Original Research Article

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. 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 IAAS, Lamjung Campus from Poush 2079 to Magh 2079, 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, FYM, Poultry Manure, Goat Manure, Farm Yard Manure (FYM) + Poultry Manure (PM), FYM + Goat Manure,Poultry Manure + Goat Manure) with 3 replications of each. Tokinashi variety of radish was used in the experiment. Experiment was done in field with the plot size of (2 x 1)m² and plant spacings of 30 cm x 20 cm with the total land area of 90m².The effect of different treatments on growth and yield of radish was affected significantly. 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 found to be more beneficial and significantly better growth and yield performance of radish.

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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, ~~Ibrahim, Iro, and Obidola~~ 2019). Radish is the dicotyledonous biannual root vegetables of the Brassicaceae family. 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/hectare(Ministry of Finance 2022)~~)~~

Radish ~~(Raphanus sativus L.)~~ 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*. 1970). 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 andhazardous a such resulted in poor health condition of soil andwater if used repeatedly. So, alternative cheap organic sources of nutrients should be used.(Sanjay 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*). For improving cropplant development at 45 and 60 days after sowing (DAS), organic manures, combination applications of vermicompost and poultry~~chicken~~ manure (50% each), FYM+vermicompost (50%+50%), performed best.(*International journal of plant science*)

The response of ~~In~~ radish to plant height, number of leaves, leaf breadth, root length, root diameter, and biomass yield ~~all~~ rose significantly after the application of organic manures (Yadav *et al.*, 2018) The highest yields of biomass and roots were from the application of chicken manure, which was in line with the fertilizer's recommended rate. (Khatri *et al.*, 2019).The application of PM considerably changed the physical characteristics of the soil (p 0.05); it decreased bulk density and increased porosity and moisture content (Kiran *et.al.*, 2016)

Materials and Methods~~Methodology~~

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Comment [A5]: Tonnes per hectare or t ha^{-1} is the best format

Comment [A6]: The botanical name has already been cited in the first paragraph therefore there is no point mentioning it for the second time.

Comment [A7]: Provide the year

Comment [A8]: Define the PM for the first time before usage.

Comment [A9]: It should be Methodology or Materials and Methods

The experiment was carried out at ~~inthe~~ field of the Institute of Agriculture and Animal Science, Lamjung Campus, Sundarbazzar in the western mid hills of the Nepal year 2079/80. This place has a humid tropical climate. The average temperature is 18 ^{o}C. The total annual rainfall in this area is reported as 2800mm. The location is at 28.2765 ^{o}N, 84.3542 ^{o}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 plants in each row were sown with the spacing of 20 cm* 30 cm with the total are of 2m² plot Tokinashi variety of radish was selected to planted. All the treatment rate were taken according to National Krishi Diary 2021/22.

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Table 1: Different treatments and their proportion in plot

S. N	Treatment	Rate (Kg per plot)
T1	Control	0
T2	FYM	8
T3	Poultry Manure	2.67
T4	Goat Manure	4
T5	FYM + Poultry Manure	4 + 1.3
T6	FYM + Goat Manure	4 + 2
T7	Poultry Manure + Goat Manure	1.33+2

Comment [A13]: The unit should be converted to t ha^{-1}

Table 2: Experimental design of the plot

	R1		R2		R3	
	T2		T3		T5	
	T1		T2		T2	
	T7		T7		T4	
	T5		T6		T3	
	T4		T1		T7	
	T3		T4		T1	
	T6		T5		T6	

Comment [A14]: No need of this table

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~~it~~ was partitioned into different sections following the experimental layout on Poush 2, 2079 BS. Well decayed organic manure ~~were~~was applied seeding was done days prior to seed sowing, while chemical fertilizers were applied at the time of sowing. Chemical fertilizers were applied in 2 doses, half doses at sowing and half as split dose 30 days after sowing.

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, 45 days after seeding and 60 days after seeding. And at final harvest data was taken for yield parameters.

Comment [A15]: The 45 days should be in sequential such as 40 ideal not 45 days.

Vegetative Parameters

Plant height: Measured from the base of the plant up to the tallest growing point (Tip of the longest leaf) using scale.

Comment [A16]: Provide the unit cm of inches

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

Leaf area: Length and breadth of three largest 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 tand the average valus was taken and recorded.

Root Length: By using measuring scale.

Root Diameter: Measured using vernier caliper.

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

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

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

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

Data Analysis

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

Results and Discussion

Effect of Organic manure on the plant height of Radish

The ~~highest plant~~ tallestheight was recorded from FYM+ Goat at 30 Days After sowing (DAS) which was similar with all other treatment except the control. AT 40 DAS ~~higher~~ tallestplant ~~height~~ 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 50DAS higher plant height was obtained from poultry and goat alone and its combination and combination of FYM and goat. At 60 DAS higher values for plant height was obtained from poultry and its combination with FYM as compared to control which was similar~~like~~ 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 (Shiyam,~~ Garjila, and Bobboyi~~ *et al.*,2017) Poultry manure performed best with regards to the ~~in~~plant height and this could be due to the least value

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of C/N ratio of poultry manure that enhance faster decomposition and quicker release of nutrients than other organic manure sources

Table 3 Effect of organic manure sourceon ~~the~~ plant height of Radish

Treatment	Ph1	Ph2	Ph3	Ph4
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
Mean	5.09	11.96	16.84	22.99

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

Comment [A20]: It should be Day after sowing not Ph1... and if the usage is necessary this be written in full or the acronyms be spelt in the footnote.

Effect of Organic manure on the ~~leaf~~ number ofleaves Radish

There was no significant effect of any manure on leaf number at 30 DAS. All manure except FYMwere 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 manure sources. At 60 DAS, poultry and its combination with goatmanure, FYM and combination of FYM and goatmanure were superior in increasing the leaf 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. (Sandeep and 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 4 Effect of organic manure source on the leaf numbers of leaves of Radish

Treatment	Lno1	Lno2	Lno3	Lno4
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.

Comment [A21]: The table should have or maintained similar trend as provide in table 4.

Comment [A22]: Provide the sampling period which the number of leave were taken.

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

Root Weight

The highest fruit weight (204.33 gm) 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~~dung~~ provided a better response than control and FYM alone but was inferior to all other treatments.

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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.

(Shiyam, *et al.*,~~Garjila, and Bobboyi~~ 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(Hasan*et 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~~chicken~~ manure, FYM + goat manure~~dung~~, 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.

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Table 5 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	41.00000d	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

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 significant~~ly~~ highest harvest index value of (0.7746691) was recorded in ~~treatment T3~~ (Poultry manure) which was followed by ~~T5>T7>T4>T6>T1>T2~~ in descending order. A lowest~~minimum~~ harvest index value of (0.5908403) was recorded in~~under the treatment T2~~ (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~~ on the research conducted~~ by (Khatri *et al*. 2019)~~ at the horticulture farm of the Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal~~

Leaf yield

Comment [A24]: Mention the treatment e.g. poultry manure goat manure, FMY etc.

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Among the different treatments, the significantly highest leaf yield of (59.33[a]) was recorded in treatment T3 (Poultry Manure) which was followed by T4>T7>T5>T6>T2>T1 in descending order. A minimum leaf yield (20.0) was recorded under the treatment of 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 on the research conducted by (Khatri *et al.,* 2019) at the horticulture farm of the Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal.

Biological yield

Among the different treatments, the significantly highest yield of (263.67) was observed in T3 (Poultry Manure) which was followed by T4>T7>T5>T6>T2>T1 in descending order. A minimum biological yield of 51.6 was recorded under the treatment of Control.

Comment [A26]: Recast and follow the same trend as in Harvest index.

Table 6 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~~fertilizers~~, demonstrating improvements in both growth characteristics and yield performance. Among all the treatments evaluated~~tested~~, the best ~~most significant~~ 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.~~under this treatment~~.

Comment [A27]: Be consistent with the terms in responding to the organic manure or synthetic fertilizer.

Research has shown that poultry manure not only provides essential nutrients but also improves soil health, creating optimal growing conditions for radish cultivation in the Lamjung District. 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. 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.

Comment [A28]: This paragraph can best fit justification or discussion.

Comment [A29]: This paragraph should serve as recommendation

6. REFERENCES:

1. Brintha, I. and Seran, T. H. (2009). Effect of paired row planting of radish (*Raphanus sativus* L.) intercropped with vegetable amaranthus (*Amaranthus tricolor* L.) on yield components of radish in sandy regosol. Journal of Agricultural Science, 4: 19-28.

2. Chapagain, Tika Rak et al. (1970). "Comparison of Commercial and Local Varieties of Radish at Different Levels of Manures and Fertilizers." *Nepal Journal of Science and Technology* 11(September 2022): 51–56.

3. Hasan, Mohammad and Solaiman, Dr Abul. (2012). Efficacy of organic and organic fertilizer on the growth of Cabbage (*Brassica oleracea* L.)(Cabbage).(*Internal Journal of plant science*)

4. Kiran, Mehwish, Muhammad Saleem Jilani, Kashif Waseem, and Muhammad Sohail. (2016). "Effect Of Organic Manures And Inorganic Fertilizers On Growth." 29(4):363–72.

5. Kitamura, S. (1958). Cultivars of radish and their change. In Radish in Japan. (Nishiyama, I. Ed.). Japanese replications of each. Society for the Promotion of Science, Tokyo, Japan. 1–19. (In Japanese).

6. Ijoyah, MO, and VL Sophie. (2009). "Effects Of Different Levels Of Decomposed Poultry Manure On Yield Of Cabbage (*Brassica Oleraceae* L.) At Anse Boileau, Seychelles." *Agro-Science* 8(1): 20–23.

7. Khatri, Keshar Bahadur, Roshan Babu Ojha, Keshab Raj Pande, and Babu Ram Khanal. (2019). "The Effects of Different Sources of Organic Manures in Growth and Yield of Radish (*Raphanus Sativus* L.)." *International Journal of Applied Sciences and Biotechnology* 7(1): 39–42.

8. Kumar, Sandeep, Sutanu Maji, Sanjay Kumar, and H.D Singh. (2014). "Efficacy of Organic Manures on Growth and Yield of Radish (*Raphanus Sativus* L.) Cv." *International Journal of Plant Sciences* 9(1): 57–60.

9. Kumar, Sanjay, Subhash Kumar Verma, Manoj Kumar, and Devendra Kumar. (2016). " Effect of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Radish (*Raphanus Sativus* L.) CV. Japanese White ." *Annals of Horticulture* 9(2): 133.

10. Ministry of Finance. (2022). "Economic Survey Analysis 2021/2022." 3: 378.

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https://www.mof.gov.np/uploads/document/file/1674635120_*Economic_Survey_*~~2022.~~pdf.

~~12~~.Oladotun, A. O. (2002). Managing manure as a fertilizer; Saskatchewani, Agriculture, Food and Rural Revitalization. 5 pp.

~~13~~.Shahi, Priya ~~et al.~~(2022). "Effect of Different Organic Manures on Growth and Yield of Radish At Kailali District." *Journal of Wastes and Biomass Management* 4(2): 92–95.

~~14~~.Stephenson, A. H., McCaskey T. A. and Ruffin B. G. (1990). A survey of broiler litter composition and potential value as a nutrient resource. *Biological wastes* 34: 1-9.

~~15~~.Umar, U. M., I. Ibrahim, Iro, and S. M. Obidola. (2019). "Growth and Yield of Radish (*Raphanus* ~~S~~*sativus* L.) as Influenced by Different Levels of Kalli Organic Fertilizer on the Jos Plateau." *Asian Journal of Research in Crop Science* (September): 1–8.

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