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Effect of organic manures and mulching on growth, yield and quality traits of Radish (*Raphanus sativus* L.)

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Abstract

The present investigation was conducted at the Agricultural Research Farm, Suresh Gyan Vihar University, Jaipur to study the effect of organic manures and mulching on growth, yield and quality traits of radish (*Raphanus sativus* L.). The experiment was laid out in factorial randomized block design with two factors viz. first factor: organic manure (4 levels, control, FYM @20 q/ha, vermicompost @7 t/ha, poultry manure @6 t/ha) and second factor: mulching (4 levels, control, saw dust @ 10 t/ha, black polythene mulch and wheat straw @ 5 t/ha) replicated thrice. The observed data was analyzed in OPSTAT. The results revealed significant differences among the treatments. Among the treatment combination, vermicompost (@7 t/ha) X black plastic mulch (O₂M₂), recorded the maximum plant height (36.74cm), leaf length (30.16 cm), total chlorophyll content in leaves (2.967 mg/g), number of leaves per plant (12.40), maximum diameter of root (4.96 cm), length of root (17.80 cm), weight of root (132.5 g), minimum days to harvest (59.07), maximum yield of the roots (441.70 q/ha), TSS content in roots (5.19 °Brix), ascorbic acid in root (30.15 mg/100g), minimum cracking percentage (2.14%) and highest B:C ratio of 2.41 whereas the minimum was observed in control. Although these results are only indicative and require further experimentation to arrive at more consistent and credible conclusion, the treatment vermicompost (@7 t/ha) X black plastic mulch (O₂M₂) may be recommended for obtaining higher yield and superior quality of radish.

Keywords: Black plastic mulch, organic manure, Radish, vermicompost

Introduction

Radish (*Raphanus sativus* L.) is mostly grown root vegetable which belongs to Brassicaceae, genus *Raphanus* and species *sativus* and having a chromosome number 2n=18. Its cultivation occurs in both subtropical and tropical regions of the world and is probably a indigenous of Europe and Asia (Dongarwar *et al.*, 2014) [8]. Radish (*Raphanus sativus* L.) is a annual and biennial herb. It is grown for its young fleshy tuberous roots and hypocotyls, consumed raw mainly as salad and used as pickle. Radish roots have many shapes ranging from round to oval, icicle, half long and long (conical, cylindrical or spindle shape with blunt or semi-blunt end). Radish is largely cultivated in Haryana, West Bengal, Punjab, Assam, Chattisgarh, Bihar, Madhya Pradesh, Uttar Pradesh, Orissa, Tamilnadu. In India, radish is cultivated on 209 thousand hectares by means of an annual production of 3347 thousand metric tonnes (Anonymous, 2023-24). In 2025, Rajasthan reported a radish cultivation area of approximately 0.672 lakh hectares Major radish producing districts Jaipur, Sirohi. Satari *et al.*, (2020) [25] revealed that a hundred gram of edible root contains, 4 percent carbohydrate, 1 per cent protein, little fat 15 calories, negligible vitamin A, 0.03 mg thiamine, 0.03mg riboflavin, 0.30mg niacine, 25mg vitamin C, 30mg calcium and 1.00mg iron. The leaves are also rich in nutrition. 100 g of edible leaf having 18660 IU vitamin A, 103 mg vitamin C and 310 mg calcium. The pungency of radish is due to the occurrence of volatile isothiocyanate which treats against colon cancer, oral cancer, intestinal cancer and kidney cancer. Radish is effective in the treatment of liver, gall bladder troubles, urinary complaints and piles etc. In homeopathy, it is curable for neurological disorders, headache, sleeplessness and chronic diarrhoea (Seran and Brintha, 2009) [27].

Application of chemical fertilizers is now considered as a necessary agriculture tool/ practice, but the continuous use over a long period of time causes a detrimental impact/effect on the physicochemical and soil biological properties. Moreover, it destabilises the structural and

functional diversity of microorganisms present in soil. Plants are unable to grow nutritious or strong stems, and as a result of the conditions created, they have a lesser chance of surviving and are more prone to diseases and pests. Chemical fertilizers prevent plants from absorbing enough water, resulting in root burning (Pahalvi *et al.*, 2021) [20].

Vermicompost provided sustained nutrient release, while biofertilizers supported nitrogen fixation and phosphorus solubilisation (Sidhya *et al.*, 2026) [28]. Organic manures like FYM, poultry manure, Vermicompost improves the soil structure, aeration, Slow Release nutrient which support root development leading to higher growth and yield of radish (Adib *et al.*, 2025) [1].

Mulching is an important agronomic practice used for conserving soil moisture, regulating soil temperature, suppressing weed growth and improving soil physical conditions. It plays a vital role in enhancing the growth and yield of root vegetable crops like radish, as the crop develops its edible portion below ground where soil microclimate is critical. Mulches such as black polythene, wheat straw, saw dust and other organic residues create a favourable environment around the root zone by reducing evaporation losses and maintaining uniform soil temperature, which promotes better root elongation and expansion. The use of mulching materials also improves aeration, increases nutrient availability and enhances water-use efficiency, making it a highly beneficial component in sustainable vegetable production systems (Iriany *et al.*, 2018) [12]. The present study was conducted to assess the effect of organic manure and mulching on growth, yield and quality traits of radish (*Raphanus sativus* L.).

Materials and Methods

The present investigation was conducted on the Agricultural Research Farm, Department of Horticulture, School of Agriculture at Suresh Gyan Vihar University, Jaipur (Rajasthan) during 2025-26. It was laid out in Factorial Randomized Block Design with two factors, first factor was Organic manure with 4 levels viz. Control (O₀), FYM (20 q/ha) (O₁), Vermicompost (@7 t/ha) (O₂) and Poultry manure (@6 t/ha) (O₃) and second factor was Mulching with 4 Levels viz. Control (M₀), Saw dust (@ 10 t/ha) (M₁), Black Plastic mulch (M₂) and Wheat straw (@ 5 t/ha) (M₃) replicated thrice and Pusa Himani variety of radish was used in this experiment. Seeds were sown at 30 cm x 10 cm spacing. The observed data was analyzed in OPSTAT.

Results and Discussion

From the experiment it was recorded that organic manures and mulching had a significant effect on vegetative traits. Superior vegetative parameters viz. maximum plant height (36.74cm) (Table 1), leaf length (30.16 cm) (Table 2), total chlorophyll content in leaves (2.967 mg/g) (Table 3) and number of leaves per plant (12.40) (Table 4) were observed in the treatment consisting vermicompost (@7 t/ha) X black plastic mulch (O₂M₂). This treatment combination has been recorded significantly superior over all the treatments whereas the minimum was observed in control. The significant improvement in vegetative parameters of radish under the combination of vermicompost and black plastic mulch can be attributed to the synergistic effect of enhanced nutrient availability and a stabilized soil microclimate. Vermicompost acts as a potent source of readily available macro and micronutrients, alongside plant growth regulators like auxins and gibberellins, which directly stimulate cell division, leaf elongation, and chlorophyll synthesis, thereby boosting photosynthetic capacity (Akay,

2019; Balci *et al.*, 2025; Dulal *et al.*, 2021; Muthukannan *et al.*, 2024; Yashvardhan *et al.*, 2023) [2, 6, 9, 19, 32].

Combined application of vermicompost and black polythene mulch significantly enhanced the yield and yield attributing traits of radish. Superior yield parameters viz. diameter of root (4.96 cm) (Table 5), length of root (17.80 cm) (Table 6), weight of root (132.5 g) (Table 7), minimum days to harvest (59.07) (Table 8) and maximum yield of the roots (441.70 q/ha) (Table 9) were observed in the treatment combination vermicompost (@ 7 t/ha) X black plastic mulch (O₂M₂) whereas the minimum was observed in control. The significant enhancement in the yield and yield-attributing traits of radish under the synergistic application of vermicompost and black plastic mulch is fundamentally attributed to the optimization of the source-sink relationship and the stabilization of the root-zone microclimate. The application of vermicompost facilitates superior root expansion by improving soil physical properties, specifically through increased porosity and reduced bulk density, which minimizes mechanical resistance for root elongation and radial thickening (Hossain *et al.*, 2024; Marahatta, 2025; Muthukannan *et al.*, 2024; Yashvardhan *et al.*, 2023) [11, 18, 19, 32]. Furthermore, the inclusion of humic substances and plant growth-promoting rhizobacteria (PGPR) within the vermicompost enhances nutrient bioavailability and uptake efficiency, promoting greater dry matter accumulation in the sink tissue (Bhardwaj *et al.*, 2023; Yadav *et al.*, 2024) [7, 30]. Complementing this, the black plastic mulch establishes an ideal hydrothermal regime by conserving soil moisture and regulating root-zone temperatures, which accelerates metabolic activities and suppresses weed competition (Fayaz *et al.*, 2025; Thakur, 2021) [10, 29].

Significantly best results of quality attributes of radish recorded organic manures and mulching. Superior quality parameters viz. maximum TSS content in roots (5.19 °Brix) (Table 10), ascorbic acid in root (30.15 mg/100g) (Table 11) and minimum cracking percentage (2.14%) (Table 12) were observed in the treatment consisting vermicompost (@7 t/ha) X black plastic mulch (O₂M₂). This treatment combination has been recorded significantly superior over all the treatments whereas the minimum was observed in control. This enhancement may be driven by an enhanced metabolic rate and nutrient bioavailability. The observed increase in TSS and ascorbic acid was attributed to the presence of humic acids and growth-promoting hormones in vermicompost, which act as catalysts for the biosynthesis of sugars and antioxidant compounds (Arancon *et al.*, 2005; Dulal *et al.*, 2021) [9]. Furthermore, the stable hydrothermal regime provided by the black plastic mulch maximizes leaf chlorophyll content, thereby optimizing photosynthetic efficiency and the subsequent translocation of photo-assimilates to the storage roots. A critical qualitative benefit of this combination is the substantial reduction in root cracking, as the mulch acts as a barrier against rapid soil moisture fluctuations a primary trigger for cellular turgor stress and tissue rupture in root crops (Parmar *et al.*, 2013) [22]. This synergy between organic enrichment and microclimate regulation not only enhances the nutritional density of the radish but also improves its physical marketability by maintaining structural integrity and reducing physiological disorders (Ali *et al.*, 2025; Rani *et al.*, 2016) [3, 23].

The economic feasibility of radish cultivation is a critical determinant for its adoption by farmers and the results from this study demonstrated that the integration of vermicompost and black plastic mulch provided the most superior financial returns. The maximum net return of ₹566420.48/ha and benefit-cost ratio (B:C ratio) of 2.41 were achieved under the O₂M₂ treatment,

significantly outperforming the absolute control (O_0M_0), which yielded the lowest B:C ratio of 1.22 (Table 13). This economic superiority may be primarily driven by the exponential increase in root yield, which offsets the production costs and maximizes the gross returns. The high B:C ratio under vermicompost application is supported by Pandey *et al.* (2024) ^[21], who observed that the nutrient-rich nature of vermicompost enhances crop productivity to an extent that significantly increases the profit-to-investment margin. Furthermore, the economic advantage of utilizing black plastic mulch is corroborated by Semwal *et al.* (2012) ^[26] and Kapoor *et al.* (2022) ^[14], who noted

that while synthetic mulches involve an initial investment, they dramatically increase net income by minimizing labor costs for weed management and ensuring a higher percentage of marketable, high-quality roots. The findings suggest that the O_2M_2 combination was a highly lucrative production model, providing the highest return on every rupee invested compared to traditional or non-mulched systems. These results concur with those of Kanaujia *et al.*, (2012) ^[13], Reddy *et al.*, (2011) ^[24], Yanthan *et al.*, (2012) ^[31]; Mali *et al.*, (2018) ^[17], Khede *et al.*, (2019) ^[16] and Khatri *et al.*, (2019) ^[15].

Table 1: Effect of organic manures and mulching on plant height (cm), leaf length (cm) and total chlorophyll content in leaves (mg/g) of radish

Factors	Plant height (cm)					Leaf length (cm)					Total chlorophyll content in leaves (mg/g)				
	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean
O ₀	24.31	24.75	25.54	25.04	24.91	16.90	17.37	18.21	17.68	17.54	1.62	1.68	1.79	1.72	1.71
O ₁	26.04	28.46	30.38	29.47	28.59	18.75	21.33	23.37	22.41	21.46	1.86	2.21	2.47	2.34	2.22
O ₂	27.55	33.38	36.74	34.49	33.04	20.36	26.58	30.16	27.76	26.21	2.07	2.91	2.96	2.82	2.69
O ₃	25.99	31.77	33.11	32.09	30.74	19.05	24.86	26.29	24.91	23.77	1.91	2.67	2.86	2.72	2.54
Mean	25.97	29.59	31.44	30.27		18.76	22.53	24.50	23.19		1.86	2.36	2.52	2.41	
Factors	C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)	
Factor (O)	1.508	0.735	0.52	5.73		1.186	0.578	0.409	6.36		0.115	0.056	0.04	6.30	
Factor (M)	1.508	0.735	0.52			1.186	0.578	0.409			0.115	0.056	0.04		
Factor (O X M)	3.016	1.47	1.039			2.371	1.156	0.817			0.231	0.113	0.08		

Table 2: Effect of organic manures and mulching on number of leaves per plant, diameter of root (cm) and length of root (cm) of radish

Factors	Number of leaves per plant					Diameter of root (cm)					Length of root (cm)				
	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean
O ₀	7.3	7.48	7.8	7.6	7.54	3.06	3.13	3.25	3.17	3.15	9.36	9.66	10.2	9.85	9.76
O ₁	8.01	9.01	9.79	9.42	9.05	3.33	3.69	3.99	3.85	3.71	10.54	12.18	13.48	12.86	12.26
O ₂	8.63	11.02	12.4	11.48	10.88	3.56	4.45	4.96	4.62	4.39	11.56	15.52	17.8	16.27	15.28
O ₃	8.13	10.36	10.91	10.49	9.97	3.23	4.133	4.48	4.183	4.01	10.73	14.43	15.34	14.64	13.78
Mean	8.01	9.46	10.22	9.74		3.29	3.851	4.17	3.956		10.54	12.94	14.21	13.41	
Factors	C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)	
Factor (O)	0.54	0.26	0.18	5.19		0.22	0.109	0.077	7.00		0.81	0.395	0.279	6.60	
Factor (M)	0.54	0.26	0.18			0.22	0.109	0.077			0.81	0.395	0.279		
Factor (O X M)	1.08	0.52	0.37			0.44	0.218	0.154			1.621	0.79	0.558		

Table 3: Effect of organic manures and mulching on weight of roots (g), days to harvest and yield of roots (q/ha) of radish

Factors	Weight of root (g)					Days to harvest of radish					Yield of the roots (q/ha)				
	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean
O ₀	77.4	79.37	82.85	80.62	80.06	65.64	65.41	64.99	65.26	65.325	258	264.56	276.18	268.73	266.868
O ₁	85.09	95.81	104.3	100.28	96.37	64.72	63.44	62.43	62.91	63.375	283.63	319.38	347.69	334.28	321.245
O ₂	91.79	117.6	132.5	122.53	116.11	63.92	60.84	59.07	60.26	61.023	305.97	392.09	441.7	408.48	387.06
O ₃	86.34	110.4	116.41	111.9	106.28	64.57	61.7	60.99	61.53	62.198	287.8	368.25	388.06	373.02	354.283
Mean	85.15	100.81	109.01	103.83		64.713	62.84	61.87	62.49		283.85	336.07	363.408	346.128	
Factors	C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)	
Factor (O)	4.605	2.244	1.587	5.51		0.744	0.362	0.256	5.41		15.513	7.56	5.345	5.57	
Factor (M)	4.605	2.244	1.587			0.744	0.362	0.256			15.513	7.56	5.345		
Factor (O X M)	9.209	4.488	3.173			1.487	0.725	0.512			31.027	15.119	10.691		

Table 4: Effect of organic manures and mulching on weight of roots (g), days to harvest and yield of roots (q/ha) of radish

Factors	TSS content in roots (°Brix)					Ascorbic acid in root (mg / 100 g)					Cracking percentage (%)				
	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean	M ₀	M ₁	M ₂	M ₃	Mean
O ₀	4.53	4.56	4.61	4.58	4.57	18.12	18.233	19.01	18.517	18.472	5.65	5.52	5.3	5.45	5.48
O ₁	4.64	4.8	4.93	4.87	4.81	19.51	21.923	23.83	22.923	22.048	5.16	4.48	3.94	4.19	4.443
O ₂	4.74	5.12	5.34	5.19	5.09	21.01	26.813	30.15	27.913	26.473	4.73	3.09	2.14	2.77	3.183
O ₃	4.66	5.02	5.1	5.04	4.95	19.79	25.21	26.54	25.53	24.269	5.08	3.54	3.16	3.45	3.808
Mean	4.64	4.87	4.99	4.92		19.61	23.045	24.883	23.721		5.155	4.158	3.635	3.965	
Factors	C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)		C.D.	SE(d)	SE(m)	CV (%)	
Factor (O)	0.106	0.051	0.036	2.59		0.795	0.388	0.274	3.81		0.167	0.082	0.058	3.03	
Factor (M)	0.106	0.051	0.036			0.795	0.388	0.274			0.167	0.082	0.058		
Factor (O X M)	0.21	0.103	0.073			1.591	0.775	0.548			0.335	0.163	0.115		

Table 5: Effect of organic manures and mulching on economics of production of radish

Treatment	Total Cost (₹./ha)	Gross Return (₹./ha)	Net Return (₹./ha)	B:C Ratio
O ₀ X M ₀	180000	400102.40	220102.40	1.22
O ₀ X M ₁	190000	480017.66	290017.66	1.53
O ₀ X M ₂	195000	501100.99	306100.99	1.57
O ₀ X M ₃	190000	487583.71	297583.71	1.57
O ₁ X M ₀	189000	514618.27	325618.27	1.72
O ₁ X M ₁	199000	579483.07	380483.07	1.91
O ₁ X M ₂	204000	630848.73	426848.73	2.09
O ₁ X M ₃	199000	606517.63	407517.63	2.05
O ₂ X M ₀	220000	555151.96	335151.96	1.52
O ₂ X M ₁	230000	711408.09	481408.09	2.09
O ₂ X M ₂	235000	801420.48	566420.48	2.41
O ₂ X M ₃	230000	741146.11	511146.11	2.22
O ₃ X M ₀	210000	522184.32	312184.32	1.49
O ₃ X M ₁	220000	668152.80	448152.80	2.04
O ₃ X M ₂	225000	704096.06	479096.06	2.13
O ₃ X M ₃	220000	676807.48	456807.48	2.08

Conclusion

Radish (*Raphanus sativus* L.) is mostly grown root vegetable cultivated in both subtropical and tropical regions of the world is one of the most important root vegetable consumed raw as salad or cooked as vegetable and also stuffed in paranthas. From the present study it can be concluded that application of vermicompost (@ 7 t/ha) X black plastic mulch enhanced not only the vegetative performance of radish but also their yield, quality traits and benefit cost ratio.

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