



Research Article

Effects of Different Sources of Organic Manures in Growth and Yield of radish (*Raphanus sativus* L.)

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Abstract

Sandy loam soil of Chitwan is low in native nitrogen supply. Slow release of nitrogen through organic manure mineralization help to increase soil nitrogen supply and increase radish production. A field experiment was conducted in an Inceptisols with sandy loam soil of the research farm of Agriculture and Forestry University, Rampur, Chitwan, Nepal from October 2016 to January 2017 to evaluate and quantify the effects of different sources of organic manure in growth and yield of radish. The experiment was carried out in a Randomized Complete Block Design with six treatments (Poultry manure, goat manure, FYM, biogas byproduct, recommended dose of fertilizer and control) and were replicated four times. Pyuthane Red variety (released on 1994) of radish was used as a test crop. 100 kg N per hectare (recommended dose of N for Radish) was supplied from each treatment calculated based on nitrogen content of the organic manures. The application of organic manures significantly increased the plant height, number of leaves, leaf breadth, root length, root diameter and biomass yield. The highest total biomass yield (75.16 Mg/ha) and highest delta root yield (34.13) was obtained from poultry manure application which was similar with chemical fertilizer. The study suggested that application of poultry was found more beneficial and significantly improved growth and yield of radish in the first season of application. Long term effects of poultry manure application is necessary to study to see nitrogen supply/mineralization rate and subsequent crop production.

Keywords: Organic manure; Radish; poultry manure; yield

Introduction

Sandy loam soils are dominated by sand particles containing enough silt and low clay particles due to which the properties primarily governed by sand particles (Brady and Weil, 2013). It is characterized by higher aeration, lower nutrient content, lower water holding capacity, lower cation exchange capacity and lower buffering capacity than clayey and loam soil (White, 1987; Brady and Weil, 2013).

High drainage capacity of sandy loam enhances the leaching of nitrate (Gaines and Gaines 1994) resulting low in nitrogen content. Chitwan is dominated by sandy loam soil (Ghimire and Bista, 2016) due to which nitrogen is always a limiting nutrient that seeks proper management options.

Radish (*Raphanus sativus* L.) is an important winter season -short duration (70-80) vegetable used as root vegetable.

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Nitrogen application upholds the overall growth, yield and quality of radish (Brintha, and Seran, 2009). Nitrogen management is generally done with the use of chemical fertilizers (urea) creates adverse effects in the environment and demand a high amount of energy and cost (Oad et al, 2004). Thus, long-term management of nitrogen through organic manures is one of the options to minimize nitrogen loss from soil and improves radish productivity (Delate and Camberdella, 2004).

Organic manure addition improves nutrient supply and water retention (Kale et al, 1991). FYM, poultry manure, goat manure and biogas slurry are easily available organic manure sources in Chitwan and are the effective means to supply nitrogen for plant growth by improving physiochemical properties of sandy loam soil. The use of these manures has not been quantified yet in radish crop in terms of nitrogen management in Chitwan. So, this study aimed to know the best potential source of organic manure in fulfilling the nitrogen requirement of radish grown in sandy loam soil of Rampur, Chitwan.

Methodology

The field experiment was conducted at the horticulture farm of the Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal. The experiment was set in a randomized complete block design with six treatments (poultry manure, goat manure, FYM, biogas byproduct, recommended dose of fertilizers and control) and four replications. The area of each plot was 8 m² (4 × 2 m). As a test crop, Pyuthane Red variety of radish was planted in geometry 30 x 20 cm. In RDF treatment 100:60:40 kg NPK/ha was used. Full dose of P (di- ammonium phosphate) and K (muriate of potash) and half dose of N (urea) were applied at basal dose and the remaining half dose of N was applied at 35 days after sowing (DAS). Organic manures were incorporated into the soil 15 days prior to radish seed sowing.

Seven plants were tagged randomly with red thread leaving two rows in each side for data collection at 20 DAS, 35

DAS, 50 DAS and final harvest stage (65 DAS). Plant height, leaf breadth and root length were measured with measuring scale and root diameter by Vernier Caliper. Destructive sampling technique was used for the measurement of root diameter and root length at 20, 35 and 50 DAS. At harvesting all sample plants were harvested manually and root and shoots were weighted separately along with other parameters. For yield determination, plants within 1 m² were harvested. One-way ANOVA was done to see the significance level and means were separated by Ducans multiple range test (DMRT) at 5% level of significance using GenStat 2009 version.

Results and Discussion

The highest plant height was recorded from PM application at all stages but similar with RDF at 35 and 50 DAS. Similarly, at 20 DAS, the highest leaf number was recorded from RDF whereas highest leaf number was recorded from PM at 35 and 50 DAS which was similar with RDF. The highest leaf breadth was also recorded from PM at all growth stages which was similar with FYM at 20 DAS and with RDF at other stages. The lowest plant height, leaf number and leaf breadth was recorded from control treatment at all stages (Table 2).

The highest root length was obtained from PM application at 20, 35, 50 and 65 DAS which was similar with RDF at 20, 35 and 50 DAS. Similarly, the highest root diameter (26.49 mm and 37.21 mm) was recorded from PM, which was at par with other treatments except control at 35 DAS and 50 DAS. At 65 DAS, the highest root diameter (42.82 mm) was obtained from poultry manure, which was similar with other treatments except control and GM application. The highest total biomass (75.16 t/ha), delta root biomass (34.13 t/ha) and delta shoot biomass (14.12 t/ha) were recorded from PM application. The lowest total biomass was recorded from control treatment. The lowest delta root biomass was obtained from BGP and lowest delta shoot biomass was obtained from FYM (Table 3).

Table 1: Nutrient status of various organic manures

Treatments	N (%)	Amount of manure equivalent to 100 kg N (kg/ha)
Poultry manure(PM)	3.5	7137.5
Goat manure(GM)	1.25	26650
Farm yard manure (FYM)	0.95	42100
Biogas by-product(BGP)	0.70	71250
Recommended dose of fertilizer (RDF)	46	217.39
Control	-	

Note: Nutrients content in the organic manure was calculated on dry weight basis

Table 2: Effect of different sources of organic manures on plant height, leaf number and leaf breadth

Treatment	Plant height (cm)			Number of leaves				Leaf breadth (cm)			
	20 DAS	35 DAS	50 DAS	20 DAS	35 DAS	50 DAS	65 DAS	20 DAS	35 DAS	50 DAS	65 DAS
PM	21.61 ^a	39.11 ^a	44 ^a	6.321 ^b	10.07 ^a	13.54 ^a	12.5 ^a	7.964 ^a	11.143 ^a	11.61 ^a	12.39 ^a
GM	17.46 ^{bc}	29.25 ^{bc}	34.3 ^{bc}	5.821 ^b	8.54 ^b	12 ^b	10.82 ^{ab}	6.393 ^{bc}	9.0 ^b	10.04 ^{ab}	10.18 ^{bc}
FYM	17.96 ^{bc}	29.36 ^{bc}	33.3 ^{bc}	5.107 ^c	8.39 ^b	10.43 ^c	10.93 ^{ab}	7.017 ^{ab}	9.357 ^b	9.86 ^{ab}	9.79 ^c
BGP	18.64 ^b	29.36 ^{bc}	34.3 ^{bc}	5.857 ^b	8.18 ^{bc}	10.54 ^c	10.57 ^b	6.714 ^{bc}	8.643 ^b	9.8 ^{ab}	10.18 ^{bc}
RDF	18.46 ^b	34.43 ^{ab}	40.5 ^{ab}	7 ^a	10 ^a	12.79 ^{ab}	12.07 ^{ab}	6.536 ^{bc}	10.821 ^a	11.79 ^a	11.79 ^{ab}
Control	15.79 ^c	25.50 ^c	30.1 ^c	4.714 ^c	7.25 ^c	9.89 ^c	8.89 ^c	5.857 ^c	8.643 ^b	9.32 ^b	9.21 ^c
Grand Mean	18.32	31.26	36.1	5.8	8.74	11.53	10.96	6.76	9.6	10.42	10.6
SEM ±	0.812	1.969	3.02	0.2191	0.331	0.439	0.52	0.314	0.483	0.729	0.535
LSD (0.05)	2.449	5.936	9.11	0.6604	0.997	1.324	1.606	0.947	1.456	2.196	1.613
C.V %	8.9	12	16	7.6	7.6	6.7	9.7	9.3	10.1	14	10.1

Means followed by the same letter (s) in a column are not significantly different at 5% level of significance as determined by DMRT

Table 3: Effect of different sources of organic manures on root length, root diameter, total biomass, delta root and shoot biomass yield of radish

Treatment	Root Length (cm)				Root diameter (mm)			Yield		
	20 DAS	35 DAS	50 DAS	65 DAS	35 DAS	50DAS	65DAS	Total biomass (t/ha)	Delta root biomass (t/ha)	Delta shoot biomass (t/ha)
PM	12.75 ^a	22.83 ^a	26.03 ^a	27.96 ^a	26.49 ^a	37.21 ^a	42.82 ^a	75.16 ^a	34.13	14.12
GM	10.62 ^c	18.25 ^c	22.70 ^{bc}	23.01 ^b	23.31 ^{ab}	31.42 ^{ab}	33.89 ^b	63.20 ^{bc}	24.54	11.76
FYM	10.84 ^{bc}	18.42 ^c	20.75 ^{cd}	23.31 ^b	23.94 ^{ab}	33.83 ^{ab}	36 ^{ab}	60.98 ^{bc}	25.36	8.72
BGP	10.98 ^{bc}	18.75 ^{bc}	21.46 ^{cd}	22.82 ^b	23.71 ^{ab}	31.83 ^{ab}	33.47 ^{ab}	55.97 ^c	19.47	9.59
RDF	11.97 ^{ab}	20.86 ^{ab}	24.37 ^{ab}	24.07 ^b	23.79 ^{ab}	33.42 ^{ab}	35.83 ^{ab}	70.88 ^{ab}	31.5	12.48
Control	9.28 ^d	15.50 ^d	19.50 ^d	19.63 ^c	20.84 ^b	28.25 ^b	31.80 ^b	26.91 ^d	0	0
Grand Mean	11.07	19.1	22.47	23.47	23.6	32.66	35.63	58.9		
SEM±	0.384	0.748	0.856	0.722	1.133	2.121	2.342	3.86		
LSD (0.05)	1.156	2.253	2.579	2.176	3.415	6.394	7.059	11.63		
C.V %	6.9	7.8	7.6	6.2	9.6	13	13.1	13.1		

Means followed by the same letter (s) in a column are not significantly different at 5% level of significance as determined by DMRT

Based on the correlation coefficient of selected yield attributing characters and total biomass yield of radish, leaf number ($r = 0.967$) has positive and highly significant correlation with total biomass yield of radish (Table 4). Similarly, plant height ($r = 0.83$), leaf breadth ($r = 0.814$) and root length ($r = 0.884$) has positive and significant correlation with total biomass yield.

Table 4: Correlation coefficient between total biomass yield and yield attributing characters of radish

	Yield	Plant height	Leaf number	Leaf breadth	Root length	Root diameter
Yield	1					
Plant height	.830*	1				
Leaf number	.967**	.935**	1			
Leaf breadth	.814*	.997**	.923**	1		
Root length	.884*	.923**	.932**	.891*	1	
Root diameter	0.733	.875*	.830*	.835*	.954**	1

Note: *. Correlation is significant at the 0.05 level

** . Correlation is significant at the 0.01 level

Poultry manure performed best in all measured parameters could be due to the least value of C/N ratio of poultry manure that enhance faster decomposition and quicker release of nutrients than other organic manure sources. This observation was supported by Ijoyah and Sophie (2009)

who reported that the application of poultry manure increased crop yield. Sunassee (2001) reported that about 30% of nitrogen from poultry litter was in nitrate or ammonical form and thus was readily available to plants. 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. Costellanos and Pratt (1981) estimated that about 55 percent of the organic N was mineralized in first year and availability of total nitrogen was about 90 percent from poultry manure in first year. Espitiru *et al.* (1995) reported that the crop yield improvement due to addition of poultry manure was attributed to the presence of both readily available and slow release nitrogen. The application of RDF significantly increased the root diameter and radish yield than that of goat manure and biogas byproduct application could be due to the supply of readily available nutrients from the NPK fertilizer to the plant. Makinde (2013) also reported an increase in the readily available nitrate from the NPK fertilizer which can be easily utilized by the crops. These results were also consistent with several findings (Yasmeen *et al.*, 2009; Akani, 2005). The higher crop yield was found with application of poultry manure than chemical fertilizer (Zakaria and Vimala, 2002). Poultry manure is slightly

basic with a pH 7.8 and higher organic matter and available plant nutrients contents relative to other organic materials. Presently, application of poultry manure as organic source is cost effective because of its low moisture content and high macronutrient content (Sims and Wolf, 1994). The use of poultry manure improves soil fertility and aeration and increases water holding capacity. However, heavy application of poultry manure in long run may cause yield reduction due to the toxicity of trace elements (Pendias and Kabata-Pendias, 1984) and can enter into the water systems through surface run-off and leaching (Moore et al., 1998). So, long term study is necessary to see the effects of poultry manure application in Chitwan soil condition.

Conclusion

The application of organic manures significantly increased the plant height, number of leaves, leaf breadth, root length, root diameter and yield of radish crop. Among the various sources of organic manures, application of poultry manure was found more beneficial source and significantly improved growth parameters and yield of Pyuthane red variety of radish grown under Rampur, Chitwan condition. The research was limited to sandy loam inceptisols for a single season. Rigid conclusion can be drawn after the detailed and expanded study in long term and in different soil types.

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References

- Akanni DI (2005) Response of nutrient composition and yield components of tomato (*Lycopersicon esculentum* Mill) to livestock manure (Doctoral dissertation, Ph. D Thesis, Department of Crop, Soil and Pest Management, Federal University of Technology, Akure, Nigeria).
- Bakhsh KB, Ahmad Z and Hassan S (2006). Estimating indicators of higher yield in radish cultivation. *International Journal of Agriculture and Biology*, **8**(6): 783-787.
- Brady NC, and Weil R. (2013). *Nature and properties of soils, the: Pearson new international edition*. Pearson Higher Ed.
- 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. *J. Agric. Sci.*, **4**: 19-28.
- Costellanos SJZ and Pratt PF (1981) Mineralization of manure, nitrogen correlation with laboratory indices. *Soil Science Society of America*, **45**: 254-357.
- Delate K and Camberdella CA (2004) Agro- ecosystem performance during transition to certified organic grain production. *Agron. J.*, **96**(5): 1288-1298.
- Espiritu BM, Palacapp MG, Camtera JJJ and Willavar L (1995) Studies on chemical and microbiological parameters for organic fertilizers as basis for quality standards: *Terminal Report* (November, 1994 to May, 1995), College Leguna, Philippines.
- Gaines TP and Gaines ST (1994). Soil texture effect on nitrate leaching in soil percolates. *Communications in soil science and plant analysis*. Aug 1;25(13-14):2561-70.
- Ghimire R & Bista P (2016). Crop diversification improves pH in acidic soils. *Journal of Crop Improvement*, **30**(6): 657-667.
- Hati KM, Swarup A, Singh D, Misra A K, and Ghosh PK (2006). Long-term continuous cropping, fertilisation, and manuring effects on physical properties and organic carbon content of a sandy loam soil. *Soil Research*, **44**(5): 487-495.
- Ijoyah MO and Sophie VL (2009) Effect of different levels of decomposed poultry manure on the yield of cabbage (*Brassica Oleracea* L). *Agro Sci. J. Trop Agric Food Environ Ext* **8**(1): 20–23.
- Kale RN, Bano K, Styati GP. Influence of vermicompost application on growth and yield of cereals, vegetables and ornamental plants. Final Report of KSCST Project N67-04/Vermi/34B:(3478), 1991.
- Makinde A (2013) Effect of inorganic fertilizer on the growth and nutrient composition of moringa. *J Emerg Trends Eng Appl Sci (JETEAS)* **4**(2): 34–343.
- Moore P A, Daniel T C, Gilmore J T, Shreve B R, Edwards D R and Wood B H (1998). Decreasing metal runoff from poultry litter with aluminum sulfate. *J. Environ. Qual.* **27**(1):92–95.
- Oad FC, Buriro UA and Agha SK. (2004) Effect of organic and inorganic fertilizer application on maize fodder production. *Asian J. Plant Sci.*, **3**(3): 375-377.
- Sims JT and Wolf DC (1994). Poultry waste management: Agricultural and environmental issues. *Adv. Agron.* **50**:1–83. Stevenson, F., and L. Welch, 1979. Migration of applied lead in a field soil. *Environ. Sci. Technol.* **26**(4): 966–974.
- White RE (1987). In: Introduction to the Principles and Practice of Soil Science. English Language Book Society/Blackwell Scientific Publication. London.
- Zakaria, A and Vimala P (2002) Research and development of organic crop production in Malaysia. Paper presented at expert group workshop on presentation of technical guidelines on organic cultivation of tropical and subtropical fruits July, 2002, INTAN, Bukit Kiara, Kuala Lumpur. pp. 22–26.