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Influence of organic manures and inorganic fertilizers on growth, yield and profitability of radish (*Raphanus sativus* L.)

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ABSTRACT

A field experiment was conducted during rabi season of 2015-16 at Vegetable Research Farm, College of Horticulture, Mandsaur (MP) to study the influence of organic manures, inorganic fertilizers and their combinations on growth and yield of radish.Ten treatments were evaluated under randomized block design with 3 replications. Application of recommended dose of fertilizers through combination of fertilizer and organic manures significantly increased the crop growth, yield attributes and root yield as compared to other treatments. Among these treatments application of 75 % NPK + 25 % nitrogen through vermicompost resulted in significantly higher values of plant height (35.2 cm), number of leaves per plant (13.5), length of leaves (29.9 cm), root length (19.9), diameter of root (3.84 cm), days to harvest (51.5), average root weight (117.8) and yield (392.8 q ha^{-1}) and harvest index (56.8 %). The cost benefit-ratio (4.1) was also recorded maximum in this treatment. Thus, the application of 75 % NPK + 25 % nitrogen through vermicompost showed highest growth, yield and better return as compared to other treatments.

Key words: Organic manure, vermicompost, radish, yield, poultry manure, net income, B: C ratio

INTRODUCTION

Radish (*Raphanus sativus L.*) is a popular root vegetable of brassicaceae family grown all over world. In India it is widely cultivated in northern and southern plains, as well as in hills. It can be cultivated under cover for early production but large scale production in field is more common in India. Radish is grown for its young tender tuberous root which is consumed either raw as salad or cooked as a vegetable. Radish has cooling effect, prevents constipation and increases appetite. It is recommended for patients suffering from piles, liver troubles and jaundice. The juice of fresh leaves is used as diuretic and laxative. Radish is a good source of vitamin- C (ascorbic acid), containing 15-40 mg per 100 g of edible portion and supplies a variety of minerals. Trace elements in radish include aluminum, barium, lithium, manganese, silicon, titanium, fluorine and iodine (up to 18 u g/10 g). Beside tender leaves which are used as greens are rich in vitamin-A and C. roots are also rich in carbohydrate and protein. Pink skinned radish is generally richer in ascorbic acid than the white skinned one. The characteristics pungent flavor of radish is due to the presence of volatile isothiocynates (Bose *et al.*, 2000).

Chemical fertilizers deteriorate the quality of produce and are expensive too, leading to reduction in net profit and returns to the farmers. The integrated nutrient management system approach utilizes a judicious combination of inorganic fertilizer and organic manure in building soil fertility and to the increase the production potential of crop (Kumar *et al.*, 2013). In recent years use of organic manures like FYM, vermicompost and neem cake for improving the productivity of crop and maintaining soil fertility and productivity of soil is gaining prominence (Mahokar *et al.*, 2007). Vermicompost is a rich source of micro and macro nutrients, vitamins, growth hormones and enzymes. FYM is not a rich source of nutrients, increase organic carbon content to the soil and improves soil physical properties. Being a short duration and quick growing crop, the root growth should be rapid and uninterrupted in radish. Hence, for the production of good quality radish, optimum nutrition through organic, inorganic and biofertilizers are essential for

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sustainable production. Organic agriculture practices rely upon recycling of crop residues, animal manure, farm organic residues and wastes etc. In view of higher cost of synthetic fertilizers and its contribution to poor health of soil and water it becomes imperative to go for alternative and cheaper source like organic manures (Kumar *et al.*, 2014 and Arivazhagan *et al.*, 2019). Keeping the above facts in view, a field experiment was conducted to find out the effect of organic manures, inorganic fertilizers and their combinations on growth and yield of radish.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2015-16 at the research farm, College of Horticulture, Mandsaur (M.P.) situated at latitude of 23^{o} 45' to 24^{o}13' North, longitude of 74^{o} 44' to 75^{o}18' East and at an altitude of 435.2 m above mean sea level. Mandsaur has sub-tropical and semi-arid climatic conditions with a temperature range of 5^{0} C minimum and 44^{0} C maximum in winter and summer respectively. In this region maximum rainfall is received during mid June to September. The average annual rainfall is 544.05 mm. The South - West monsoon is responsible for major part of annual precipitation. The experiment was conducted in medium black (Vertisols) clay soils. The initial soil sample of experimental field had 7.2 pH, 0.46 dSm^{-1} electrical conductivity, low nitrogen (144 Kg ha^{-1}), medium phosphorus (33 kg ha^{-1}) and high potassium (419 kg ha^{-1}). The experiment was laid out in randomized block design with three replications. The ten treatments were T_1- RDF (100:80:50 kg NPK ha^{-1}), T_2-100 % N through FYM, T_3-100% N through vermicompost, T_4-100% N through poultry manure, T_5-75% NPK + 25 % N through FYM, T_6-75% NPK + 25% N through vermicompost), T_7 -75% NPK + 25% N through poultry manure, T_8-50% NPK + 50% N through FYM, T_9-50% NPK + 50% N through vermicompost and T_{10}-50% NPK + 50% N through poultry manure. The variety under study was Japanese White. Seeds were sown on 15th December, 2015 by hand dibbling method maintaining row to row distance of 30 cm and plant to plant distance 10 cm. Gap filling was done to maintain desired plant population in the plots. Nitrogen, Phosphorus and Potash were applied through urea, DAP and muriate of potash, respectively as per treatments. Full quantity of phosphorus, potash and 1/3 of nitrogen was applied as basal dressing as per treatments, while the remaining nitrogen was top dressed at 15 and 30 days after sowing. Organic manures viz., FYM, vermicompost and poultry manure were incorporated as per treatment to respective plots 15 days prior to sowing on the basis of nitrogen percentage. The nitrogen content in FYM, vermicompost, and poultry manure was 0.5, 1.5 and 2%, respectively. Optimum soil moisture was maintained in the field by regular irrigation. Observations were recorded on plant growth parameters, yield attributes and yield of radish roots. The data obtained on various observations for each treatment were statistically analyzed as per standard procedures.

RESULTS AND DISCUSSION

Growth attributes

There was significant effect of organic manures, inorganic fertilizers and their combinations on all the growth parameters (Table 1). Among the treatments, T_6 (75 % NPK + 25 % N through vermicompost) recorded the maximum value of plant height at different stages of growth followed by T_7 (75 % NPK + 25 % N through poultry manure). The minimum value of plant height was observed with T_2 (100 % N through FYM) at all the stages of crop growth. The increase in height of plant by the use of vermicompost with integration of NPK fertilizer may be due to beneficial influence of nitrification inhibition properties of vermicompost in the soil. Besides, it may also be due to rapid elongation and multiplication of cell in the presence of adequate quantity of nitrogen (Barman *et al.*, 2014). Similar results were reported by Kumar *et al.* (2014) in radish and Bhattarai and Maharjan (2013) and Kushwah *et al.* (2019) in carrot. Application of different sources of nutrients resulted in significant variation for number of leaves per plant at all the growth stage. Highest number of leaves was observed with T_6 (75 % NPK + 25 % N through vermicompost) followed by T_7 (75 % NPK + 25 % N through poultry manure), while the lowest number of leaves was noted with T_2 (100 % N through FYM) at all the stages of crop growth.

Table 1: Effect of organic manures, inorganic fertilizers and their combinations on growth attributes of radish

Treatments	Plant height (cm)			Number of leaves plant^{-1}			Length of leaves (cm)		
	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest
T_1	10.47	25.73	27.73	4.87	8.63	11.13	8.63	20.77	24.27
T_2	9.13	22.83	25.90	4.60	7.87	10.83	6.83	18.43	21.83
T_3	10.20	24.97	26.93	4.77	8.23	10.93	7.80	20.03	23.19
T_4	9.80	23.77	26.07	4.63	8.10	10.97	7.67	19.69	23.01
T_5	11.90	27.30	29.67	5.27	9.03	11.43	9.10	22.25	25.21
T_6	14.43	32.37	35.23	6.53	11.03	13.50	11.33	27.03	29.97
T_7	13.07	29.53	32.53	5.87	10.07	12.47	10.17	24.33	27.49
T_8	10.63	25.83	27.90	4.97	8.70	11.23	8.70	21.70	24.45
T_9	11.63	26.97	29.10	5.20	8.80	11.37	9.07	22.01	25.20
T_{10}	10.97	26.70	28.20	5.10	8.77	11.30	8.80	21.95	24.56
SEm±	0.45	0.94	0.89	0.18	0.32	0.34	0.37	0.90	0.77
CD	1.34	2.81	2.65	0.54	0.96	1.02	1.12	2.69	2.30

T_1-RDF (100:80:50 kg NPK ha^{-1}), T_2-100 % N through FYM, T_3-100 % N through vermicompost, T_4-100 % N through poultry manure, T_5-75 % NPK + 25 % N through FYM, T_6-75 % NPK + 25 % N through vermicompost), T_7 -75 % NPK + 25 % N through poultry manure, T_8-50 % NPK + 50 % N through FYM, T_9-50 % NPK + 50 % N through vermicompost and T_{10}-50 % NPK + 50 % N through poultry manure

Present studies clearly indicated that vermicompost in combination with 75% recommended dose of fertilizers played significant role in increasing the growth and ultimately number of leaves in radish. Highest number of leaves in T_6 (75 % NPK + 25 % N through vermicompost) due to slow release of nutrients through vermicompost thus enriching available nutrient pool of the soil that resulting in more number of leaves per plant (Bhattarai and Maharjan, 2013). Similar findings have been reported by Kumar *et al.* (2014) and Khalid *et al.* (2015) in radish. Among treatments, maximum length of leaves was found with the treatment T_6 (75 % NPK + 25 % N through vermicompost) which was followed by T_7 (75 % NPK + 25 % N through poultry manure). Minimum length of leaves was recorded under nutrient treatment T_2 (100 % N through FYM). Highest length of leaves in T_6 treatment was due to vermicompost provides the micronutrients such as zinc, copper, iron and manganese etc. in the adequate amount to the plant (Bhattarai and Maharjan, 2014). The present findings were in agreement with Kumar *et al.* (2014) in radish and Kushwah *et al.* (2019) in carrot.

Yield Parameters and Yield

Maximum length of root was recorded under the treatment T_6 (75 % NPK + 25 % N through vermicompost) and it was followed by T_7 (75 % NPK + 25 % N through poultry manure). Minimum length of root was found with 100 % N through FYM (Table 2). The beneficial effect of combined application of organic manure (vermicompost or compost) and fertilizer might be attributed to the increased efficacy of inorganic fertilizers and supply of all the essential nutrients in a balanced amount owing to their control release coinciding with the stage of root growth (Kumar *et al.*, 2014). Maximum diameter of root was found with the application of 75 % NPK + 25 % N through vermicompost followed by T_7 (75 % NPK + 25 % N through poultry manure), while the minimum diameter of root was recorded with treatment T_2 (100 % N through FYM). These findings are in agreement with those reported by Uddain *et al.* (2010) and Kumar *et al.* (2014) in radish and Kumar *et al.* (2014) in carrot. Maximum days to harvest was recorded under the treatment T_2 (100 % N through FYM) followed by T_4 (100% N through poultry manure), while the minimum days was observed with T_6 (75 % NPK + 25 % N through vermicompost). These findings are in agreement with those reported by Malik and Kumar (2009) in tomato.Treatments indicated significant and beneficial effect on average weight of root and maximum average weight of root (117.8 g) was observed with 75 % NPK + 25 % N through vermicompost followed by 75 % NPK + 25 % N through poultry manure. The minimum average weight of root (81.4 g) was observed with T_2 (100 % N through FYM). This was attributed to solubilizing effect of plant nutrients by the

addition of vermicompost leading to increased uptake of NPK. Organic manure plays a direct role in plant growth as a source of all necessary macro and micro-nutrients in available forms during mineralization, improving physical and physiological properties of soil. Similar findings have been reported by Kumar *et al.* (2014) in radish and Kumar *et al.* (2014) in carrot.

Table 2: Effect of organic manures, inorganic fertilizers and their combinations on yield and harvest index and economics of radish

Treatments	Length of root (cm)	Diameter of root (cm)	Day to harvest	Weight of root (g)	Root yield (q ha^{-1})	Harvest index (%)	Gross income (Rs. ha^{-1})	Net income (Rs.ha^{-1})	B:C ratio
T_1	17.0	2.88	59.0	91.2	303.9	55.4	151985	120213	3.78
T_2	15.8	2.74	60.3	81.4	271.5	52.2	135786	90686	2.01
T_3	16.9	2.81	59.1	90.0	300.0	53.9	150041	91611	1.57
T_4	16.8	2.80	59.6	83.1	276.9	52.3	138486	98386	2.45
T_5	17.8	3.11	57.1	101.0	336.8	54.5	168439	133335	3.80
T_6	19.9	3.84	51.5	117.8	392.8	56.8	196415	157979	4.11
T_7	18.3	3.48	54.6	101.2	337.3	54.5	168670	134816	3.98
T_8	17.3	2.96	58.3	93.5	330.0	53.5	155873	117437	3.06
T_9	17.8	3.03	57.8	98.8	329.3	54.5	310.75	1154015	2.65
T_{10}	17.6	2.99	58.0	93.5	311.8	54.1	155946	120010	3.34
SEm±	0.55	0.12	1.04	3.3	11.1	0.76	5557	5557	0.14
CD at 5%	1.65	0.36	3.09	9.9	33.0	2.25	16510	16510	0.43

The maximum root yield (392.8 q ha^{-1}) was recorded under the 75 % NPK + 25 % N through vermicompost followed by 75 % NPK + 25 % N through poultry manure. The minimum root yield (271.5 q ha^{-1}) was observed with T_2 (100 % N through FYM). An important feature of vermicompost is that during the processing of the various organic wastes by earthworm, many of the nutrients that it contents are changed to forms that are more readily taken by plants (Degwale, 2016). Similar findings have been reported by Kumar *et al.* (2014) in radish, Kumar *et al.* (2014) in carrot, Barman *et al.*(2014) and Narayan *et al.*(2014) in potato. Harvesting index of radish significantly affected by treatments and the maximum harvesting index was recorded under the treatment T_6 (75 % NPK + 25 % N through vermicompost) followed by 75 % NPK + 25 % N through poultry manure, while the minimum harvesting index was noted under treatment T_2 (100 % N through FYM). The response of vermicompost might be due to insufficient amount of organic matter to amend physical and chemical properties of soil of the soil (Degwale, 2016). Similar findings have been reported by Narayan *et al.* (2014) in potato.

Economics

The various treatments indicated significant effect on gross income, net income and B: C ratio. Highest gross income (Rs. 196415 ha^{-1}), net income (Rs. 157979 ha^{-1}) and B: C ratio (4.1) was found with the application of 75 % NPK + 25 % N through vermicompost which was significantly superior over all other treatments. The minimum gross income (Rs. 135786 ha^{-1}), net income (90686 ha^{-1}) were reported under T_2 (100 % N through FYM), while minimum B: C ratio (1.5) was obtained in the treatment T_3 (100 % N through vermicompost) due to lesser yield, ultimately lesser gross income and higher cost of vermicompost. Therefore, balance nutrition in integration is essential to enhance the benefit: cost ratio in radish. The results are in line with the findings of Vithwel and Kanaujia (2013) and Sharma *et al.* (2015) in carrot and Narayan *et al.* (2014) in potato.

Thus, it may be concluded from the results that the conjoint use of 75% recommended dose of fertilizers and 25% recommended dose of Nthrough vermicompost increased the growth, productivity, profitability and reduced the use of chemical fertilizers in radish.

REFERENCES

Arivazhagan, E., Kandasamy, R. and Maniram, S. (2019) Influence of organic inputs on the growth, yield and quality of tomato (*Solanum lycopersicum* L.) cv. SIVAM.*Annals of Plant and Soil Research***21**(4): 367-370.

Barman, K. S., Ram, B. and Verma, R. B. (2014) Effect of Integrated nutrient management on growth and tuber yield of potato (*Solanum tuberosum*) cv. Kufri Ashoka.*Trends in Biosciences***7**(9): 185-187.

Bhattarai, B. P. and Maharjan, A. (2013) Effect of organic nutrient management on the growth and yield of carrot *(Daucus carota* L.)and soil fertility status.*Nepalese Journal of Agricultural Sciences***11**:16-25.

Bose, T. K., Kabir, J., Das, P. and Joy, P. P. (2000) Tropical Horticulture, Volume-1 Naya Prokash, Calcuta. pp. 145.

Degwale, A. (2016) Effect of vermicompost on growth, yield and quality of garlic (Allium sativum L.) in Enebse Sar Midir District, Northwestern Ethiopia. *Journal of Natural Sciences Research***6**(3): 2224- 3186.

Khalid, M., Yadav, B. K. and Yadav, M. P. (2015) Studies on the effect of integrated nutrient management on growth and yield attributes of radish (*Raphanus sativus* L*.).* Annals of Horticulture**8** (1): 81-83.

Kumar, P., Meghwal, P. R. and Painuli, D. K. (2014) Effect of organic and inorganic nutrient sources on soil health and quality of carrot.*Indian Journal of Hort*iculture**71**(2): 222-226.

Kumar, P., Shukla, Y. R. and Kumar, R. (2013) Effect of integrated nutrient management practices on seed yield and contributing characters in radish (*Raphanus sativus* L.) cv. Chinese Pink. *Advance Research Journal of Crop Improv*ement**4** (1): 74- 78.

Kumar, S., Maji, S., Kumar, S. and Singh, H.D. (2014) Efficacy of organic manures on growth and yield of radish (*Raphanus sativus* L.) cv. Japanese White.*International Journal of Plant Sciences* **9**(1): 57-60.

Kushwah, G.; Sharma, R. K.; Kushwah, S.S. and Mishra, S. N. (2019).Effect of organic manures, inorganic fertilizers and varieties on growth, yield and quality of tropical carrot.*Indian Journal of Horticulture* **76**(3): 451-456.

Mahokar, V.K., Bodkhe, V.A., Ingle, V.G., Jadhao, B. J. and Gomase, D.G. (2007) Effect of various organic manures on growth and yield of radish.*Asian Journal of Horticulture***2**(1): 155-157.

Malik, M.F. and Kumar, V. (2009) Influence of INM on growth and yield of tomato. *Annals of Horticulture***2** (2): 221- 223.

Narayan, S., Kanth, R. H., Narayan, R., Khan, F. A., Saxena, A. and Hussain, T. (2014) Effect of planting dates and integrated nutrient management on productivity and profitability of potato (*Solanum tuberosum*) in Kashmir valley. *Indian Journal of Agronomy* **59**(1): 145-150.

Sarma, I. Phookan D.P. and Boruah, S. (2015) Influence of manures and biofertilizers on carrot (*Daucus carota*L.) cv. Early Nantes growth, yield and quality.*Journal of Eco-friendly Agriculture* **10**(1): 25-27.

Uddain, J., Chowdhury, S. and Rahman, M. J. (2010) Efficacy of different organic manures on growth and productivity of radish (*Raphanus sativus*L.).*International Journal of Agriculture, Environment and Biotechnology***3**(2): 189-193.

Vithwal and Kanaujia, S. P. (2013).Integrated nutrient management on productivity of carrot and fertility of soil.*SAARC Journal of Agri*culture **11**(2): 173-181.