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

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***Abstract*: A field experiment was carried out at Vegetable Demonstration and Research Block, Department of Vegetable Science, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, during March-May 2017. The study consisted of 9 treatments having sole application of organic manure, inorganic fertilizers and their combinations. The treatments were replicated thrice in a plot having dimensions 1.80 m × 1 m and a spacing of 45 cm × 10 cm was followed. The experiment was laid out in a randomized complete block design. Observations on various yield parameters of radish were recorded. The results revealed that root weight (144.53 g), root length (28.21 cm), middle diameter of root (3.49 cm), yield per plot (4.65 kg/), yield per hectare (258.32 q) and total soluble solids (5.67 °Brix) was observed in treatment T5 [50% FYM + 50% VC]. Further maximum cost: benefit ratio (1: 2.49) was obtained in treatment T6 [50% FYM + 50% RDF (NPK)].**

***Keywords*: Farmyard Manure, Vermicompost, RDF (NPK), Radish, Yield Parameters.**

1. Introduction

Radish (*Raphanus sativus L.*) belongs to family Brassicaceae or Cruciferae originated from the Central and Western China and India. It is mainly grown in West Bengal, Bihar, Uttar Pradesh, Karnataka, Punjab, Maharashtra and Assam. It is a root cum leafy vegetable suitable for tropical and temperate climates. The leaves and roots are consumed both as salad and as cooked vegetable (Thamburaj and Singh, 2016). Radish contains glucose as the major sugar and smaller quantities of fructose and sucrose. The characteristics pungent flavour of radish is due to the presence of volatile isothiocynates (trans-4-methylthiobutenyl isothiocynate) and the colour of the pink cultivar is due to the presence of anthocyanin pigment. It is relished for its pungent flavor and is considered as an appetizer. The young leaves are also cooked and consumed as vegetable. It has refreshing and diuretic properties. 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 nondrying fatty oil suitable for soap making illuminating and edible purposes (Kumar et al., 2014a). Due to increasing demands for food supply by the ever growing population, production systems using chemicals and fertilizers were adopted. This has dramatic effect on the enhancement of production and productivity, but not without a cost (Dhangar, 2016). The continuous use of chemical fertilizers, oftenly in excess over a long period of time in arable land has led to contamination of food material, environmental pollution and depletion of soil fertility. The concept of integrated farming by the appropriate use of organic and inorganic fertilizers as sources of nutrients may be helpful to increase soil fertility and improvement of crops quality and growth. A site specific integrated nutrient management after sustainable productivity, availability and supply of plant nutrients in balance proportion in the soil, a key factor in the practical way for high productivity. Keeping the above facts in view, an experiment was conducted to study effect of organic manures, inorganic fertilizers and their combinations on yield of radish.

2. Materials and Methods

A field experiment was carried out at Vegetable Demonstration and Research Block, Department of Vegetable Science, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry Bharsar, during March-June 2017. The study consisted of 9 treatments having sole application of organic manures (Farmyard manure and vermicompost), inorganic fertilizers (Urea, SSP and MOP) and their combinations. The treatments were replicated thrice in a plot having dimensions 1.80 m × 1 m and a spacing of 45 cm between rows and 10 cm between plants was followed. The experiment was laid out in a randomized complete block design. Cultivar 'Japanese White' of Radish was chosen for the present study. Observations were recorded on growth parameters at the time of harvesting.

3. Results and Discussion

The present study was undertaken to study the effect of

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Table 1
Effect of organic manures, inorganic fertilizers and their combinations on radish var. Japanese White on yield

Treatments	Root weight (g)	Root length (cm)	Upper diameter of root (cm)	Middle diameter of root (cm)	Yield per plot (kg)	Yield per hectare (q)	TSS (°Brix)	Shelf life (days)	B:C Ratio
T_1 Control	88.37	26.26	2.73	2.75	2.25	125.00	4.67	9.33	1:1.15
T_2 FYM	94.13	25.69	2.79	2.87	2.96	164.77	4.33	7.00	1:1.37
T_3 VC	116.60	25.43	3.25	2.36	4.62	256.66	5.33	7.67	1:1.20
T_4 RDF (NPK)	110.47	24.05	3.26	3.33	4.08	226.59	4.33	9.00	1:2.39
T_5 50% FYM + 50% VC	144.53	28.21	3.02	3.49	4.65	258.32	5.67	9.67	1:1.57
T_6 50% FYM + 50% RDF (NPK)	143.80	23.52	3.36	3.21	4.27	237.59	5.00	10.00	1:2.49
T_7 50% VC + 50% RDF (NPK)	134.33	22.39	3.20	3.31	4.54	252.39	5.33	9.67	1:1.54
T_8 25% FYM + 25% VC + 50% RDF (NPK)	99.17	24.89	3.33	3.12	3.37	187.37	5.33	6.33	1:1.32
T_9 25% FYM + 25% VC + 100% RDF (NPK)	110.93	26.29	3.12	2.95	3.45	191.87	5.67	9.33	1:1.24
S.E.(d)	10.534	1.327	0.186	0.232	0.631	36.843	0.636	1.114	
$C.D._{(0.05)}$	22.523	2.837	0.398	0.496	1.349	78.771	1.116	2.382	

organic manures, inorganic fertilizers and their combinations on yield of radish. It was significantly recorded by organic manures, inorganic fertilizers and their combinations on root weight, root length, upper and diameter of root, yield per plot, yield per hectare and shelf life of radish as shown in table 1. Maximum root weight (g) was recorded at harvesting stage under the treatment T_5 [50% FYM + 50% VC] 144.53 g while, minimum root weight was recorded in treatment T_1 [Control] 99.17 g. This was attributed due 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., (2014a) in radish and Kumar et al., (2014b) in carrot. Maximum root length was recorded in treatment T_5 [50% FYM + 50% VC] 28.21 cm followed by T9 [25% FYM + 25% VC + 100% RDF (NPK)] 26.29 cm. Root length was maximum in plants involving vermicompost treatments. Root length increase indicates efficient absorption of water followed by transport and conduction. Vermicompost may influence plant growth directly via the supply of plant growth regulating substances (PGRs) proposed by Tomati et al., (1990); Grapelli et al., (1987) and Tomati and Galli (1995). Maximum upper diameter of root was recorded in treatment T_6 [50% FYM + 50% RDF (NPK)] 3.36 cm while, minimum upper diameter of root was recorded in treatment T_1 [Control] 2.73 cm. Maximum middle diameter of root (cm) was recorded in treatment T_5 [50% FYM + 50% VC] 3.49 cm followed by T_4 [RDF (NPK)] 3.33 cm. This might be due to the reason that application of vermicompost increase the root diameter. 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 root diameter of the plants. The root diameter may be attributed to solubilization of plant nutrients by addition of vermicompost leading to increase uptake of NPK. Similar results have been reported by Ahmed et al., (2005), Asghar et al., (2006), Rani et al., (2006), Sunandarani and Mallareddy (2007), Kumar et al., (2007), Vijayakumari et al., (2009), Kumar et al., (2009), Kirad et al., (2010), Kanaujia et al., (2010), Uddain et al., (2010), Jeptoo et al., (2013), Randy and Politud (2016) and Verma and Pandey (2016). Higher yield per plot and per hectare respectively was observed maximum in treatment T_5 [50% FYM + 50% VC] 4.65 kg, which was statistically at par with treatment T_3 [VC] 4.60 kg and T_7 [50% VC + 50% RDF (NPK)] 4.54 kg. This might be due to accumulation of humus substances could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. These findings are in agreement with the findings of Ahmed et al., (2005), Anjaiah and Padmaja (2006), Asghar et al., (2006), Rani et al., (2006), Sunandarani and Mallareddy (2007), Kumar et al., (2007), Kumar et al., (2009), Kirad et al., (2010), Kanaujia et al., (2010), Bodkhe and Mahorkar (2010), Uddain et al., (2010), Reddy et al., (2011a), Islam et al., (2011), Jatav et al., (2011), Yanthan et al., (2012), Vithwel and Kanaujia (2013), Jeptoo et al., (2013), Ali et al., (2014) and Randy and Politud (2016). Highest TSS (5.67 ^{0}Brix) was determined with T_5 [50% FYM + 50% VC] and T_9 [25% FYM + 25% VC + RDF (NPK)]. Lowest TSS (4.33 0Brix) was determined with T_2 [FYM]. It might be due to accumulation of more reserve substances in root. Similar results have been also reported by Sunandarani and Mallareddy (2007) and Kumar et al., (2014a) in carrot and Degwale (2016) in garlic. The treatments T6 [50 % FYM + 50 % RDF (NPK)] recorded higher value for cost: benefit ratio i.e. 1:2.49 whereas, the minimum cost: benefit ratio was observed in treatment T_1 [Control] 1:1.15. The result obtained with respect to cost: benefit ratio is in line with the findings of Sunandarani and Mallareddy (2007), Vithwel and Kanaujia (2013) and Sharma et al., (2015) in carrot and Narayan et al., (2014) in potato.

4. Conclusion

This paper represented Effect of Organic Manures, Inorganic Fertilizers and Their Combinations on Yield of Radish (*Raphanus sativus L.*) CV. Japanese White

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