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Effect of Integrated Nutrients Management (INM) Practices on Growth and Yield of Radish

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Integrated Nutrient Management (INM) is necessary to enhance sustainable yield in an eco-friendly way. A field experiment was conducted during November 2021 in winter season at School of Agriculture, Abhilashi University Mandi (Chail Chowk), Himachal Pradesh to study the effect of integrated nutrients management on growth and yield of the radish cv. Pusa Desi. The experiment consisted of 7 treatments with control, laid out in Randomized Block Design with three replications. The treatment combination consisted of organic manure (FYM and Vermicompost) and inorganic fertilizers (NPK). The quantitative growth and yield parameters were recorded at 30 DAS and at harvest. Number of leaves (7.72) at 30 DAS and (14.28) at harvest, root length (12.10 cm) at 30 DAS and (26.43 cm) at harvest, root diameter (3.13 cm) at 30 DAS and (5.70 cm) at harvest, was recorded in T_5 (NPK 50% + FYM 25% + Vermicompost 25%) Whereas the fresh weight (195.18 g) and dry weight of roots (39.04 g), root yield per plot (28.23 kg), root yield per hectare (470.53 q) and harvest index (45.45%) was also maximum recorded in T_5 (NPK 50% + FYM 25% + Vermicompost 25%). The study suggested that the combined application of inorganic and organic manure and fertilizers (NPK 50% + FYM 25% +Vermicompost 25%) was highly beneficial for all the growth and yield parameters of radish.

Keywords: Integrated nutrients managements; growth; radish; yield.

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1. INTRODUCTION

Radish (*Raphanus sativus* L.) is one of the most important root crops grown in the world and India. Radish is a quick growing herbaceous annual plant belonging to the family Brassicaceae having chromosome number 2n=2x=18. Radish is probably said to be originated in Europe and the Western Asian region.

The fleshy roots that grow from both the primary root and the hypocotyl are the major part of a radish that are consumed. It is eaten raw as salad, cooked as a vegetable and also used to prepare pickles. The roots are reportedly helpful for stomach issues, piles, gastrodynia, enlarged spleen, jaundice, and urinary symptoms. The strong flavour of radish is due to volatile isothiocyanates (trans-4-methyl-thibutenyl-isothiocyanate). The total area under radish cultivation in India is 208.55 thousand hectares with a production of 3061.29 Mt. Radish is grown throughout the country, mainly in Punjab, Uttar Pradesh, Maharashtra and Kashmir. West Bengal ranks number one in area and production of radish. In Himachal Pradesh, it is cultivated under an area of 206 thousand hectares with a production of 3304 Mt [1].

Organic manure like farm yard manure (FYM) not only provides nutrients to plants but also improves the soil texture by binding effect to soil aggregates. Organic manure increases water holding capacity and phosphate availability of the soil, besides improving the fertilizer use efficiency and microbial population in the soil; it reduces nitrogen loss due to the slow release of nutrients [2]. Vermicompost provides essential macronutrients (N, P_2O5, K2O, Ca and Mg) and micronutrients Fe, Mn, Zn and Cu). Vermicompost helps in reducing C:N ratio (carbon-nitrogen ratio), increasing humic acid content, cation exchange capacity and water-soluble carbohydrates. It helps to reduce soil erosion and also helps to decrease soil pollutants [3].

The growing of radish plants has been affected most severely due to lack of N and subsequently by P as well as K. The application of nitrogen with different doses increases plant growth and yield of radish. Deficiency of nitrogen first appears on older leaves due to the high mobility of the element. Its deficiency causes interveinal yellowing, development of anthocyanin pigment, rolling of leaves, chlorosis and necrosis [4]. According to the phosphorus deficiency, the radish plants were shorter in height, leaves were distorted in shape and a pink tinge appeared along the margins and veins. Phosphorus is an indispensable constituent of nucleic acids, phospholipids and several enzymes. It is also needed for the transfer of energy within the system of plants and is involved in its various metabolic activities [5]. In potassium-deficient plants, the colour of leaves changed from green to pale yellow and brown scorches appeared on the leaves at later stages. So, potassium has a very important role in the proper growth and development of plants. It regulates transpiration through the opening and closing of the stomata by affecting the activities of guard cells. In these organelles, Potassium activates & the fat-producing enzymes and enhances the oil content [6].

Thus, it is essential to find out adequate nutrient requirements of nitrogen, phosphorus and potash along with organic manure in radish crops. This study aimed to analyse the influence of various sources of organic nutrients on the yield and quality parameters of radishes.

2. MATERIALS AND METHODS

The present investigation was conducted during 2021-2022 (*rabi*) at the agriculture research farm school of agriculture, Abhilashi University, Mandi (HP).). The experimental farm is located at 31°33’32’’N latitude and 77°00’47’’E longitude with an elevation of 14,04m above mean sea level. The soil of the experimental field was sandy lome with a pH of 5.95.

The experiment consists of 7 treatments laid out in a Randomized Block Design with three replications. Treatments included T_1 (Absolute Control), T_2 (100% recommended NPK through chemical fertilizers), T_3 (100% FYM), T_4 (100% recommended dose through Vermicompost), T_5 (NPK 50% + FYM 25% + Vermicompost 25%), T_6 (NPK 25% + FYM 50% + Vermicompost 25%), T_7 (NPK25%+ FYM 25% + Vermicompost 50%). All the treatments except absolute control received uniform doses of NPK, FYM and Vermicompost.

The seeds of radish cv. Pusa Desi were dibbled at spacing of 30 x 10cm in ridge and furrow method. Thinning was done 10 – 15 days after sowing. Irrigation immediately after seed sowing and then once in 7-9 days. The proper irrigation

helps to maintain the optimum soil moisture in the field. Two weedings were done manually first after 15 days, second 25 days after germination, and one-time hand hoeing before root development. With the help of proper weeding practices, the farmers can improve the quality of their product, because the nutrient uptake capacity of the weeds are much higher than the crop plants. The organic manures under study were FYM, vermicompost and inorganic manures were Urea, SSP and MOP. Both organic and inorganic manures were applied alone and in combinations. Organic manures were incorporated as basal dose during field preparation 15 days before sowing. The observations were recorded growth, yield attributes and economics. The data was collected with the help of 5 randomly selected plants in each plot and the observations were recorded at 30 DAS and at harvest.

The obtained data was subjected to analysis using MS-Excel and OPSTAT online statistical program (sheoran et al. 1998). To interpret the treatment differences the results were compared at 5 per cent level of significance. The treatment effects were compared using the transformed means. The significance of the treatment difference was judged by using critical difference (C.D).

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

All the growth parameters i,e. Days to 50 % crop emergence (5.66), Numbers of leaves per plant at 30 DAS (7.72) and at harvesting (14.28), Root Length at 30 DAS (12.10 cm) and at harvesting (26.43 cm) and Shoulder Diameter of root 30 DAS (3.13 cm) and at harvesting (5.70) maximum values was recorded in T5 (NPK 50% + FYM 25% + Vermicompost 25%). Maximum parameters were followed by T_2 (100% NPK). Whereas the minimum values were recorded in T_1 (Absolute Control). Increasing the values of all growth parameters directly depend upon the proper nutrient supply to the crop plant. The nutrients need of crop was fulfil by the proper combination of organic and inorganic fertilizers supply to the soil. So in treatment T_5 there was the combination of integrated nutrient management, and in proper ways the nutrients was supplied to the soil. Similar results was recorded by Mohmmad et al. [7], Mani et al. [8] and Khede et al. [9].

As a result, it was clear that the best result in T5 was reported with the use of proper amount of organic and inorganic fertilizers to the soil. The data presented in Table 1.

3.2 Yield and its Attributes Parameters

All the yield parameters i,e. Effective plant population at harvest (per ha) (156), fresh weight of root (195.18 gm), Dry weight of root (39.04 gm), Root Yield per plot (28.23 kg) and harvest index (45.45%) maximum value was recorded in T_5 (NPK 50% + FYM 25% + Vermicompost 25%). Maximum parameters were followed by T_2 (100% NPK). Whereas the minimum values were recorded in T_1 (Absolute Control). Increasing the yield is directly proportional to the sufficient amount of manure and fertilizers to the soil according to the nutrients demand of crop and soil. As a result, with proper nutrients supply plays very important role in the growth of any plant or any crop. If growth of the plants are good already the yield parameters should be increased. So, in treatment T_5 there was the combination of integrated nutrient management, and in proper ways the nutrients were supplied to the soil. Similar findings were observed by Jadhav et al. [10] and Singh et al. [11].

As a result, it was clear that the best result in T_5 was reported with the use of proper amount of organic and inorganic fertilizers to the soil. The data presented in Table 2.

3.3 Economics

Higher money value and less cultivation cost are the desirable traits for getting higher returns. The following treatments, the maximum cost of cultivation (Rs/ha 123814.2) was recorded in T_4 (100% recommended doze through vermicompost) Similar results was recorded by Meena et al. [12]. and maximum Gross return (Rs/ha^{-1} 470530), maximum net return (Rs/ha^{-1} 376997.53) and maximum B:C ratio (1: 5.7) was recorded in T_5 (NPK 50% + FYM 25% + Vermicompost 25%). Whereas the minimum gross return and net return was recorded in T_1 (Absolute Control). Similar findings was observed by Verma et al. [13] and Khede et al. [9]. Economically the study suggested that the combined application of inorganic and organic manure and fertilizers (NPK 50% + FYM 25% + Vermicompost 25%) were highly beneficial for all the growth and yield parameters of radish. The data presented in Table 3.

Table 1. Effect of integrated nutrient management on growth parameters

S. No.	Treatments	Days to 50% crop emergence	Numbers of leaves		Root Length		Shoulder Diameter	
			30 DAS	At harvest	30 DAS	At harvest	30 DAS	At harvest
T_1	Absolute Control	15.33	5.83	9.81	7.06	17.66	1.66	3.80
T_2	100% recommended NPK through chemical fertilizers	8.33	6.66	13.70	9.26	23.16	3.06	5.10
T_3	100% FYM	14.00	6.04	12.58	8.20	20.50	1.80	4.40
T_4	100% recommended dose through Vermicompost	12.33	6.17	12.73	8.36	20.90	2.00	4.78
T_5	NPK 50% + FYM 25% + Vermicompost 25%	5.66	7.72	14.28	12.10	26.43	3.13	5.70
T_6	NPK 25% + FYM 50% + Vermicompost 25%	11.33	6.33	13.31	8.70	21.70	2.40	4.93
T_7	NPK 25% + FYM 25% + Vermicompost 50%	9.66	6.48	13.49	8.80	21.96	2.80	5.03
SE (m) ±		0.563	0.337	0.581	0.55	1.24	0.22	0.17
CD at 5%		1.755	1.050	1.809	1.73	3.88	0.68	0.55

Table 2. Effect of integrated nutrient management on yield of radish attributes

S. No.	Treatments	Effective plant population at harvest	Weight of Roots		Root Yield		Harvest Index
			Fresh	Dry	Yield (kg)	Yield (q)	
T_1	Absolute Control	104.67	130.89	26.17	13.73	228.76	31.01
T_2	100% recommended NPK through chemical fertilizers	143.33	191.78	38.35	27.10	451.81	41.56
T_3	100% FYM	127.00	166.22	33.24	21.08	351.43	33.42
T_4	100% recommended dose through Vermicompost	128.33	172.83	34.56	22.12	368.75	36.94
T_5	NPK 50% + FYM 25% + Vermicompost25%	156.00	195.18	39.04	28.23	470.53	45.45
T_6	NPK 25% + FYM 50% + Vermicompost 25%	134.00	183.80	36.76	24.69	411.62	36.37
T_7	NPK 25% + FYM 25% + Vermicompost 50%	141.67	185.30	37.06	26.62	443.72	40.65
SE (m) ±		3.303	7.662	1.532	1.168	19.48	1.12
CD at 5%		10.289	23.869	4.773	3.640	60.68	3.5

Table 3. Effect of integrated nutrient management on economics of radish

S. No.	Treatments	Cost of cultivation (Rs/h)	Gross Return (Rs/ha)	Net Returns (Rs/ha)	B: C Ratio
T_1	Absolute Control (no manure or fertilizers)	70314.2	228770	158455.8	1: 1.3
T_2	100% recommended NPK through chemical fertilizers	78250.29	451810	373559.71	1: 5.0
T_3	100% FYM	93814.2	351430	257615.8	1: 3.7
T_4	100% recommended dose through Vermicompost	123814.2	368750	244935.8	1: 2.9
T_5	NPK 50% + FYM 25% + Vermicompost25Vermicompost 25%	93532.47	470530	376997.53	1: 5.7
T_6	NPK 25% + FYM 50% + Vermicompost 25%	97423.42	411620	314196.58	1: 4.2
T_7	NPK 25% + FYM 25% + Vermicompost 50%	104923.42	443120	338196.58	1: 4.2

4. CONCLUSION

It may be concluded that the present study that among the different treatments, T_5 (NPK 50% + FYM 25% + Vermicompost 25%) showed in the highest growth, yield parameters of radish such as number of leaves, root length, shoulder diameter, fresh weight of root, dry weight, yield of root plot^{-1}, yield of root ha^{-1}. And closely followed by the treatment T_2 (100% recommended NPK through chemical fertilizers). It was revealed from the data obtained that a significantly maximum root yield (470.53q ha^{-1}) was recorded in T_5 (NPK 50% + FYM 25% + Vermicompost25%) with net return (376997.5 Rs/ha) and B:C ratio (1: 5.7).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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