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Research Article

Growth and yield performance of radish (*Raphanus sativus* L.) to different organic nutrient sources

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ABSTRACT

Radish (*Raphanus sativus* L.) is an edible root vegetable of the family *Brassicaceae*, grown and consumed all over the world and is considered part of the human diet, even though it is not common among some populations. An experiment to evaluate the effect of different organic fertilizers (cow dung and poultry manure) on the growth and yield of radish was conducted between April and May 2019, on an experimental site at Mile 7, NEPA, Zaria Road, Jos, Plateau state. The experiment was laid out in a randomized complete block design with three replicates. Plant height, number of leaves, and root length were highest; 27.85 cm, 13.1 cm, and 14 cm, respectively, with cow dung, while leaf length, leaf width, root diameter, weight of whole plant, and root weight were the highest; 18.45 cm, 9.25 cm, 11.2 cm, 159.04 g, and 83.41 g, respectively, with poultry droppings. Overall, radish performed better with poultry manure than with cow dung. Therefore, poultry manure is highly recommended for the cultivation of radish.

Keywords: Growth and yield, organic fertilizer, radish

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INTRODUCTION

Radish (*Raphanus sativus* L.) is an edible root vegetable of the family *Brassicaceae*, grown and consumed all over the world and is considered part of the human diet, even though it is not common among some population. Radish which is grown both as an annual and a biennial belongs to the genus *Raphanus* and species *sativus*. It is originated in Europe and Asia. Usually, people eat radishes raw as a crunchy vegetable, mainly in salad, while it also appears in many European dishes. Some people, at least in the Middle East, prefer to drink its juice in pursuit of certain health benefits. Radishes have different skin colors (red, purple, black, yellow, and white through pink); while their flesh is typically white.[1] In addition, the edible root of radish varies in its flavor, size, and length throughout the world. It is a mainly cool-season crop and popular in both tropical and temperate regions. The fleshy edible portion of the root develops from both the primary root and the hypocotyl. The root is the part consumed, that is, it is the commercial product. One of the unique features of this plant is its short cycle, of approximately 30 days, which permits rapid gains of working capital.[2] In general, commercial radishes are approximately 2 cm in diameter; they reach market size in about 21–28 days (or longer in cold weather). It is a quick-growing cool-season vegetable. The seeds will germinate in 3–4 days with soil temperatures of 18–30°C with good moisture. The crop requires a well-drained sandy loam or loam with a good supply of organic matter. It is a minor crop and quite limited. The consumption of fresh vegetables has increased worldwide, not only through population growth but also due to the greater awareness of the importance of a healthy diet. Consumers are also becoming increasingly demanding in terms of the quality of the produce and its year-round availability.[3] Maximum productivity cannot be achieved through the optimum use of inorganic fertilizers as result of the depletion of soil nutrients.[4] The average yield of radish is way less compared to its potential and has not been fully explored as an important vegetable in Nigeria.[5] However, this study aims to evaluate the effects of different organic fertilizers on the growth and yield of radishes.

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MATERIALS AND METHODS

A field trial was conducted at Mile 7, NEPA, Zaria Road, Jos North, Plateau State, Nigeria, between April and May 2019, during the late dry season and the early rainy season. Daikon white radish seeds were obtained from a local market (Tomato market Farin-Gada) Jos. The experiment was laid out in a randomized complete block design with three treatment combinations and three replications. Beds of 1 m by 1 m were made on farmland, the beds were ploughed. Organic fertilizers of cow and poultry were applied on four out of the six beds, 2 weeks before planting at 0.5 kg/bed. The seeds were planted by broadcasting method mixed with soil in a ratio of 1:4 and scattered over the beds evenly, and the beds were watered thoroughly. Plants were spaced after germination during weeding. The plants were watered at an interval of 2 days using a watering can until the rains started. Weeding was carried out during the early stages of growth and 2 weeks before harvesting. Field observation and data collection began immediately after the germination of seeds until seedlings attained 6 weeks (42 days). Parameters assessed during the work period include plant height, number of leaves, leaf length, leaf width as well as root length, root diameter, weight of whole plant, and root weight of the plant.

RESULTS

The accessions differed significantly in plant height, number of leaves, leaf length, leaf width, root length, root diameter, weight of whole plant, and root weight of the plant with respect to treatment.

Plant Height

R. sativus was tallest with cow dung ranging from 2, 5, and 6 WAP and this was significantly different from those with control ($P \leq 0.05$) but not significantly different ($P > 0.05$) from those planted with poultry manure as shown in Table 1. Plant height also showed to be taller in poultry manure at 1, 3, and 4 WAP and this was also significantly different ($P \leq 0.05$) from the control, but not significantly different ($P > 0.05$) from those planted with cow dung. The result for plant height at 6 WAP showed that radish with cow dung treatment was 26% higher than those of control and 1.3% higher than those with poultry manure. Regardless of the treatments, plant height increased as a number of weeks after planting increases.

Leaf Length

R. sativus had the highest leaf length with cow dung 1–5 WAP and was significantly different from the control ($P \leq 0.05$) but not significantly different ($P < 0.05$) from poultry manure. At 6 WAP, the leaf length for *R. sativus* with poultry manure was higher (18.45 cm) compared to that of cow dung (17.85 cm) and control (15.05 cm) as shown in Table 2 below.

Leaf Width

Table 3 below shows a similar response of *R. sativus* to organic fertilizer at different weeks after planting as observed in leaf length. Leaf width of *R. sativus* was higher with cow dung at 1–5 WAP and was significantly different ($P \leq 0.05$) from control but not significantly different from poultry manure ($P < 0.05$). At 6 WAP, *R. sativus* had its highest leaf width (9.25 cm) with poultry manure followed by cow dung (8.85 cm) and the control (7.45 cm) and this was significant ($P \leq 0.05$).

Table 1: Main effects of different organic fertilizers on mean plant height of radish

Treatment	Weeks after planting					
	1	2	3	4	5	6
Control	3.15^{b}	6.00^{b}	12.95^{b}	15.20^{b}	17.15^{b}	20.60^{b}
Cow dung	4.80^{a}	10.45^{a}	14.00^{a}	18.00^{a}	22.95^{a}	27.85^{a}
Poultry manure	5.65^{a}	10.20^{a}	14.30^{a}	18.80^{a}	21.20^{a}	27.55^{a}
Significance	*	*	*	*	*	*
LSD $_{(0.05)}$	2.15	2.25	0.67	2.64	3.48	4.76

Means with the same letter (s) within the same column are not significantly different at 5% level of probability. The asterisk (*) simply means Significance at 5% level of probability

Table 2: Main effects of different organic fertilizers on mean leaf length of radish

Treatment	Weeks after planting					
	1	2	3	4	5	6
Control	1.20^{c}	4.00^{c}	6.80^{c}	8.95^{b}	11.80^{b}	15.05^{b}
Cow dung	1.95^{a}	4.80^{a}	8.05^{a}	13.10^{a}	14.30^{a}	17.85^{a}
Poultry manure	1.50^{b}	4.15^{b}	7.50^{b}	12.00^{a}	14.00^{a}	18.45^{a}
Significance	*	*	*	*	*	*
LSD$_{0.05}$	0.19	0.24	0.52	1.64	2.48	1.6

Means with the same letter (s) within the same column are not significantly different at 5% level of probability. The asterisk (*) Significant at 5% level of probability

Number of Leaves

R. sativus had the highest number of leaves per plant with cow dung at 5 and 6 WAP and this was significantly different ($P \leq 0.05$) from *R. sativus* planted without organic manure but was not significantly different ($P > 0.05$) from that of poultry manure. The least number of leaves were observed in the controlled treatment from weeks 1 to 6. However, at 1 to 3 WAP, *R. sativus* had the same mean number of leaves per plant as shown in Table 4.

Root Length

Mean root length of *R. sativus* was significantly different ($P \leq 0.05$) as affected by the different treatments used as shown in Table 5 below. Root length was higher (13.10 cm) for Radish planted with cow dung and was significantly different ($P \leq 0.05$) from that of poultry manure (11.90 cm) and control (11.40 cm).

Root Diameter

R. sativus treated with poultry manure had the highest root diameter (11.20 cm) and this was significantly different ($P \leq 0.05$) from that of cow dung (7.30 cm) and control (6.30 cm) as shown in Table 5 below.

Weight of Whole Radish Plant

R. sativus treated with poultry manure had the highest mean weight (159. 40 g) of whole radish plant and was significantly different ($P \leq 0.05$) from that of cow dung (89.10 g) and control (34.67 g) as shown in Table 5 above.

Root Weight of Radish

Table 5 below showed that *R. sativus* treated with poultry manure was 51% higher in root weight than that of cow dung and 122% higher than Radish planted with no fertilizer and was significantly different ($P \leq 0.05$).

Total Radish Yield

Figure 1 shows the effects of the different treatment nutrients on the total yield of *R. sativus*.

Total yield of *R. sativus* varies from 0.21 tonnes per hectare with poultry manure and 0.09 tonnes per hectare with the control treatments and was significantly different ($P \leq 0.05$).

DISCUSSION

Organic manure has gained a lot of attention from the public as they are available abundantly, free from any chemicals, as well as can increase soil fertility. The soil fertility can be improved by organic and inorganic fertilizers application depends on several factors such as soil type, nature of crop, and socioeconomic conditions of the area. Organic manures improve soil fertility by activating soil microbial biomass.[6] Application of manures sustains the cropping system through better nutrient recycling.[7] Manures provide a source of all necessary macro- and micro-nutrients in available forms, thereby improving the physical and biological properties of the soil.[8] The analysis of variance showed that significant differences were observed for the growth and yield attributes studied in the 6th week after planting. The increase in growth and yield attributes with organic fertilizer

Table 3: Main effects of different organic fertilizers on mean leaf width of radish

Treatment	Weeks after planting					
	1	2	3	4	5	6
Control	1.75^{c}	2.55^{c}	4.30^{a}	5.75^{a}	6.10^{b}	7.45^{b}
Cow dung	2.15^{a}	3.05^{a}	4.30^{a}	5.80^{a}	7.00^{a}	8.85^{a}
Poultry manure	2.00^{b}	2.90^{b}	3.95^{b}	4.65^{c}	6.20^{b}	9.25^{a}
Significance	*	*	*	*	*	*
$LSD_{(0.05)}$	0.05	0.08	0.05	0.56	0.32	1.19

Means with the same letter (s) within the same column are not significantly different at 5% level of probability. The asterisk (*) Significant at 5% level of probability

Table 4: Main effects of different organic fertilizers on the number of leaves of radish

Treatment	Weeks after planting					
	1	2	3	4	5	6
Control	2.00^{b}	4.00^{b}	6.50^{b}	7.50^{b}	9.00^{b}	12.00^{b}
Cow dung	3.00^{a}	5.00^{a}	7.00^{a}	8.50^{a}	11.00^{a}	14.00^{a}
Poultry manure	3.00^{a}	5.00^{a}	7.00^{a}	9.00^{a}	10.50^{a}	13.00^{a}
Significance	*	*	*	*	*	*
$LSD_{(0.05)}$	0.44	0.44	0.11	0.77	1.44	1.33

Means with the same letter (s) within the same column are not significantly different at 5% level of probability. The asterisk (*) Significant at 5% level of probability

Table 5: Main effects of different organic fertilizers on the root length and diameter, weight of root, and whole plant of radish

Treatment	Root length (cm)	Root diameter (cm)	Wt of whole plant (g)	Root Wt (g)
Control	11.40[b]	6.30[b]	34.67[c]	18.60[c]
Cow dung	13.10[a]	7.30[b]	89.10[b]	40.34[b]
Poultry manure	11.90[b]	11.20[a]	159.04[a]	83.41[a]
Significance	*	*	*	*
$LSD_{(0.05)}$	1.02	1.02	15.51	24.47

Means with the same letter (s) within the same column are not significantly different at 5% level of probability. The asterisk (*) Significant at 5% level of probability

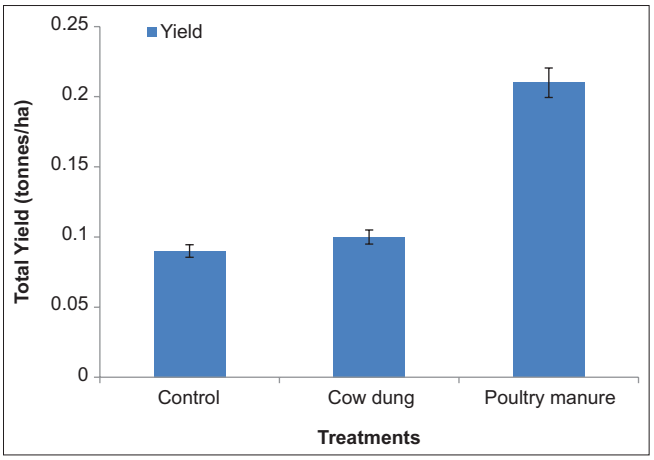

Figure 1: Effects of different nutrient treatments on the total yield of radish

application as observed in this study corroborated reports of Waseem *et al.*[9] that organic fertilizer enhances crop growth and yield in most vegetable crops. Nitrogen from organic fertilizer enhances photosynthetic activity and physiological processes resulting in increased production of assimilates and consequently higher crop yield.[10,11] Excessive organic fertilizer application is, however, not encouraged as this may result in prolonged vegetative growth and poor root development.[6] A balanced nutrient application is, therefore, required for optimum productivity. Root length, root diameter, and mean fruit weight varied with treatment and the rate of fertilizer application. Indirectly, these traits are environmentally influenced as suggested by Bosland *et al*.[4] These attributes are considered to be major yield components in radish.[7] The total root yield varied with treatment, being highest in poultry manure, indicating that root yield in radish is influenced by the nutrient media which agrees with the findings of Rodrigues *et al.*[12] Root yield is dependent on the number of leaves produced and the proportion that develops into mature roots. Plant height, leaf length, and leaf width have also been reported as yield-contributing components.[7,13,14] Effect of treatment on leaf length, leaf width, and number of leaves was significantly different ($P < 0.05$) for all the treatments. This shows that the different treatments perform differently under the same environmental condition and their yield which corroborate the work of Ayuso *et al*.[15]

CONCLUSION

Cow dung and poultry manures showed no significant difference in their effects on the vegetative growth of radish plants as seen from the results of the study. Both organic manures could be explored for vegetative propagation depending on Interest. However, the results from this trial have also shown that poultry manures can be adopted as a media to proficiently achieve growth, development, and productivity of radish plants.

RECOMMENDATION

Further studies involving more fertilizer treatments on radish varieties are recommended. Understanding the agronomic and management practice of radish plants will enhance the potential drive for breeding programs and initiatives in under-explored environments.

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