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Effect of Integrated Nutrient Management on Yield and Quality Attributes of Radish (*Raphanus sativus* L.)

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ABSTRACT

Background: Radish (*Raphanus sativus* L.) is one of the most popular root crops during the *rabi* season and it is well praised for its high nutritional and therapeutic value. The current study on "impact of integrated nutrient management on yield and quality characteristics of radish" was carried out to determine the interacting effects between organic manures and inorganic fertilizers and effective integrated nutrient management strategies advised for radish.

Methods: A field experiment was conducted during 2017-18. The research trial was laid out in factorial randomized block design with nine treatments and was replicated thrice in which consists of different organic manures integrated with reduced inorganic fertilizer *viz.,* Vermicompost, FYM and 50% RD of NPK, 100% RD of NPK

Result: The results of the experiment revealed that application of vermicompost in combination with 50% NPK showed maximum yield and quality attributes of Radish.

Key words: 100% RD of NPK, 50% RD of NPK, FYM, Vermicompost.

INTRODUCTION

Radish (*Raphanus sativus* L.) is one of the most popular root crops grown in the *rabi* season. It is widely acclaimed for its excellent nutritive and medicinal values and is mainly grown in tropical and temperate countries. The total area under radish cultivation is 212 thousand ha, with an average production of 3,316 thousand tonnes in India (Anonymous, 2020). Mainly, agriculture in India depended upon chemical fertilizers. Higher usage of chemical fertilizers leads to soil health deterioration and increases the production cost, Therefore, integration of less costly organic nutrient sources with inorganic sources can reduce the demand for chemical fertilizers, reduce the cost of production and long-term management of soil fertility and soil productivity (Sharma, 2000). FYM helps improve crop growth by providing nutrition and improving the physical, chemical and biological properties of soil (Mengistu and Mekonnen, 2012). Organic manure (FYM) provides nutrients to plants and improves the soil texture by the binding effect to soil aggregates. Organic manure increases cation exchange capacity, water holding capacity and soil phosphate availability. Besides improving the fertilizer use efficiency and microbial population of soil, it reduces nitrogen loss due to the slow release of nutrients (Menka Pathak *et al.,* 2018).

In recent years, the use of Vermicompost has advocated integrated nutrient management (INM) system in vegetable crops, which is a slow-releasing and organic manure that has most of the macro and micronutrients in chelated form and fulfils the nutrient requirement of the plant for a more extended period. It also helps in reducing the C: N ratio, increasing humic acid content, cation exchange capacity and water-soluble carbohydrates (Talashilkar *et al.,* 1999). It also contains biologically active substances such as plant growth regulators (Krishnamoorthy and Vajranabhaiah, 1986). This organic manure positively influences soil texture and water holding capacity (Kale *et al.,* 1991). Integration of both organic and inorganic may also increase the quality of the crop due to reduced inorganic fertilizer application. Keeping the preceding facts in mind, the present study was planned to study the effect of organic and inorganic fertilizers on the yield and quality of radish.

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MATERIALS AND METHODS

A field experiment was conducted during 2017-18 at Horticulture farm, Bhagwant University. The climate of Ajmer is typically semi-arid, characterized by extremes of temperature both in summer and winter with low rainfall and moderate humidity. Ajmer falls in a belt of semi-arid to sub-humid climate. The experimental plot was classified as sandy loam in texture acidic in reaction, poor in nitrogen as well as phosphorus and moderate in potash content. The experiment was laid out in factorial randomized block design (FRBD) in which factor 'M' consists of organic manures *viz.,* Control (M_0), Vermicompost @ 5 t ha^{-1} (M_1), FYM @ 15 t ha^{-1} (M_2) and Factor 'F' consists of Inorganic fertilizers *viz.,* 0 % RD of NPK (F_0), 50% RD of NPK (F_1), 100% RD of NPK (F_2)

and was replicated thrice. Pusa Rashmi was used as test crop. Vermicompost and FYM were applied at the rate of 5 and 15 t ha^{-1} spread uniformly in the beds. As per the treatments, nitrogen, phosphorus and potassium were applied through urea, single super phosphate and muriate of potash, respectively in the experiment. The data generated through present investigation was analysed by using AGRES software.

RESULTS AND DISCUSSION

Yield and yield attributes

Effect of organic manures

The data presented in the Table 1 shows that application of vermicompost recorded significantly higher length and diameter of the root. The mean maximum length of root (30.18 cm), The mean maximum diameter (4.31 cm) was recorded with 15 t ha^{-1} vermicompost (M_1), which was found significantly higher over control and M_2. The increase in length of root at harvest M_2 treatment was 41.69 and 11.48 per cent higher over control and M_1 treatment, respectively. Vermicompost, might have increased the efficiency of added chemical fertilizers in the soil, activities of nitrogen fixing bacteria and increased rate of humification which enhances the availability of both native and added nutrients in soil resulting in increased yield and yield attributing characters. These results are in accordance with the finding of Reddy *et al.* (1998), Tomar *et al.* (1998) and Oliveira *et al.* (2001).

The data presented in Table 1 clearly indicated that different organic manure significantly influenced the yield of radish per plot and hectare. The maximum yield per plot (18.03 kg $plot^{-1}$) was recorded under M_1 (5 t ha^{-1} vermicompost) treatment while minimum under M_0 (12.58 kg $plot^{-1}$) treatment. The treatment M_1 was found significantly superior over control and M_2. The beneficial effect of vermicompost on yield and yield attributing characters might be due to enhanced supply of macro and micro nutrients during entire growing season. Significant increase in yield under the influence of vermicompost was largely a function of improved growth and the consequent increase in different yield attributes. It could be attributed to the availability of nutrients and plant development affecting components such as growth regulators and humic acid formed by the microbial community due to earthworm activities. Mahorkar *et al.,* (2007) and Gupta *et al.,* (2011) confirmed our findings, showing that plots treated with vermicompost produced higher yields than plots treated with other organic manures in radish crops. During the study, Kumar and Gupta (2018) also observed the best yield of radish when vermicompost was used.

Effect of inorganic fertilizers

The perusal of data further reveal that different inorganic fertilizers influence significantly the length of root. The maximum length of root (30.35 cm), diameter of root (4.54 cm) was recorded under F_2 treatment (100 per cent recommended dose of NPK) which was found significantly maximum over control and F_1. The application of 100 per cent recommended dose of N and P favoured the metabolic and Auxin activities in plants and ultimately resulted in increased weight of root and total yield ha^{-1}. The results are in close conformity with the findings of Uddain *et al.* (2010), Kumar *et al.* (2014) and Choudhary (2006).

Application of inorganic fertilizers influenced significantly the total yield (kg $plot^{-1}$) at harvest. The maximum total yield (17.96 kg $plot^{-1}$) was recorded in treatment F_2 (100 per cent recommended dose of NPK), which was found to be significantly higher over control and F_1. This might be due to the fact that increased N, P and K levels, help in the expansion of leaf area and chlorophyll content, which together might have accelerated the photosynthetic rate and in turn increased the supply of carbohydrates to the plants. The application of 100 per cent recommended dose of N and P favoured the metabolic and Auxin activities in plants and ultimately resulted in increased weight of root and total yield ha^{-1}. The results of present findings are in close conformity with the findings of Yadav

Table 1: Effect of organic and inorganic fertilizers on yield and yield attributes of Radish.

Treatments	Length of root (cm)	Diameter of root (cm)	Yield (kg $plot^{-1}$)	Yield (q ha^{-1})
Organic manures				
M_0 (Control)	21.30	3.13	12.58	166.48
M_1 (VC @ 5 t ha^{-1})	30.18	4.31	18.03	231.64
M_2 (FYM @ 15 t ha^{-1})	27.07	3.53	17.45	215.37
SEm±	0.85	0.30	0.10	3.42
CD at 5%	2.43	0.86	0.36	11.87
Inorganic fertilizers				
F_0 (Control)	20.36	2.67	12.67	166.48
F_1 (50% RD of NPK)	27.84	3.66	17.42	219.98
F_2 (100% RD of NPK)	30.35	4.64	17.96	227.02
SEm±	0.85	0.30	0.13	1.50
CD at 5%	2.43	0.86	0.45	5.37

and Paliwal (1990) while working with response of cauliflower to nitrogen and fertilization on irrigation with saline water stress. Similar findings were reported by Srivastava and Singh (1994) in mid-season cauliflower and Prabhakar and Ramachander (1999) in radish.

Quality attributes

Effect of organic manures

The perusal of data (Table 2) further reveal that different organic manures significantly affected the ascorbic acid (mg/100 g) at harvest. The mean maximum (12.52 mg/100 g) ascorbic aid content was found in treatment M_1 (5 t ha^{-1} vermicompost), which was found significantly higher over control and M_2. The data revealed that TSS content (%) in root of radish was found to be non-significantly influenced by the application of organic manures applied treatments. The increased concentration of nutrients in plant under vermicompost fertilization might be due to adequate supply of nutrients resulting in increased N content, TSS and ascorbic acid in root. The results obtained in the present investigation are in close conformity with the findings of Choudhary (2006) and Gupta *et al*. (2011).

Effect of inorganic fertilizers

Application of inorganic fertilizers significantly affected within the treatments. The data presented in Table 2 clearly indicated that application of 100% RD of NPK (F_2) showed significant increase in TSS content, ascorbic acid content. It may be due to adequate supply of nutrients through Inorganic fertilizer Data further, showed that TSS (%), ascorbic acid content in root increased significantly under application of inorganic fertilizers. The maximum ascorbic acid content (12.31 mg/100 g), TSS content (7.41%) in root was recorded with F_2 (100 per cent recommended dose of NPK) which was found to be significantly higher over control and F_1. These findings were in line with those of Jat *et al.* (2017).

Interaction (M × F)

Yield and yield attributes

The findings in Table 3 clearly showed that using vermicompost in conjunction with 100% RD of NPK resulted in greater root length and diameter. This was ascribed to the plant's solubilizing action nutrients by adding vermicompost, resulting in higher NPK absorption. Organic manure contributes directly to plant growth by providing all required macro and micronutrients in usable forms during mineralization, increasing the soil's physical and physiological qualities. Kumar *et al.* (2014) found similar findings in radish and Kumar *et al.* (2014) in carrot.

The interactive effect of different organic manures and inorganic fertilizers on total yield (kg $plot^{-1}$) was found significant. The maximum yield (20.22 kg $plot^{-1}$) (257.15q ha^{-1}) was recorded under the treatment combination 100% RD of NPK + Vermicompost @ 5 t ha^{-1}, which was significantly higher to control and other treatment combinations. However, it was statistically at par with 50% RD of NPK along with Vermicompost @ 5 t ha^{-1}. Integration of the full recommended dose of NPK combined with

Table 2: Effect of organic and inorganic fertilizers on quality attributes of radish.

Treatments	Ascorbic acid (mg/100 g)	TSS (%)
Organic manures		
M_0 (Control)	8.88	5.79
M_1 (VC @ 5 t ha^{-1})	12.52	6.55
M_2 (FYM @ 15 t ha^{-1})	10.59	6.08
SEm±	0.46	0.38
CD at 5%	1.59	NS
Inorganic fertilizers		
F_0 (Control)	9.03	4.76
F_1 (50% RD of NPK)	10.66	6.25
F_2 (100% RD of NPK)	12.31	7.41
SEm±	0.34	0.29
CD at 5%	1.40	1.02

Table 3: Interaction effect of organic and inorganic fertilizers on yield and yield attributes of radish.

Treatments	Length of root (cm)	Diameter of root (cm)	Yield (kg $plot^{-1}$)	Yield (q ha^{-1})
Control	17.65	2.27	9.95	135.53
Control + 50% RD of NPK	21.67	3.17	13.68	179.09
Control + 100% RD of NPK	24.58	3.95	14.10	184.81
Vermicompost @ 5 t ha^{-1} + Control	24.19	3.01	14.27	188.58
Vermicompost @ 5 t ha^{-1} + 50% RD of NPK	32.11	4.14	19.61	249.19
Vermicompost @ 5 t ha^{-1} + 100% RD of NPK	34.24	5.78	20.22	257.15
FYM @ 15 t ha^{-1} + Control	19.24	2.73	13.80	175.33
FYM @ 15 t ha^{-1} + 50% RD of NPK	29.74	3.67	18.98	231.68
FYM @ 15 t ha^{-1} + 100% RD of NPK	32.23	4.19	19.56	239.09
S.Em±	0.18	0.05	0.07	1.30
C.D at 0.05	1.31	0.25	0.47	9.31

Table 4: Interaction effect of organic and inorganic fertilizers on quality attributes of radish.

Treatments	Ascorbic acid (mg/100 g)	TSS (%)
Control	7.50	4.26
Control + 50% RD of NPK	9.04	5.75
Control + 100% RD of NPK	10.65	7.36
Vermicompost @ 5 t ha^{-1} + Control	10.36	5.24
Vermicompost @ 5 t ha^{-1} + 50% RD of NPK	12.44	6.94
Vermicompost @ 5 t ha^{-1} + 100% RD of NPK	14.08	7.47
FYM @ 15 t ha^{-1} + Control	9.24	4.78
FYM @ 15 t ha^{-1} + 50% RD of NPK	10.49	6.07
FYM @ 15 t ha^{-1} + 100% RD of NPK	12.19	7.41
S.Em±	0.19	0.07
C.D at 0.05	1.42	0.53

vermicompost resulted in increased root volume, which may be attributed to the immediate availability of nutrients by chemical fertilisers. In the long run, vermicompost, rich in micronutrients, aids in root growth.

Quality attributes

In Table 4, the total soluble solid of tuber enhanced as the source of organic fertilisers in conjunction with inorganic fertilisers increased. The greatest T.S.S. concentration was found in the treatment vermicompost combined with 100% R.D. of N.P.K. (7.47%). The largest T.S.S. concentration in tuber might be related to the highest moisture content dry weight of root because organic fertilisers provide practically all micro and macronutrients essential for plant growth. The ascorbic acid concentration (14.08 mg/100 g) in vermicompost + 100% R.D. of N.P.K. was likewise high. These are results are in cobordance with Kareem, 2013.

CONCLUSION

In light of the above, the current study found that combining both vermicompost and 100 per cent RD of NPK led to the most significant root length (34.24 cm), yield kg $plot^{-1}$ (20.22), root yield ha^{-1} (257.15 q) and TSS (7.47%), ascorbic acid content (14.08 mg/100 g). It can be concluded that the conjugated application of organic manures with inorganic fertilizers results in higher crop yield and quality due to micronutrients present in organic manures. Also, microbes in manure enhance the inorganic fertilizers by solubilizing the unavailable nutrients to available form, resulting in higher crop yield and quality of the radish crop.

REFERENCES

Anonymous, (2019-2020). Department of Agriculture and Farmer's Welfare. 1st Advance Estimates. www.agricoop.nic.in.

Choudhary, S. (2006). Effect of organic and inorganic sources of nutrients on growth, yield and quality of sprouting broccoli [*Brassica oleracea* (L.) var. italica Plenck] cv. C.B.H-1. Submitted to M.Sc. Thesis, Rajasthan Agricultural University, Bikaner, Campus-Jobner, Rajasthan.

Gupta, A.K., Ray, B., Singh, M.P. and Upadhyaya, V. (2011). Effect of fertilizers and vermicompost and growth, yield and biochemical changes in *Abelmoschus esculentus*. Plant Archives. 11(1): 285-287.

Jat, P.K., Singh, S.P., Devi, S., Mahala, P. and Rolaniya, M.K. (2017). Performance of organic manures, inorganic fertilizer and plant density of yield and quality of radish. International Journal of Agricultural Science and Research. 7(2): 261-266.

Kale, R.N., Bano, K. and Styati, G.P. (1991). Influence of Vermicompost Application on Growth and Yield of Cereals, Vegetables and Ornamental Plants. Final Report of KSCST Project N67-04/Vermi/34B (3478).

Kareem, I. (2013). Fertilizer's treatment effects on yield and quality parameters of sweet potato (*Ipomoea batatas*). Research Journal of Chemical and Environmental Sciences. 1: 40-49.

Krishnamoorthy, R.V. and Vajranabhaiah, S.N. (1986). Biological activity of earthworm casts on assessment of plant growth promoters' levels in the cost. Proceedings of Indian Academy Sciences (Animal Science). 95: 341-351.

Kumar, A. and Gupta, R. (2018). The effects of vermicompost on growth and yield paameters of vegetable crop radish (*Raphanus sativus*). Journal of Pharmacognosy and Phytochemistry. 7(2): 589-592.

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

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 Science. 9(1): 57-60.

Mahorkar, 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.

Mengistu, D.K. and Mekonnen, L.S. (2012). Integrated agronomic crop managements to improvement of productivity under terminal drought. Water stress, In tech open, pp. 235-254. DOI: 10.5772/30662.

Pathak, M., Tripathy, P., Dash, S.K., Sahu, G.S. and Pattanayak, S.K. (2018). Efficacy of bio-fertilizer, organic and inorganic fertilizer on yield and quality of radish (*Raphanus sativus* L.). International Journal of Chemical Studies. 6(4): 1671-1673.

Oliveira, A.P., Ferreira, D.S., Casta, C.C., Silva, A.F. and Alves, E.V. (2001). Utilization of cattle manure and earthworm compost in hybrid cabbage production. Horticultura Brasileira. 19(1): 70-73.

Prabhakar, B.S. and Ramchander, P.R. (1999). Response surface of radish for NPK fertilization, South India Horticulture. 47(1/6): 240-241.

Reddy, R., Reddy, M.A.N., Reddy, Y.T.N., Reddy, N.S., Anjanappa, N. and Reddy, R. (1998). Effect of organic and inorganic sources of NPK on growth and yield of pea [*Pisum sativum* (L)]. Legume Research. 21(1): 57-60.

Sharma, M.P., Bali, S.V. (2000). Long term effect of different cropping systems on physico-chemical properties and soil fertility. Journal of Indian Society of Soil Science. 48: 181-183.

Srivastara, B.K. and Singh, M.P. (1994). Effect of spacing, nitrogen and phosphorus on performance of mid-season cauliflower. Indian Journal of Horticulture. 51(2): 187-191.

Talashilkar, S.C., Bhargarath, P.P. and Metha, V.B. (1999). Change in chemical properties during compositing of organic residues as influenced by earthworm activity. Journal of India Society Soil Science. 47(1): 50-53.

Tomar, V.K., Bhatnagar, R.K. and Palta, R.K. (1998). Effect of vermicompost on production of brinjal and carrot. Bhartiya Krishi Anusardhan Patrika. 13(3-4): 153-156.

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.

Yadav, B.P. and Paliwal, K.V. (1990). Response of cauliflower to nitrogen and fertilization on irrigation with saline water stress. Vegetable Science. 17: 1-6.