Original Research Article

"~~Impact~~the effect of organic manure and inorganic fertilizers on growth and yield of Radish (*Raphanus sativus* L.) in Gird region of Madhya Pradesh."

ABSTRACT

Aims: ~~In the Rabi season of 2022, a field experiment was set up at the Crop Research Centre II, School of Agriculture, ITM UniversityGwalior (M.P.) in a randomised block design (RBD factorial) with three replications.~~

A field experiment was conducted to study the effect of of organic manure and inorganic fertilizers on growth and yield of Radish (Raphanussativus L.) in Gird region of Madhya Pradeshas factorial base on the randomized complete block design in four replications at the research farm of……The location of the research project….,

Ten treatments viz., T_1-(100 % NPK through inorganic sources), T_2-(100 % NPK through Farm Yard manure (16t/ha)), T_3-100 % NPK through Vermicompost (12t/ha), T_4-100 % NPK through Poultry Manure (9.48t/ha), T_5-75% NPK + 25%N through FYM, T_6-75% NPK +25% N through Vermicompost, T_7-75% NPK + 25% N through Poultry manure, T_8-50% NPK + 50% N through FYM, T_9-50% NPK + 50% N through Vermicompost, T_{10}-50% NPK + 50% N through Poultry manure were made up of single variety Ivory whitethe experiment was planted in the CRC-II.At all of the periodic crop growth phases except at 15 DAS, T_6 showed significant plant height and leaf count increases across crop phases. T_5, T_6 had maximum heights; T_3, T_{10} had minimum. T_5, T_6, T_8displayed the highest leaf counts; T_1 the least. Leaf lengths followed a similar trend, with T_8, T_6 having the longest; T_1 the shortest. Overall, T_6 exhibited prominent growth in both height and leaf attributes, while T_1 consistently showed the lowest values throughout all stages and measurements.The conventional practices T_6 had significant positive influence on yield and yield attributing parameters, viz; root length (35.05cm), weight of whole plant (418.91g),

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initial fresh weight of roots (355.54g) but initial fresh weight of leaves (72.52g) in recorded in treatment T_2, root diameter (50.61mm), girth of root (12.3cm), dry weight of leaves (13.49g) measured in T2, dry weight of root (102.19g), root yield per plot (21.33kg), root yield per hectare (319.98qha^{-1}).Conclusion: Economically the application of 75% NPK+25% N through vermicompost gave maximum net return (Rs. 262553.80) and BC ratio (3.94).

***Keywords*:** Economics, FYM,NPK, ~~FYM, Vermicompost,~~ Poultry Manure, VermicompostEconomics

INTRODUCTION

Vegetables are the most important crops which are grown and consumed worldwide. India is second largest producer of vegetable after china; the share of the total vegetable production is almost 13.82 percent **(Anonymous, 2016).** Radish (*Raphanussativus* L.) 2n=18.) is an important root vegetable crop belongs to the family Brassicaceae and originated from Europe. It is called '*Mooli*'.

Radish is grown in almost all the states of India with an area of **206** thousand hectare and production **3304** thousand MT**(2nd Advance estimates for 2021-22 as per PIB data base,2022**).However, as per the final estimated data for 2020-21, the area was **207** thousand hectares with production of **3263** thousand MT **(NHB data base, 2022)**.West Bengal is leading producer of Radish. The production of Radish is 502.05 thousand tonnes in West Bengal **(Anon, 2015)**. Large scale production in the field is more common in Haryana, West Bengal, Punjab, Bihar, Assam, Madhya Pradesh and other some states of India. In Madhya Pradesh radish is grown in 10440 ha with a production of 153270 tonnes (**Anonymous, 2016-2017).**

Radish is of great medicinal significance as it can be used for neurological headache, sleeplessness and chronic diarrhoea**.** The roots are more beneficial in urinary complaints and piles while the leaves of radish are good sources 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 **(Politud, 2016).**Radish is predominantly a cool season vegetable crop, it sown during winter from September to January in northern plains of India; Asiatic types can tolerate higher temperatures than European varieties, so in the mild climate of peninsular India, radish can be grown almost all the year round expect for few months of summer. It is an annual or biennial crop depending upon the type for the purpose it is grown**(PCARRD, 2009).**Organic manure like farm yard manure (FYM), poultry manure and Vermicompost should also be used as they also make the

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soil fertile and give nutrition to plant. FYM helps to improving the physical, chemical and biological properties of soil **(Mengistu & Mekonnen, 2012).**In compare to chemical fertilizers, Vermicompost improves soil quality and productivity. Similarly, another organic manure i.e. poultry manure; contains higher levels of nitrogen, phosphorous and potassium than that of other animals additionally poultry manure enhances the fertility of soil, soil aeration, and water holding capacity.**(Khatri*et al*.,2019).**Chemical fertilizer deteriorates the quality of produce and are expensive too, leading to reduction in the net profit and returns to the farmers. The integrated nutrient management system approach utilizes a judicious combination of inorganic fertilizer and organic manure in building soil fertility and to the increase the production potential of the crop **(Kumar *et al*., 2013).**

MATERIALS AND METHODS

The experimental site is located in Gwalior's district of Madhya Pradesh which is situated in subtropics at an elevation of 196 m above sea level with coordinates at 26° 21'N latitude and 78° 17' E longitude which represents Indo-gangetic plains region.

Gwalior receives about 80 to 90% of the total rainfall in between the July to September from the southwest monsoon and rare showers of cyclonic rains received in winter or late spring season. Also the rainfall is restricted mainly among the months of July to September along with some showers of cyclic rains during winter and spring season. During the summer and winter, the mean maximum and minimum temperatures show a wide range of variations. The region's regular climate ranges from a max of 48°C in the summer with hot desiccating winds to a minimum of 0°C or even lower in the winter with frost.

With three (3) replications, the experiment was carried out using a (as factorial base on the)~~randomised~~ randomized block design (RBD Factorial) at ……farm or…….Ten treatments viz., T_1-(100 % NPK through inorganic sources, T_2-(100 % NPK through Farm Yard manure (16t/ha)), T_3-100 % NPK through Vermicompost (12t/ha), T_4-100 % NPK through Poultry Manure (9.48t/ha), T_5-75% NPK + 25%N through FYM, T_6-75% NPK +25% N through Vermicompost, T_7-75% NPK + 25% N through Poultry manure, T_8-50% NPK + 50% N through FYM, T_9-50% NPK + 50% N through Vermicompost, T_{10}-50% NPK + 50% N through Poultry manure were made up of single variety Ivory white to determine the influence of organic manure and inorganic fertilizers on growth and yield attributes

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for increased output of radish. On November 28, 2022, the experiment was planted in the CRC-II.NPK applied through urea, DAP and MOP as per treatments. Full quantity of phosphorous, potash and 1/3 of nitrogen was applied as basal dose dressing as per treatments, while the remaining nitrogen was top dressed at 15 and 30 DAS. The net plot area of each treatment has five randomly chosen plants that were tagged for the purpose of recording various measurements. The data were then statistically evaluated using the method outlined byPanse and Sukhatme, (1989).

RESULTS AND DISCUSSION

Growth attributing characters:

The results summarized in Table I reveal treatment T_6 (75% NPK + 25% N through vermicompost) as the consistent leader in promoting plant height growth across all stages, showcasing its efficacy with a remarkable 28.6 cm height at harvest. However, the growth journey is far from monotonous, with treatments like T_4-100% NPK through Poultry Manure (9.48t/ha) and T_5-75% NPK + 25%N through FYMdemonstrating competitive potential at specific stages. The variability in growth patterns underlines the diverse interactions between treatments and growth factors**.**The close findings are supported by Kumar *et al.,* (2014) in radish,Basirkutawa*et al*., (2020) in okra, Kushwah*et al.*,(2019) in carrot and Aswathi P *et al*., (2021). Application of different sources of nutrients resulted in significant variation for number of leaves per plant at all growth stages. Highest number of leaves was recorded with T_6 (75% NPK + 25% N through vermicompost) at 30 and 45 days while T8 at harvest followed by T_3-100 % NPK through Vermicompost (12t/ha), T_8-50% NPK + 50% N through FYM, T_6-75% NPK +25% N through Vermicompostat 30, 45 DAS and at harvest) while lowest number of leaves was noted with T_1 (100% NPK through inorganic sources). Treatment T_6 (75% NPK + 25% N through vermicompost) excels with the highest leaf count due to gradual nutrient release from vermicompost. This enriches soil nutrients, yielding more leaves per plant. The study highlights vermicompost's role in sustained nutrient supply, enhancing leaf growth under T_6-75% NPK +25% N through Vermicompostat 30 and 45 DAS while T_8-50% NPK + 50% N through FYM at 15 DAS and at harvest. Similar findings have been reported by Bhattarai and Maharjan, (2013), Kumar *et al.*, (2014) and Khalid *et al.*, (2015) in radish. Among treatments, highest length of leaves was recorded with T_8-(50% NPK + 50% N through FYM) 15 DAS and at harvest followed by T_6-(75% NPK +25% N through Vermicompost) at 45 DAS and at harvest, while minimum length of leaves was

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recorded with T_1-(100 % NPK through inorganic sources). Similar findings have been reported by Kumar *et al*., (2014) in radish and Rao *et al.*,(2010) in onion.

yield and yield components: ~~**Yield and yield attributing characters:**~~

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The data presented clearly in Table III.Maximum length of root (35.05 cm) was recorded under the treatment T_6(75% NPK +25% N through Vermicompost) and it was followed by (33.55 cm)T_9(50% NPK + 50% N through Vermicompost)and minimum length of root (28.61 cm) recorded in T_7(75% NPK + 25% N through Poultry manure). Treatments recorded significant effect on diameter of root. Maximum diameter of root (50.61 mm) recorded under the treatmentT_6 (75% NPK +25% N through Vermicompost), it was(46.05 mm) followed by T_9 (50% NPK + 50% N through Vermicompost) and minimum (35.47mm) in T_{10} (50% NPK + 50% N through Poultry manure). These findings are in agreement with reported by Uddain*et al.* (2010), Kumar *et al.*(2014) in radish and Kumar *et al.* (2014) carrot.

The Table II presented that treatments indicated significant effect on fresh weight of root. Maximum Initial fresh weight of root (402.21 g) was observed with treatment T_6 (75% NPK +25% N through Vermicompost)followed by (285.78g) in T8 (50% NPK + 50% N through FYM) and minimum root weight (180.36g) observed in T_{10} (50% NPK + 50% N through Poultry manure). The treatments recorded significant effect on Initial fresh weight of leaves (73.52g) in T_2 followed by (63.37g) in T_6 (75% NPK+25% N through Vermicompost)and minimum fresh weight of leaves (44.52g) was recorded in T_{10} (50% NPK + 50% N through Poultry manure).Similar findings related to Kushwah*et al*. (2016) in radish, Kumar *et al.* (2014) in radish. The data summarized in Table III the treatment T_6-75% NPK +25% N through Vermicompost (50.61 mm) exhibit the widest root diameter among all treatments. Treatments T_9(46.05 mm), T_4 (43.59 mm), and T_2 (42.74 mm) also show relatively wider root diameters while (35.47 mm) recorded lowest in T_{10} (50% NPK + 50% N through Poultry manure). The variation in root diameters across treatments emphasizes the role of various factors in shaping the root development patterns of radish crops. Maximum Root girth (12.3 cm)was observed in T_6 (75% NPK +25% N through Vermicompost) followed by T_9(11.69 cm) and minimum Girth of root(8.33 cm) was found in T_{10} (50% NPK + 50% N through Poultry manure). Similar findings are agreement with Kumar *et al.* (2009), Uddain*et al*., (2010), Kumar *et al.*, (2014) and Kushwah*et al.*, (2016) in radish.

The treatment indicated significant effect on dry weight of root and leaves. The data in Table IV represents that the treatment T_6-75% NPK +25% N through Vermicompost (102.19g) exhibits the highest dry weight of roots among all treatments. Treatments T_8 (50% NPK + 50% N through FYM)(99.24g), T_2 (96.91g), and (95.99g) in T_9 (50% NPK + 50% N through Vermicompost)also show relatively higher root dry weight while treatment T_{10}-50% NPK + 50% N through Poultry manure (47.29 g) has the lowest and Treatments T_6-75% NPK +25% N through Vermicompost (12.25g), T8-50% NPK + 50% N through FYM (12.04g), and T_7-75% NPK + 25% N through Poultry manure (11.29g) also show relatively higher leaf dry weights while treatments T8-50% NPK + 50% N through FYM (7.00 g) and T_5-75% NPK + 25%N through FYM (7.87g) have relatively lower dry weight. The close findings are supported by Kumar *et al.*,(2009), Uddain*et al.*,(2010) and Kumar *et al.*,(2014). The outcome of the investigation presented in Table V. Root yield per plot and per hectare was significantly increased due to use of different nutrient management in radish crop. The highest root yield of radish per plot (21.33kg) and per hectare (319.98q/ha) was obtained in T6-75% NPK +25% N through Vermicompost, while lowest root yield (10.82 kg, 162.3q/ha) in T_{10}(50% NPK + 50% N through Poultry manure).

ECONOMICS

The regional adaptability of any agronomic practice in the cultivation of any crop is completely based on maximum economic value of treatments. Based on the cost analysis, highest net profit of Rs. 262553.8 ha^{-1} and maximum B: C (3.9) was recorded in T_6 75% NPK + 25% N through Vermicompost(Table VI).

CONCLUSION

On the basis of present investigation it is concluded that the treatment T_6(75% NPK + 25% N through vermicompost) was found to be the best treatment combination in respect of plant growth and root yield parameter and has also given maximum B: C ratio of Radish (*Raphanus sativus* L.) cultivated variety Ivory white grown under gird region of Madhya Pradesh.

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Table I: Effect of organic manure and inorganic fertilizers on growth parameters

	Plant Height(cm)				Number of leaves per plant				Length of Leaves per plant(cm)			
Treatment	**15 DAS**	**30 DAS**	**45 DAS**	**At harvest**	**15 DAS**	**30 DAS**	**45 DAS**	**At harvest**	**15 DAS**	**30 DAS**	**45 DAS**	**At harvest**
T1	10.87	18.54	20.83	23.21	3.07	5.07	10.47	15.00	7.45	12.46	17.33	20.79
T2	11.58	17.83	22.61	23.07	4.00	6.87	15.60	19.33	11.18	17.42	21.53	22.66
T3	9.94	18.97	23.23	23.84	4.67	7.73	16.33	18.67	10.21	18.57	22.15	23.44
T4	12.09	19.39	23.91	25.01	4.53	6.93	14.97	15.67	10.35	18.98	22.49	23.61
T5	13.59	19.51	24.23	27.39	5.20	7.53	15.20	17.73	10.51	19.11	22.83	23.98
T6	11.10	20.57	27.13	28.67	4.87	7.87	17.60	19.73	11.23	20.17	24.06	26.27
T7	11.45	18.24	22.82	23.26	4.20	7.47	15.73	18.53	11.35	17.84	21.55	22.86
T8	11.43	20.03	22.43	24.58	4.97	6.80	16.73	20.47	11.75	19.63	23.70	26.93
T9	10.82	19.67	24.17	24.63	4.40	7.47	14.80	15.80	10.55	20.61	23.10	24.89
T10	11.11	16.71	22.39	22.26	3.60	6.33	15.60	17.80	10.70	16.29	20.65	21.86
SE(m)±	**0.55**	**1.44**	**0.77**	**0.93**	**0.42**	**0.48**	**1.21**	**1.15**	**0.60**	**1.34**	**1.22**	**1.17**
C.D. at 5%	**1.66**	**NS**	**2.29**	**2.78**	**1.25**	**1.43**	**3.61**	**3.45**	**1.81**	**4.00**	**3.65**	**3.49**

Table II: Effect of organic manure and inorganic fertilizers on fresh weight of plant of Radish

Treatment	Weight of whole plant(g)	Initial fresh weight of roots(g)	Initial fresh weight of leaves(g)
T1	254.81	204.54	50.27
T2	348.43	274.91	73.52
T3	285.86	234.98	50.88
T4	321.95	259.81	62.13
T5	291.83	241.72	50.11
T6	418.91	355.54	63.37
T7	256.95	210.27	46.68
T8	346.51	285.78	60.73
T9	317.43	264.67	52.76
T10	224.88	180.36	44.52
SE(m)±	**13.27**	**10.24**	**3.23**
C.D. at 5%	**39.72**	**30.67**	**9.66**

Table III: Effect of organic manure and inorganic fertilizers on root of Radish

Treatment	Root length(cm)	Root diameter(mm)	Girth of Root(cm)
T1	32.53	41.907	10.47
T2	31.94	42.74	10.27
T3	31.03	41.14	10.07
T4	33.41	43.587	10.25
T5	29.92	42.52	9.9
T6	35.05	50.607	12.3
T7	28.61	39.833	9.56
T8	32.63	40.833	11.38
T9	33.55	46.047	11.69
T10	30.29	35.467	8.33
SE(m)±	**1.06**	**1.62**	**0.41**
C.D. at 5%	**3.19**	**4.87**	**1.24**

Table IV: Effect of organic manure and inorganic fertilizers on dry weight of root and leaves of Radish

Treatment	Dry Weight of Root(g)	Dry weight of leaf(g)
T1	90.89	9.91
T2	96.91	13.49
T3	79.93	7.00
T4	93.43	9.85
T5	83.67	7.87
T6	102.19	12.25
T7	76.73	11.29
T8	99.24	12.04
T9	95.99	9.19
T10	47.29	9.26
SE(m)±	**3.25**	**0.46**
C.D. at 5%	**9.73**	**1.38**

Table V: Effect of organic manure and inorganic fertilizers on yield of Radish

Treatment	Root Yield per plot(kg)	Root yield (q/ha)
T1	12.273	184.087
T2	16.497	247.417
T3	14.1	211.483
T4	15.59	233.83
T5	14.5	217.547
T6	21.333	319.983
T7	12.62	189.24
T8	17.147	257.203
T9	15.88	238.2
T10	10.82	162.327
SE(m)±	0.615	9.218
C.D. at 5%	1.841	27.601

Table VI: Effect of organic manure and inorganic fertilizers on economics of Radish

Treatment	Treatment Details	Radish yield	Gross return (a)	Cost of cultivation (b)	Net return (a-b)	Benefit: cost ratio [(a/b]
		q ha-1	Rs. ha-1	Rs. ha-1	Rs. ha-1	
T1	T1-100 % NPK through inorganic sources	184.09	202495.70	54690.00	147805.70	3.70
T2	T2-100 % NPK through Farm Yard manure (16t/ha)	247.42	272158.70	97640.00	174518.70	2.79
T3	T3-100 % NPK through Vermicompost (12t/ha)	211.48	232631.30	97640.00	134991.30	2.38
T4	T4-100 % NPK through Poultry Manure (9.48t/ha)	233.83	257213.00	79640.00	177573.00	3.23
T5	T5-75% NPK + 25%N through FYM	217.55	239301.70	65427.50	173874.20	3.66
T6	T6-75% NPK +25% N through Vermicompost	319.98	351981.30	89427.50	262553.80	3.94
T7	T7-75% NPK + 25% N through Poultry manure	189.24	208164.00	75927.50	132236.50	2.74
T8	T8-50% NPK + 50% N through FYM	257.20	282923.30	76165.00	206758.30	3.71
T9	T9-50% NPK + 50% N through Vermicompost	238.20	262020.00	76090.00	185930.00	3.44
T10	T10-50% NPK + 50% N through Poultry manure	162.33	178559.70	67090.00	111469.70	2.66