Not Significant

Plant Diameter

Effect of organic amendments on plant diameter is presented in Table 3. The results as presented in Table 3 showed a significant (P≤0.05) effect of the treatments used with respect to plant diameter. The result further revealed that, except at 8 WAT where significant difference exists, no significant difference was observed in respect to plant diameter throughout the study period. The result also indicated that, application of poultry manure + cow dung significantly (P≤0.05) produced higher plant diameter than all other nutrient treatment used. This indicated that manure application promotes luxuriant vegetative growth of crops. This is inconformity with the findings of Shaheen *et al*. (2007), who affirmed that neck thickness is influenced by the combined application of organic and inorganic fertilizers.

Table 3. Effect of Organic Amendments on Plant Diameter of Onions (*Allium cepa* L.)

	WAT			
Treatments	**4**	**6**	**8**	**10**
Control	3.12	4.13	4.00[d]	5.93
Poultry Manure	3.53	4.34	5.57[b]	6.23
Cow Dung	3.64	3.71	4.37[c]	6.07
Rice Husk	2.91	3.94	4.13[d]	6.17
Cowpea husk	3.15	4.00	4.44[c]	6.44
Poultry Manure + CH	2.92	4.21	4.33[c]	6.00
Poultry Manure + Cow Dung	3.14	4.32	6.37[a]	6.65
Cow Dung + Rice Husk	3.17	3.90	5.32[b]	5.63
Cow Dung + CH	3.51	4.11	5.32[b]	6.34
LS	NS	NS	**	
SE (±)	0.65	0.32	0.42	0.65

Means followed by the same letter within the same column are not statistically different following DMRT. LS= Level of Significance, SE=Standard Error, **= significance at 0.01, *=significance at 0.05 and NS= Not Significant.

Bulb Diameter (cm)

Effect of organic amendments on Bulb diameter (cm) is presented in Table 4. The results revealed a significant (P≤0.05) difference among the treatments used. The result further revealed that, application of poultry manure significantly (P≤0.05) produced higher Bulb

diameter (cm) than all other nutrient treatment used with the mean of bulb diameter ranges from 5.03 to 2.28. This indicated that manure applications have positive impact on the growth and yield of onions. These results are in line with Negasi *et al*. (2017), who found that higher rates of poultry manure increased onion bulb diameter. Shaheen *et al*. (2007) also observed similar results.

Bulb Yield/Plot (kg)

Effect of organic amendments on yield per plot is also presented in Table 4. The results indicated a significant (P≤0.05) difference among the treatments used with respect to yield per plot. The result further revealed that, application of poultry manure significantly (P≤0.05) produced higher yield per plot than all other nutrient treatment used with the mean of yield per plot ranges from 17.97 to 13.86. This indicated that manure applications have positive impact on the growth and yield of onions. These results are similar to those of Lchi *et al*. (2020), who confirmed that the highest bulb yield was obtained from the highest rates poultry manure. Salami *et al.* (2018) also indicated that the control plots achieved lower total yields as compared to the higher nitrogen doses. Bua (2017) also observed a significant increase in total bulb yield in response to increased application of nitrogen.

Table 4. Effect of Organic Amendments on Bulb Yield of Onion (*Allium cepa* L.)

Treatments	Bulb Diameter (cm)	Yield/ Plot (kg)	Yield/ha (ton/ha)
Control	2.28^{g}	13.86^{e}	33.80^{e}
Poultry Manure	5.03^{a}	17.97^{a}	44.02^{a}
Cow Dung	4.20^{b}	17.20 ^{ab}	42.13^{ab}
Rice Husk	2.91^{ef}	15.70 ^{d}	38.46^{d}
Cowpea husk	4.54^{b}	16.64 ^{b}	40.76^{b}
Poultry Manure + CH	4.13^{c}	16.33^{bc}	40.00^{bc}
Poultry Manure + Cow Dung	3.96^{cd}	15.89 ^{cd}	38.92^{cd}
Cow Dung + Rice Husk	3.17^{e}	15.78^{c}	38.65^{c}
Cow Dung + CH	3.84^{d}	15.89^{cd}	38.93^{cd}
LS	**	**	**
SE (±)	0.21	0.89	1.65

Means followed by the same letter within the same column are not statistically different following DMRT. CH=Cowpea, LS= Level of Significance, SE=Standard Error, **= significance at 0.01, *=significance at 0.05 and NS= Not Significant

Bulb Yield (ton/ha)

Effect of organic amendments on bulb yield per ha is equally presented in Table 4. The results showed a significant (P≤0.05) difference between the treatments used. The result further revealed that, application of poultry manure significantly (P≤0.05) produced higher bulb yield per ha than all other nutrient treatment used with the mean of bulb yield per ha ranges from 44.02 to 33.80. This indicated that manure applications have positive impact on the growth and yield of onions. These results are similar to those of Lchi *et al*. (2020), who said that highest bulb yield was obtained from the highest rates of poultry manure. This could be due to the activities of nitrogen from poultry manure in promoting physiological and metabolic processes in plants, which improve dry matter production and accumulation. The beneficial effect of organic fertilizers could be due to the supply of plant nutrients which improve the soil physical and biological properties (Datt *et al*., 2003).

4. CONCLUSION

In conclusion however, organic amendment has significant influence on the growth and yield of onions in the study area. Based on the findings of this study, poultry manure demonstrated high performance in terms of growth and yield and is recommended for farmers in the study area and trials with other organic amendment with different ratios is also recommended.

Acknowledgments

We sincerely acknowledge the entire staff of faculty of agriculture, Abubakar Tafawa Balewa University Bauchi for their support and contributions during the conduct of this study. Our special appreciation also goes technical staff of the department of crop production for their unwavering support and guidance, without which, this study wouldn't have been possible.

Author Contributions

Shuaibu, Yunusa Muhammad, research design, supervision and manuscript preparation.
Bala, Rashida Abdulmumini, supervision and data analysis.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or nonprofit sectors.

Conflict of interest

The authors declare that they have no conflicts of interest, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical approval

In this article, as per the plant regulations followed in the Department of Crop Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, Bauchi State, Nigeria; the authors observed the effects of organic amendment on growth and yield of onion (*allium cepa* l.) in Bauchi State, Nigeria. The ethical guidelines for plants & plant materials are followed in the study for observation, identification & experimentation.

Informed consent

Not applicable.

Data availability

All data supporting the findings of this study are embedded within the manuscript.

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