

Original Research Article

DETERMINING THE EFFECT OF DIFFERENT ORGANIC NUTRIENT SOURCES ON THE GROWTH AND YIELD OF RADISH(Raphanus sativus L.)

ABSTRACT

Indiscriminate use of chemical fertilizers is a common practice which is hazardous both for soil health and environment. Chemical fertilizers have been widely used due to their immediate availability of nutrients; however, their long-term effects on soil and crop sustainability necessitate alternatives such as organic fertilizers. It has been more than three decades that global agriculture has been depicted towards organic agriculture owing to sustainability and reduced environmental effects. A field experiment was conducted at Institute of Agriculture and Animal Science (IAAS), Lamjung Campus from December 2022 to February 2023, with the objective to study the effect of various sources of organic manure on the growth and yield of radish. The experiment was conducted in Randomized Complete Design using 7 treatments (Control, Farm Yard Manure(FYM), Poultry Manure(PM), Goat Manure, FYM + Poultry Manure, FYM + Goat Manure, Poultry Manure + Goat Manure) with 3 replications of each. Tokinashi variety of radish was used in the experiment. Radish is an important root vegetable known for its nutritional value and quick growth cycle, making it a key crop for studying the impacts of organic manure. Experiment was done in field with the plot size of (2 x 1)m² and spacings of 30 cm x 20 cm with the total land area of 90m². The growth and yield of radish were significantly affected by the different treatments. The highest total root yield (204.33) and biological yield (263.67) was found in Poultry manure. The study suggested that the application of poultry manure was more beneficial and resulted in significantly better growth and yield performance of radish.

Key words: Organic Nutrient Sources, Radish, Growth, Fertilizers

Introduction

Radish (*Raphanus sativus*L.) is one of the most popular root vegetables of the world which can be grown from tropical to temperate regions. It is grown for the consumption of its young fresh tender tuberous root which can be used to cooked or raw food as a salad(Umar *et al.* 2019). Radish is the most marketable winter vegetables(Zaki, *et al.*, 2012). It was domesticated in the eastern Mediterranean region. (Kitamura 1958). The area, production, and productivity of Radish in Nepal is 16441 hectare, 256,013 metric tonnes and 15.38 tonnes per hectare(Ministry of Finance, 2022)

Radish is a significant short-duration (70-80 days) root vegetable commonly grown during the winter season(Brintha and Seran 2009).The popularity of radish cultivation could be due to its wider adaptability, low cost of production, short crop duration and can be grown in almost all type of soil without much care. Diseases and pest problems are also less in radish as compare to other vegetable crops(Chapagain *et al.*,2011). Radish is a short-duration and quick growing crop, so,the root growth and development should be uninterrupted. For this, optimum nutrition should be provided through organic, inorganic and bio-fertilizer sources.Chemical fertilizers are expensive and hazardous a such resulted in poor health condition of soil andwater if used repeatedly. So, alternative cheap organic sources of nutrients should be used.(Kumar *et al.*, 2016)

Organic manures are the types of manures which are derived from animal, human and plant residues which contain plant nutrients in complex organic forms (Kumar *et al.*, 2014). By increasing soil moisture content, pH, bulk density, soil porosity, CEC, and nitrate nitrogen availability while lowering nitrate nitrogen leaching to lower depths, organic manure increases radish root production(Subedi, *et al.*,2018). For improving plant development at 45 and 60 days after sowing (DAS), organic manures, combination applications of vermicompost and chicken manure (50% each), FYM+vermicompost (50%+50%), performed best(Khatri,*et al.*2019).

Materials and Methods

The experiment was carried out at field of the Institute of Agriculture and Animal Science, LamjungCampus(IAAS), Sundarbazaar in the western mid hills of the Nepal year December 2022 to February 2023.. This place has a humid tropical climate and its average temperature is 18 °C. The total annual rainfall in this area is reported as 2800mm. The location is at 28.2765 °N, 84.3542 °E with an elevation of 625 meters above sea level. A factorial field experiment at randomized complete block design with three replications was carried out to investigate the effect of organic nutrient sources on the growth and yield of radish.Seven rows with five seeding in each row were sown with the spacing of 20 cm* 30 cm with the total areaof 2m² plot Tokinashi variety of radish was selected andplanted. All the treatment rate were taken according to National Krishi Diary 2021/22.

Table 1: Different treatments and their proportion in plot

S. N	Treatment	Rate (tons per hectare)
T1	Control	0
T2	FYM	40

T3	Poultry Manure	13.35
T4	Goat Manure	20
T5	FYM + Poultry Manure	20+6.5
T6	FYM + Goat Manure	20+10
T7	Poultry Manure + Goat Manure	6.65+10

The field was ploughed twice, harrowed and leveled by planking. The weeds and leftover crop residue were removed from the field, and after which plots was partitioned into different sections following the experimental layout on December 17, 2022. Well decayed organic manure was applied prior to seed sowing, while chemical fertilizers were applied at the time of sowing. Urea was applied in 2 times, half doses at sowing 5 gram in each plot to enhance germination and half as split dose(5 gram in each plot) at 30 days after sowing because nitrogen deficiency symptoms are seen in every plot.

There are 21 plots, with 35 plants in each plot. Daily light irrigation was done earlier 10 days. After that, the field was irrigated twice a week, prior to harvest. Manual weeding was done irrespective of the seeding days for each plot to keep them free from the competition with the unwanted plants. Radish was harvested after 60 days of sowing.

Data Collection

Data collection was done four times for the vegetative parameter at 20 days after seeding, 30 days after seeding, 40 days after seeding and 60 days after seeding. And at final harvest data was taken for yield parameters.

Vegetative Parameters

Plant height: Measured up to tallest point (Tip of the longest leaf) using scale (cm).

Number of leaves: Counting of leaves was done from base to top.

Leaf area: Length and breadth of three randomly selected leaves were measured using scale and area was calculated and multiply by a factor.

Canopy diameter: By averaging the length and breadth of diameter.

Yield Parameters

Root Weight: Weight of the root was measured by weighing balance and the average value was taken and recorded.

Root Length: By using measuring scale (cm)

Root Diameter: Measured using vernier caliper.

Leaf yield: $\frac{\text{Total weight of Leaves}(kg)}{\text{Total area}(m^2)}$

Root yield: $\frac{\text{Total weight of roots}(kg)}{\text{Total area}(m^2)}$

Biological yield: $\frac{\text{Total weight of roots+Leaves}(kg)}{\text{Total area}(m^2)}$

Harvest index : $\frac{\text{Root Yield}(kg)}{\text{Biological yield}(kg/m^2)} * 100$

Data Analysis

The Data Entry was done using MS- Excel and Data analysis was done using R-Stat(version 4.3.1).

Result and Discussion

Effect of Organic manure on the plant height of Radish

The tallest plant height was recorded from FYM+ Goat at 30 Days After Sowing (DAS) which was similar with all other treatment except control. At 40 DAS tallest plant was obtained from application of poultry manure and its combination with FYM, goat and combination of FYM with goat as compared to control which was similar to individual application of FYM and goat. At 50 DAS tallest plant height was obtained from poultry and goat alone and its combination and combination of FYM and goat. At 60 DAS higher value for plant height was obtained from poultry and its combination with FYM as compared to control which was similar to all the treatments. Overall values for plant height showed good response to poultry manure. Previous studies also confirm that poultry manure was appropriate to enhance the seedling growth at different stages (Shiyamand Bobboyi 2017). Poultry manure performed best with regards to the plant height and this could be due to the least value of C/N ratio that enhance faster decomposition and quicker release of nutrients than other organic manure sources.

Table 2 Effect of organic manure on the plant height

Treatment	30 DAS	40 DAS	50 DAS	60 DAS
T1(Control)	3.28 ^b	6.17 ^b	8.83 ^b	19.7 ^b

T2(FYM)	4.93 ^{ab}	11.17 ^{ab}	14.04 ^{ab}	22.04 ^{ab}
T3(Poultry)	5.37 ^{ab}	14.77 ^a	20.42 ^a	24.72 ^a
T4(Goat)	4.75 ^{ab}	10.99 ^{ab}	18.46 ^a	23.19 ^{ab}
T5(FYM+POULTRY)	5.19 ^{ab}	12.66 ^a	16.53 ^{ab}	25.3 ^a
T6(FYM+ Goat)	6.62 ^a	14.25 ^a	19.53 ^a	23.51 ^{ab}
T7(Poultry + Goat)	5.49 ^{ab}	13.69 ^a	20 ^a	22.45 ^{ab}
LSD	2.31	5.48	8.13	4.37
CV	25.5	25.78	27.12	10.69
SE _m	1.29	3.08	4.56	2.45

Means followed by the common letter within each column are not significantly different at 5% level of significance by Duncan Test.

Effect of Organic manure on the number of leaves in Radish

There was no significant effect of any manure on leaf number at 30 DAS. All manure except FYM were significant in increasing the leaf number at 40 DAS as compared to control. At 50 DAS leaf number was higher in poultry and the combination of FYM and goat manure as compared to control plots, but its effect was similar to other manures sources. At 60 DAS, poultry and its combination with goat manure, FYM and combination of FYM and goat manure were superior in increasing the number of leaves as compared to control.

This observation was supported by Kumar, (2014) who recorded highest number of leaves from poultry manure and minimum number of leaves was recorded in control at 60 DAS. (Kumar *et al.*, 2014), The number of leaves and plant height of radish increases with an increase in nitrogen level, which was mostly found in mustard oil cake and poultry manure. (Shahi *et al.*, 2022)

Table 3 Effect of organic manure on the leaf numbers

Treatment	30 DAS	40 DAS	50 DAS	60 DAS
T1(Control)	3.57 ^a	5.49 ^c	10.43 ^c	13.39 ^C
T2(FYM)	4 ^a	7.42 ^{bc}	12.3 ^{abc}	14.86 ^{bc}
T3(Poultry)	4 ^a	9.15 ^{ab}	15.37 ^a	18.98 ^a
T4(Goat)	4 ^a	9.18 ^{ab}	12.22 ^{abc}	15.66 ^{bc}
T5(FYM+ Poultry)	3.94 ^a	8.71 ^{ab}	11.16 ^{bc}	17.54 ^{ab}
T6(FYM+ Goat)	4.12 ^a	9.84 ^{ab}	14.73 ^{ab}	17.48 ^{ab}
T7(Poultry +Goat)	4 ^a	11.14 ^a	13.7 ^{abc}	16.67 ^{ab}
LSD	0.62	2.49	3.42	2.82
CV	8.8	16.09	14.99	9.7
SE _m	0.34	1.4	1.92	1.58
Mean	3.95	8.71	12.84	16.37

Means followed by the common letter within each column are not significantly different at 5% level of significance by Duncan Test.

Effect of different sources of organic manures on root weight, root length & root diameter of radish

Root Weight

The highest fruit weight (204.33 gram) was recorded from Poultry Manure application, surpassing all other treatments in terms of root weight per plant. Control, on the other hand, was found to be on par with FYM and had the lowest weight. However, when compared to FYM coupled with poultry manure and poultry manure combined with goat manure, goat manure displayed statistically equivalent root weight. FYM mixed with goat manure provided a better response than control and FYM alone but was inferior to all other treatments.

This observation was supported by (Ijoyah and Sophie 2009) who reported that the application of poultry manure increased crop yield. Also, Khatri *et al.* (2019) assigned the highest biomass in PM than FYM to the low C/N ratio of PM contributing to faster decomposition and quick release of nutrients.

(ShiyamandBobbyi 2017)reported that among the different organic manure, PM helps to improve soil condition, increase water holding capacity of soil and provide more macro as well as micronutrients than FYM.

The lower values radish yield and soil physio-chemical properties obtained from control treatment as compared to other treatments could be because of initial low soil nutrients status that often characterizes continuous cultivation of land without fertilizer application. This finding was supported by(Hasanet *al.*, 2012)

Root length

FYM combined with goat manure outperformed the control but was insignificant in comparison to all other treatments. The shortest root length was 14.37 cm (control) compared to 20.90 cm (FYM+GM). While all other treatments resulted in lengths ranging from 18 to 19 cm, the difference was less than the LSD value.

Root diameter

The largest root diameter (31.43 mm) was produced by FYM coupled with poultry manure, which was statistically different from FYM alone but negligible when compared to poultry manure alone. Control was shown to be equivalent to FYM alone, whereas goat manure was found to be equivalent to poultry manure, FYM + goat manure, and poultry manure plus goat manure. The thickest root (FYM+PM) was 31.43 mm, while the thinnest was 17.32 mm (control).

Subedi *et al.* (2018) observed longer and wider roots of radish in the treatments containing PM either alone or in combination with chemical fertilizer due to higher organic manure and nutrient content (NPK and micronutrients). Also, Stephenson *et al.*, (1990) and Oladotun (2002) reported that poultry manure contained macro and micro nutrients such as N, P, K, Ca, Mg, Cu, Bo and Fe that help to increase plant biomass rapidly.

Table 4 Effect of organic manure on root weight, root length & root diameter of radish

Treatment	Root Weight(gm)	Root Length(cm)	Root Diameter(mm)
Control	31.66667 ^d	14.37778 ^b	17.3238 c
FYM	41.00000 ^d	18.38889 ^{ab}	18.28622 ^c
PM	204.33333 ^a	19.44444 ^{ab}	26.84533 ^{ab}
GM	122.33333 ^b	18.4111 ^{ab}	24.91944 ^b
FYM+PM	111.00000 ^b	19.25000 ^{ab}	31.43048 ^a
FYM+GM	81.66667 ^c	20.90000 ^a	26.35944 ^{ab}
PM+GM	123.66667 ^b	18.21000 ^{ab}	24.35000 ^b
LSD	27.78876	5.650929	5.650929
CV%	15.27855	17.23907	13.11705
Mean	102.2381	18.42603	24.21639

SeM	15.6	3.2	3.2
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Means followed by the common letter within each column are not significantly different at 5% level of significance by Duncan Test.

Effect of organic manure on Root yield, Harvest index, Leaf yield and Biological yield.

Harvest index

Among the different treatments, the significantly highest harvest index of (0.7746691) was recorded Poultry manure which was followed by FYM + Poultry manure, (Poultry manure + Goat manure, Goat manure, FYM + Goat manure, Control and then by FYM in descending order. A lowest harvest index value of (0.5908403) was recorded in FYM.

Increased nutrient availability, improved soil structure and enhanced microbial activities due to addition of poultry manure could be the reason for increase in harvest index of radish. Similar finding was observed by (Khatri *et al.* 2019)

Leaf yield

Among the different treatments, the significantly highest leaf yield of (59.33^a) was recorded in treatment Poultry Manure which was followed by Goat manure, Poultry manure + Goat manure, FYM + Poultry manure, FYM + Goat manure, FYM and then by Control in descending order. A lowest value of leaf yield (20.0) was recorded in Control.

Increased nutrient availability, improved soil structure and enhanced microbial activities due to addition of poultry manure could be the reason for the increase in leaf yield of radish. Similar finding was observed by (Khatri *et al.*, 2019)

Biological yield

Among the different treatments, the significantly highest yield of (263.67) was observed in Poultry Manure which was followed by Goat manure, Poultry manure + Goat manure, FYM + Poultry manure, FYM + Goat manure, FYM and then by Control in descending order. A lowest value of biological yield of 51.6 was recorded under the treatment of Control.

Table 5 Effect of organic manure on root yield, harvest index, leaf yield and biological yield.
of radish

Treatment	Harvest Index	Leaf Yield	Biological Yield
control	0.6098 ^d	20.0 ^e	51.67 ^d
FYM	0.590 ^d	28.33 ^d	69.33 ^d
poultry	0.774 ^a	59.33 ^a	263.67 ^a
Goat	0.719 ^{bc}	47.67 ^b	170.00 ^b
FYM + Poultry	0.753 ^{ab}	36.33 ^c	147.33 ^{bc}
FYM + Goat	0.705 ^c	34.00 ^{cd}	115.67 ^c
Poultry + Goat	0.738 ^{abc}	43.67 ^b	167.33 ^b
c.v.%	2.87	10.7159	13.688
LSD value	0.035	7.3349	34.265
mean	0.69	38.476	140.71
SEm	0.23	12.82	46.90

Conclusion:

Tokinashi radishes show a good response to the use of various organic manure, demonstrating improvements in both growth characteristics and yield performance. Among all the treatments evaluated, the best results were observed with the use of poultry manure. Growth parameters, including plant height and the number of leaves per plant, increased significantly, indicating the favorable nutrient composition and efficient absorption provided by poultry manure. Similarly, other important yield parameters, such as root weight, root length, root diameter, total root yield, harvest index, leaf yield, and biological yield, also showed superior performance with poultry manure application.

This study highlights the potential of poultry manure as a sustainable and cost-effective organic fertilizer for radish production. It encourages its adoption among local farmers, thereby enhancing crop productivity.

Recommendation:

Future research could explore the long-term effects of poultry manure application and its impact on soil properties, crop rotations, and other vegetable crops in similar agro-climatic conditions.

Disclaimer (Artificial intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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