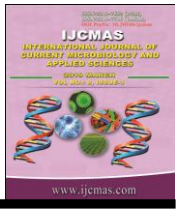
Int.J.Curr.Microbiol.App.Sci (2019) *8*(3): 400-405

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 03 (2019)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2019.803.050

Effect of Organic Manures, Fertilizers and their Combinations on Growth, Yield and Quality of Radish (*Raphanus sativus* L.) cv. Japanese White

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Keywords

Radish, *Raphanus sativus*, Organic manures, Fertilizers

Article Info

Accepted:
04 February 2019
Available Online:
10 March 2019

A B S T R A C T

The present investigation entitled "Effect of Organic Manures, Fertilizers and their Combinations on Growth, Yield and Quality of Radish (*Raphanus sativus* L.) cv. Japanese White" was conducted at the Department of Horticulture, College of Agriculture, Indore (M.P.) during the year 2017-2018. The experimental materials for the present investigation were comprised of treatments *viz*., Control- No organic manure /fertilizers, Recommended dose of fertilizer (100 Kg N, 80 Kg P_2O_5 and 50 Kg K_2O ha^{-1}), 50% RDF + 50% FYM of Recommended Dose, 50% RDF + 50% Vermicompost, 50% RDF + 50% Poultry manure, 50% RDF + 25% FYM + 25% Vermicompost, 50 % RDF + 25%FYM + 25% Poultry manure, 50% RDF + 25% Vermicompost + 25% Poultry Manure, 75% FYM + 25% RDF, 75% Vermicompost + 25% RDF, 75% Vermicompost + 25% RDF, 75% Poultry Manure + 25% RDF and 25% of each RDF + 25% FYM + 25% Vermicompost + 25% Poultry Manure, laid out in Randomized Block Design with three replications. The plant height (32.43 cm), Length of leaves (29.37), fresh weight of root (119.73 g) and Dry weight of root (20.36 g), root length (22.83 cm), diameter of root (3.87 cm), average weight of root (119.73 g) and yield of root (498.89 q ha^{-1}), total soluble solids (5.09^{0}Brix) and fiber content (749.87 mg) recorded maximum values with respectively in treatment T_8 (50% RDF + 25 % Vermicompost + 25% Poultry Manure). The number of leaves (13.23) recorded maximum values with respectively in treatment T_4 50% RDF + 50% Vermicompost.

Introduction

Radish (*Raphanus sativus* L.) belongs to the family Brassicaceae and it has 2n=18 chromosomes. It is a popular root vegetable in both tropical and temperate regions. It can be cultivated under cover for early production but large scale production in field is more common in Haryana, West Bengal, Punjab, Bihar, Assam, Madhya Pradesh and other some state of India. In Madhya Pradesh, radish is grown in 10440 ha with a production of 153270 tones (Anonymous, 2016-17).

Radish is grown for their young tender tuberous roots which are consumed either cooked or raw. The radish leaves are rich in minerals and vitamin A (5 IU) and vitamin C

(15 mg) and are roots rich in potassium (138 mg) and calcium (50 mg). It has got refreshing and diuretic properties. In homeopathy, it is used for neurological, headache, sleeplessness and chronic diarrhea. The roots are also useful in urinary complaints and piles. The leaves of radish are good source for extraction of protein on a commercial scale and radish seeds are potential source of non-drying fatty oil suitable for soap making illuminating and edible purposes. The edible part of radish is modified root which develops form both primary root and hypocotyls. The pungency in radish is due to the presence of volatile isothiocynates.

Materials and Methods

The experiments were carried out during the Rabi season, 2017-18, at the Research Farm, Department of Horticulture, College of Agriculture, Indore (M.P.). Geographically Indore is situated in Malwa plateau region in the Western part of the state of Madhya Pradesh at an altitude of 555.5 meters above mean sea level (MSL). It is located at latitude 22°43′ N and longitude of 75°66′E. It has subtropical climate having a temperature range of 29°C to 41°C during summer and 7°C to 23°C in winter season with mean relative humidity of 30-85%. The rainfall in the region has been mostly inadequate and erratic in most of the recent past seasons. Late commencement, early withdrawal of monsoon and occurrence of two to three dry spells during the rainy season are the common features. The mean annual average rainfall is 954 mm. The soil of experimental field was medium black clay in texture with uniform topography. The experiment consisted of 12 treatments in combinations of recommended dose of Recommended dose of fertilizer with bio-fertilizers. The various treatments with their symbols are presented in Table 1. The experiment was laid out in randomized block design with three replications. Different organic manures such as farmyard manure, vermicompost, and Poultry manure were incorporated in the field before sowing as per the treatments. Japanese White variety of radish was grown using the spacing of 30 x 10 cm. appropriate standard and uniform agronomical / cultural practices and plant protection measures were adopted for raising healthy crop. Observations were recorded under investigation i.e. the plant height, Length of leaves, fresh weight of root, Dry weight of root, root length, diameter of root, average weight of root, yield of root, total soluble solids (TSS) and fiber content. All the above mentioned observations were recorded from five plants were randomly selected from each treatment for determining various growth and yield parameters.

Results and Discussion

A perusal of data (Table 2) revealed that application of plant nutrients through recommended dose of Recommended dose of fertilizer with bio-fertilizers significantly affected the growth and yield attributes of radish. It is evident from the data that application of 50% RDF + 25% Vermicompost + 25% Poultry Manure (T8) resulted significantly maximum plant height (32.43 cm) Followed by T_4 (50% RDF + 50% Vermicompost) (29.90). The increase in height of plant by the use of vermicompost with integration of NPK 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. Similar results were reported by Singh *et al.,* (2016) and Verma *et al.,* (2017). The number of leaves (13.23 per plant) significantly superior treatment T_4 (50% RDF + 50% Vermicompost). Followed by (12.60 per plant) T_8 (50% RDF + 25 % Vermicompost + 25% Poultry Manure). Highest number of leaves in

T_4 (50 % RDF + 50 % vermicompost) due to slow release of nutrients through vermicompost thus enriching available nutrient pool of the soil that resulting in more number of leaves plant^{-1} (Bhattarai and Maharjan, 2013). Similar findings have been reported by Kumar *et al.,* (2014) and Mohmmad *et al.,* (2015) in radish.

The maximum and significantly higher length of leaves (29.37) was recorded in T_8 (50% RDF + 25% Vermicompost + 25% Poultry Manure). Followed by (28.40) T_4 (50% RDF + 50% Vermicompost), T_{10} (25 % RDF + 75% Vermicompost). The vegetative parameters like leaf length and numbers of leaves plant^{-1} were greatly influenced by organic source. Similar findings have been reported by Kumar *et al.,* (2014) in radish, Vijaykumari *et al.,* (2012) and Jat *et al* (2017). The maximum and significantly higher fresh weight of root (119.73 g) was recorded in T_8 (50% RDF + 25% Vermicompost + 25% Poultry Manure). Followed by (113.73 g) T_4 (50% RDF + 50% Vermicompost) Similar findings have been reported by Uddain *et al.,* (2010), Mehwish *et al.,* (2016), Vijaykumari *et al.,* (2012) and Kumar *et al.,* (2014). The maximum and significantly higher dry weight of root (20.36 g) was recorded in T_8 (50% RDF + 25% Vermicompost + 25% Poultry Manure). Followed by (19.33 g) T_4 (50% RDF + 50% Vermicompost) Similar findings have been reported by Mehwish *et al.,* (2016) and Kumar *et al.,* (2014). Higher length of root (22.83) was recorded in T_8 (50% RDF + 25 % Vermicompost + 25% Poultry Manure). Followed by (22.43) T_4 (50% RDF + 50%Vermicompost) Decrease in bulk density and increase in porosity and water holding capacity of the soil due to organic manures might have contributed in increasing the length of root the plants. The increase in length of root may be attributed to solubilization of plant nutrients by addition of poultry manure and vermicompost leading to increase uptake of NPK. Finding corroborates with their results obtained by Rajan and Mahalakshmi (2007) and Kumar *et al.,* (2014).

The maximum and significantly diameter of root was (3.87) recorded in T_8 (50% RDF + 25 % Vermicompost + 25% Poultry Manure). Followed by (3.73) T_4 (50% RDF + 50%VermicompostThese findings are in agreement with those reported by Vijayakumari *et al.,* (2012), Uddain *et al.,* (2010) and Kumar *et al.,* (2014) in radish.

Table.1 Treatments detail with their symbol

S. No.	Treatment	Symbol
1.	Control- No organic manure /fertilizers	T_1
2.	Recommended dose of fertilizer (100 Kg N, 80 Kg P_2O_5 and 50 Kg K_2O ha^{-1})	T_2
3.	50% RDF + 50% FYM of Recommended Dose	T_3
4.	50% RDF + 50% Vermicompost	T_4
5.	50% RDF + 50% Poultry manure	T_5
6.	50% RDF + 25% FYM + 25% Vermicompost	T_6
7.	50 % RDF + 25%FYM + 25% Poultry manure	T_7
8.	50% RDF + 25% Vermicompost + 25% Poultry Manure	T_8
9.	75% FYM + 25% RDF	T_9
10.	75% Vermicompost + 25% RDF	T_{10}
11.	75% Poultry Manure + 25% RDF	T_{11}
12.	25% of each RDF + 25% FYM + 25% Vermicompost + 25% Poultry Manure	T_{12}

Table.2 Effect of organic manures, fertilizers and their combinations on growth, yield and quality of radish (*Raphanus sativus* L.) cv. Japanese White

Treatment	Plant height (cm)	Number of leaves (plant^{-1})	Length of leaves (cm)	Fresh weight of root (g)	Dry weight of root (g)	Length of root (cm)	Diameter of root (cm)	Average weight of root (g)	Root yield (q ha^{-1})	Total soluble solids (^{0}Brix)	Fiber content (mg/100g)
T_1	19.37	9.37	16.77	48.70	8.28	16.27	2.03	48.70	202.92	3.67	488.87
T_2	24.87	11.20	22.96	91.17	15.50	20.97	2.83	91.17	379.86	4.27	545.83
T_3	25.30	11.60	23.33	92.23	15.68	21.23	3.20	92.23	384.31	4.33	556.03
T_4	29.90	13.23	28.40	113.73	19.33	22.43	3.73	113.73	473.89	4.93	676.20
T_5	26.17	11.90	24.83	96.50	16.41	21.43	3.40	96.50	402.08	4.40	580.87
T_6	27.40	12.53	25.90	99.43	16.90	22.27	3.53	99.43	414.31	4.60	618.37
T_7	26.87	12.30	25.33	98.77	16.79	21.73	3.50	98.77	411.53	4.47	602.43
T_8	32.43	12.60	29.37	119.73	20.36	22.83	3.87	119.73	498.89	5.09	749.87
T_9	23.77	9.97	22.27	89.37	15.19	19.23	3.32	89.37	372.36	4.03	501.97
T_{10}	28.47	12.57	26.47	111.93	19.03	22.33	3.57	111.93	466.39	4.73	647.83
T_{11}	24.47	10.83	22.77	89.90	15.28	20.70	2.53	89.90	374.58	4.20	518.97
T_{12}	24.20	10.20	22.53	89.47	15.21	19.70	2.43	89.47	372.78	4.13	507.10
SEm±	**1.18**	**0.53**	**1.00**	**3.07**	**0.64**	**0.94**	**0.14**	**3.07**	**12.80**	**0.19**	**25.42**
CD at 5%	**3.47**	**1.57**	**2.94**	**9.01**	**1.87**	**2.76**	**0.43**	**9.01**	**37.55**	**0.55**	**74.54**

Highest total soluble solids was (5.09) found with treatment T_8 (50% RDF + 25% Vermicompost + 25% Poultry Manure) Followed by (4.93) T_4 (50% RDF + 50% Vermicompost), It might be due to accumulation of more reserve substances in root. Similar results have been also reported by Sunandarani and Mallareddy (2007) and Singh *et al.,* (2016), Sharma *et al.,* (2013).

Highest fiber content was (749.87) found with treatment T_8 (50% RDF + 25% Vermicompost + 25% Poultry Manure) Followed by (676.20) T_4 (50% RDF + 50% Vermicompost), T_{10} (25 % RDF + 75% Vermicompost).

It may be concluded from the finding of the present study that among the different treatments, T_8 (50% RDF + 25% Vermicompost + 25% Poultry Manure) showed in the highest growth, yield and quality parameters of radish and it is closely followed by treatment T_4 (50 % RDF + 50 % poultry manure), for the characters like growth, yield and quality parameters of radish.

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How to cite this article:

Kaluram Khede, Ajay Kumawat and Diksha Tembare. Effect of Organic Manures, Fertilizers and their Combinations on Growth, Yield and Quality of Radish (*Raphanus sativus* L.) cv. Japanese White. *Int.J.Curr.Microbiol.App.Sci.* 8(03): 400-405.
doi: https://doi.org/10.20546/ijcmas.2019.803.050