

Effect of Integrated Nutrient Management on Growth and Yield of Radish (*Raphanus sativus* L.) cv. Japanese White

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ABSTRACT: The present investigation entitled effect of integrated nutrient management on growth and yield of radish (*Raphanus sativus* L.) cv. Japanese white was carried out the Horticultural Research Farm-1, Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A central university) Vidya Vihar, Raebareli Road, Lucknow (U.P.) during the season, 2022-2023. The experimental materials for the present investigation was consisted of 10 treatment combinations laid out in Randomized Block Design and replicated thrice. The maximum plant height at 30, 45 and 60 DAS was recorded of the treatment in T₅ followed by T₇ as compared to the minimum treatment in T₁. The fresh weight of the plants exhibited a notable variation, wherein a substantially higher fresh weight of roots was evident upon the application of NPK 50% + Vermicompost at a rate of 2 tons/ha in T₅. Following closely, T₇, with the application of NPK (50%) + Poultry Manure (50%) at 1.5 tons/ha, also demonstrated a significant increase in fresh root weight/ha and the minimum fresh weight of plant in T₁.

Keywords: Integrated Nutrient Management, Growth and Yield, Vermicompost, Poultry Manure, NPK.

INTRODUCTION

Radish (*Raphanus sativus* L.) is a root crop which is belong from the Brassicaceae family and is native to Europe or Asia. It is the most popular root crop grown all over the world. In India, it is grown in one or the other part of the country throughout the year. It is grown for its young fleshy tuberous roots which are eaten raw or as a salad or cooked. Radish is a cool-season crop and is broadly divided into two groups: European or temperate and Asiatic or Tropical. Asiatic types produce roots and seeds under tropical climates, whereas, European types varieties produce roots under sub-tropical and tropical climates. However, seed production of European types is possible only under temperate conditions in hills since these require chilling temperatures for seed production. The Asiatic varieties although are higher yielders yet poor in quality attributes, whereas, European varieties are small in size, mild in pungency, early in maturity and rich in quality parameters.

Radish is one of the most ancient vegetables. It is cultivated in India over an area of 2,09,210 ha with an annual production of 33,46,690 metric tonnes (Anonymous, 2021), the largest area under this crop in India, West Bengal 41.36 thousand hectares with a production of 548.77 thousand MT followed by Haryana 27.735 thousand hectares with a production of 550.070 thousand MT.

It is a good source of Vitamins C and minerals like calcium, potassium and phosphorus. The chemical composition of per 100 g radish is as follows; Energy-16 kcal, Carbohydrates-3.4g, Sugar-1.86g, Dietary fiber-1.6g, Fat-0.1g, Protein-0.68g, Thiamine-0.012 mg, Riboflavin-0.039 mg, Niacin-0.254 mg, Pantothenic acid-0.165 mg, Vitamin B₆-0.071 mg, Folate-25g Vitamin C-14.8 mg, Calcium-25 mg, Iron-0.34 mg, Magnesium-10 mg, Manganese-0.069 mg, Phosphorus-20 mg, Potassium-233 mg, Zinc-0.28 mg (Singh *et al.*, 2016).

MATERIAL AND METHODS

The field experiment was carried out to at the Horticultural Research Farm-I of the Department of Horticulture, School of Agriculture Science & Technology, Babasaheb Bhimrao Ambedkar University, Lucknow during the *rabi* season, 2022-2023. The details of the materials used and methods employed in the experimental work have been elaborated as under: Experimental site and climate condition.

RESULTS AND DISCUSSION

Effect of INM on growth parameters: Growth of the radish was studied with respect to plant height, number of leaves per plant, length of leaves, fresh weight of

root and dry weight of root were recorded at 30, 45 and 60 days after sowing.

Height of plant(cm): The plant height was recorded at 30, 45 and 60 DAS in Radish cv. 'Japanese White'. The result indicated that variation in height of the plant influenced significantly by the effect of INM. It is clear from the Table 1. The maximum plant height of radish at 30 days was recorded with the application NPK 50% + Vermicompost @ 2 tons/ha in T₅ (18.08cm) of which was found at par NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (17.05cm), The minimum height was noted in T₁ (11.06cm). The maximum plant height of radish at 45 days was recorded with the application NPK 50% + Vermicompost@2tons/ha in T₅ (25.45cm) of which was found at par NPK. (50%) +Poultry Manure (50%) -1.5 tons/ha in T₇ (24.56cm.). The minimum height was noted in T₁ (15.32cm). The maximum plant height of radish at 60 days was recorded with the application NPK 50% + Vermicompost @2 tons/ha in T₅ (39.09cm) of which was found at par NPK (50%) +Poultry Manure (50%) -1.5 tons/ha in T₇ (38.03cm). The minimum height was noted in T₁ (30.05cm).

Number of leaves per plant: The Number of leaves per plant was recorded at 30, 45 and 60 DAS in Radish cv. 'Japanese White. The result indicated that variation in number of leaves per plant influenced significantly by the effect of INM. It is clear from the Table 1. The maximum number of leaves per plant at 30 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (6.96cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (6.45cm). The minimum number of leaves was noted in T₁ (4.32cm). The maximum number of leaves per plant at 45 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (16.07cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (15.09cm). The minimum number of leaves was noted in T₁ (10.09cm). The maximum number of leaves per plant at 60 days was recorded with the application of NPK 50% + Vermicompost @ 2 tons/ha in T₅ (19.07cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (18.65cm). The minimum number of leaves was noted in T₁ (12.04cm).

Length of leaf (cm): The length of leaf was recorded at 30, 45 and 60 DAS in Radish cv. 'Japanese White. The result indicated that variation in height of the plant influenced significantly by the effect of INM. It is clear from the Table 1. The maximum length of leaf at 30 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (9.33cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (8.96cm). The minimum Length of leaf was noted in T₁(6.87cm). The maximum length of leaf at 45 days was recorded with the application of NPK 50% + Vermicompost @2tons/ha in T₅ (17.65cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (17.13cm), The minimum Length of leaf was noted in T₁ (12.45cm).

The maximum length of leaf plant at 60 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (21.07cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (20.02cm). The minimum length of leaf was recorded in T₁ (12.08cm).

Fresh weight of plant(g): Fresh weight of plant different combinations of INM treatments are given in Table 1 showed that fresh weight of plant was ranged from 95.05(g) to 130.11(g). The significantly higher fresh weight of plant was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (130.11g) followed by T₇ (125.15 g) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum fresh weight of plant in T₁ (95.05g).

Dry weight of plant(g): Dry weight of plant different combinations of INM treatments are given in Table 1 showed that fresh weight of plant was ranged from 12.09(g) to 23.69(g). The significantly higher dry weight of plant was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (23.69g) followed by T₇ (21.07g) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum dry weight of plant in T₁ (12.09g).

Effect of INM on yield parameters: Length of root(cm): Length of root different combinations of INM treatments are given in Table 1 showed that length of root was ranged from 18.05(cm) to 28.05(cm). The significantly higher length of root was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (28.0 cm) followed by T₇ (26.04cm) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum length of root in T₁(18.05cm).

Root weight (g): Root weight of different combinations of INM treatments are given in Table 1 showed that root weight of plant was ranged from 80.05(g) to 120.11(g). The significantly higher root weight of plant was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (120.11g) followed by T₇ (115.15g) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum root weight of plant in T₁ (12.09g).

Diameter of root(cm): Root diameter of different combinations of INM treatments are given in Table 1 that root weight of plant was ranged from 3.1 (cm) to 4.4(cm). The significantly higher diameter of root was observed with the application of NPK 50% +Vermicompost @2 tons/ha in T₅ (4.4cm) followed by T₇ (4.1cm) with the application of NPK (50%) + Poultry Manure (50%) -1.5 ton/ha and the minimum diameter of root in T₁ (3.1cm).

Root yield (q/ha): Root yield of different combinations of INM treatments are given in Table 1 that root yield were ranged from 280.05(q/ha) to 400.09 (q/ha). The significantly higher root yield was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (400.09q/ha) followed

by T₇ (370.07q/ha) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum root yield in T₁ (280.05q/ha).

Effect of INM on growth parameters: The findings pertaining to growth parameters *viz.*, plant height, number of leaves plant⁻¹, leaf length, fresh weight of root and dry weight of root were observed at 30, 45 and 60 DAS. There was significant effect of INM on all the growth parameters.

Height of plant(cm): The plant height was recorded at 30, 45 and 60 DAS in Radish cv. 'Japanese White'. The result indicated that variation in height of the plant influenced significantly by the effect of INM. It is clear from the Table 1. The maximum plant height of radish at 30 days was recorded with the application NPK 50% + Vermicompost @2 tons/ha in T₅ (18.08cm) of which was found at par NPK (50%) + Poultry Manure (50%) -1.5tons/ha in T₇ (17.05cm), The minimum height was noted in T₁ (11.06cm). The maximum plant height of radish at 45 days was recorded with the application NPK50% + Vermicompost@2 tons/ha in T₅ (25.45cm) of which was found at par NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (24.56cm.), The minimum height was noted in T₁ (15.32cm). The maximum plant height of radish at 60 days was recorded with the application NPK50% + Vermicompost@2 tons/ha in T₅ (39.09cm) of which was found at par NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (38.03 cm). The minimum height was noted in T₁ (30.05cm). The similar result also found Pathak *et al.* (2018) in Radish.

Number of leaves per plant (cm): The Number of leaves per plant was recorded at 30, 45 and 60 DAS in Radish cv. 'Japanese White'. The result indicated that variation in number of leaves per plant influenced significantly by the effect of INM. It is clear from the Table 1. The maximum number of leaves per plant at 30 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (6.96cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (6.45cm). The minimum number of leaves was noted in T₁ (4.32cm).

The maximum number of leaves per plant at 45 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (16.07cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (15.09cm). The minimum number of leaves was noted in T₁ (10.09cm). The maximum number of leaves per plant at 60 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (19.07cm) which was found at par with NPK (50%) + Poultry Manure (50%)-1.5 tons/ha in T₇ (18.65cm). The minimum number of leaves was noted in T₁ (12.04cm). The similar result also found Sentiyangla *et al.* (2010) in Radish.

Length of leaf(cm): The length of leaf was recorded at 30, 45 and 60DAS in Radish cv. 'Japanese White'. The result indicated that variation in height of the plant influenced significantly by the effect of INM. It is clear from the Table 1. The maximum length of leaf at 30 days was recorded with the application of NPK 50% +

Vermicompost @2 tons/ha in T₅ (9.33cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (8.96cm). The minimum length of leaf was noted in T₁ (6.87cm).

The maximum length of leaf at 45 days was recorded with the application of NPK 50% +Vermicompost @2tons/ha in T₅ (17.65cm) which was found at par with NPK(50%) + Poultry Manure (50%) -1.5 tons/ha in T₇ (17.13cm), the minimum Length of leaf was noted in T₁ (12.45cm). The maximum length of leaf plant at 60 days was recorded with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (21.07cm) which was found at par with NPK (50%) + Poultry Manure (50%) -1.5 tons/ha in T₅ (20.02cm), the minimum length of leaf was recorded in T₁(12.08cm). The similar result also found in Kushwah *et al.* (2020) in Radish.

Fresh weight of plant(g): Fresh weight of plant different combinations of INM treatments are given in Table 1 showed that fresh weight of plant was ranged from 95.05(g) to 130.11(g). The significantly higher fresh weight of plant was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (130.11g) followed by T₇(125.15g) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum fresh weight of plant in T₁ (95.05g). The similar result also found in Mishra *et al.* (2018) in Radish.

Dry weight of plant (g): Dry weight of plant different combinations of INM treatments are given in Table 1 showed that fresh weight of plant was ranged from 12.09(g) to 23.69(g). The significantly higher dry weight of plant was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (23.69g) followed by T₇ (21.07g) with the application of NPK (50%) + Poultry Manure (50%) -1.5tons/ha and the minimum dry weight of plant in T₁(12.09g). The similar result also found Kushwah *et al.* (2020), in Radish.

Effect of INM on yield parameter: Effect of INM (different organic manures, inorganic fertilizers and their combinations) on radish was studied with respect to yield parameters *viz.*, length of root(cm), weight of root (g), diameter of root (cm) and root yield plot⁻¹ (q/ha).

Length of root (cm): Length of root different combinations of INM treatments are given in Table 1 showed that length of root was ranged from 18.05 (cm) to 28.05 (cm). The significantly higher length of root was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅ (28.05cm) followed by T₇ (26.04cm) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum length of root in T₁ (18.05cm). The similar result also found Khalid *et al.* (2015) in radish.

Root weight (g): Root weight of different combinations of INM treatments are given in Table 1 showed that root weight of plant was ranged from 80.05(g) to 120.11(g). The significantly higher root weight of plant was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T₅

(120.11g) followed by T7 (115.15g) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum root weight of plant in T1 (12.09g). The similar result also found Uddain *et al.* (2010) in Radish.

Diameter of root(cm): Root diameter of different combinations of INM treatments are given in Table 1 showed that root weight of plant was ranged from 3.1(cm) to 4.49(cm). The significantly higher diameter of root was observed with the application of NPK50 0% + Vermicompost@2tons/ha in T5(4.4cm) followed by T7 (4.1cm) with the application of NPK (50%) + Poultry Manure (50%) -1.5 ton/ha and the

minimum diameter of root in T1(3.1cm). The similar result also found Kushwah *et al.* (2020), in Radish.

Root yield (q/ha): Root yield of different combinations of INM treatments are given in Table 1 showed that root yield were ranged from 280.05(q/ha) to 400.09(q/ha). The significantly higher root yield was observed with the application of NPK 50% + Vermicompost @2 tons/ha in T5 (400.09q/ha) followed by T7 (370.07q/ha) with the application of NPK (50%) + Poultry Manure (50%) -1.5 tons/ha and the minimum root yield in T1(280.05q/ha). The similar result also found in Pathak *et al.* (2018) in Radish.

Table 1.

Treatment	Treatment Details	Plant height(cm)			Leaves per plant(cm)			Length of leaf(cm)			Fresh weight of plant (g)	Dry weight of plant (g)	Length of root(cm)	Root weight(g)	Diameter of root (cm)	Root yield(q/ha)
		30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS						
T ₁	NPK(RDF)-50:60:80kg/ha.	11.06	15.32	30.05	4.32	10.09	12.04	6.87	12.45	12.08	95.05	12.09	18.05	80.05	3.1	280.05
T ₃	FYM@15tons/ha.	13.06	18.15	33.09	5.11	12.03	14.08	8.15	14.21	14.06	105.04	15.09	22.03	95.06	3.6	310.03
T ₄	PoultryManure@3tons/ha.	15.09	20.11	34.02	5.35	13.06	14.03	8.11	14.87	15.06	109.05	16.03	23.04	99.06	3.4	315.06
T ₅	NPK50%+Vermicompost@2tons/ha.	18.08	25.45	39.09	6.96	16.07	19.07	9.33	17.65	21.07	130.11	23.69	28.05	120.11	3.8	330.04
T ₆	NPK(50%)+FYM(50%)-7.5tons/ha.	14.05	19.22	35.08	5.45	14.02	16.07	8.05	15.78	17.08	120.13	20.02	24.03	110.13	4.4	400.09
T ₇	NPK (50%)+ Poultry Manure(50%) -1.5 tons/ha.	17.05	24.56	38.03	6.45	15.09	18.65	8.96	17.13	20.02	125.15	21.07	26.04	115.15	3.9	350.01
T ₈	Vermicompost(50%)+FYM(50%)	16.05	22.42	36.07	4.56	15.01	16.07	7.53	15.11	16.07	115.17	19.07	23.08	105.17	4.1	370.07
T ₉	Vermicompost(50%)+Poultry Manure (50%)	12.09	23.15	37.04	5.11	12.07	17.05	7.76	13.78	18.07	113.06	18.09	22.06	103.06	3.5	340.05
T ₁₀	PoultryManure(50%)+FYM(50%)	13.08	21.11	35.05	6.11	13.08	18.06	7.45	14.15	16.05	110.05	15.05	20.03	100.05	3.3	320.03
SEm±		0.25	0.32	0.64	0.08	0.19	0.28	0.12	0.24	0.26	1.34	0.24	0.20	1.211	3.2	300.04
CD (P=005)		0.76	0.96	1.91	0.24	0.57	0.85	0.36	0.72	0.79	4.02	0.74	0.62	3.625	0.05	4.26

CONCLUSIONS

On the basis of result obtained from the present investigation it can be concluded that foliar application of NPK 50%+Vermicompost @2tons/ha. was found most effective with respect to vegetative growth maximum and root yield of radish can be recommended to farmers for commercial cultivation of radish (*Raphanus sativus L.*) cv. Japanese White under the Lucknow condition.

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