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Influence of Organic Manures and Bio-Fertilizer on Growth of Radish (*Raphanus sativus* L.)

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Abstract
The experiment was entitled "Influence of Organic Manures and Bio-fertilizer on Growth of Radish (*Raphanus sativus*L.)" was investigated at School of Studies in Agricultural Sciences Samrat Vikramaditya Vishwavidhyalay, Ujjain (M.P) during the *rabi* season of 2024-2025. The experiment use Randomized Block Design with three replication in total 10 different treatment T_1- 100% Control,T_2-100% FYM (@20t ha^{-1}), T_3-100% Vermicompost (@ 5t ha^{-1}), T_4 -100% Poultry manure (@ 20t ha^{-1}),T_5- *Azotobacter* (@4.5 kg ha^{-1}), T_6- *Azotobacter* (@4.5kg ha^{-1}) + FYM (80%), T_7 - *Azotobacter* (@4.5 kg ha^{-1}) + Vermicompost (80%),T_8 -9 *Azotobacter* (@4.5 kg ha^{-1}) + Poultry manure (80%),T_9 *Azotobacter* (@4.5 kg ha^{-1}) + FYM (75%) + Vermicompost (75%) and T_{10}- *Azotobacter* (@4.5 kg ha^{-1}) + FYM (50%) + Vermicompost (50%) + Poultry manure (50%).
Application of organic manures and bio-fertilizer was recorded in treatment T_9 [*Azotobacter* (@4.5 kg ha^{-1}) + FYM (75%) + Vermicompost (75%)] produced best results in terms of characters like maximum plant height 11.37 cm at 20 DAS, 27.95 cm at 40 DAS, and 36.40 cm at harvest, leaf length 10.56 cm at 20 DAS, 25.68 cm at 40 DAS, and 29.75 cm at harvest, number of leaves per plant (4.81, 10.45 and 14.13) at 20,40 DAS and at harvest, fresh weight of shoot 84.98 g at 20 DAS, 154.21 g at 40 DAS, and 213.59 g at harvest and dry weight of shoot, i.e., 8.21 g at 20 DAS, 10.19 g at 40 DAS, and 17.26 g at harvest.

Keywords: Radish, Organic Manures and Bio-fertilizer on Growth

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. Among the root vegetables, radish is the most popular and widely grown for its fresh edible roots and it is rich source of Ca, K and P. The edible roots can be used as raw, as salad or cooked. Radish roots are said to be useful in urinary complaints, piles and in gastrodynia and also it is considered as an appetizer. The fleshy roots that grow from both the primary root and the hypocotyl are the major part of a radish that is consumed. The strong flavour of radish is due to volatile isothiocyanates (trans-4-methyl-thibutenyl-isothiocyanate). The juice of fresh leaves is used as diuretic and laxative. Radish is a good source of vitamin-C (ascorbic acid), containing 15-40 mg per 100 g of edible portion and supplies a variety of minerals. The leaves of radish are good source for extraction of protein on a commercial scale. (Kumar *et al.,* 2014) [5].
FYM being rich in organic matter is required for supplementing the nutrients provided through other manure. The organic manure not only provides nutrients to plants but also improves the soil texture by binding effect to soil aggregates. Organic manure increases CEC, water holding capacity and phosphate availability of this soil, besides improving the fertilizer use efficiency and microbial population of soil. It reduces nitrogen loss due to slow release of nutrients.
Vermicompost provides essential macronutrients (N, P, K, Ca and Mg) and micronutrients (Fe, Mn, Zn and Cu). Itis a slow releasing organic manure which has most of the macro as well as micro nutrients in chelated form and fulfills the nutrients requirement of plant for longer period Vermicompost helps in reducing C:N (Carbon-Nitrogen ratio), increasing humic acid content, cation exchange capacity and water-soluble carbohydrates. It helps to reduce soil erosion and also helps to decrease soil pollutants. It also contains biologically active substances such as plant growth regulators. It reduces soil erosion and

deodourification of soil pollutants.

Bio-fertilizer is a substance which contains living micro-organisms, when applied to seeds, plant surface or soil, they colonize at the *rhizosphere* or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. It fixes atmospheric nitrogen or solubilize soil phosphorus or stimulate plant growth through synthesis of growth promoting substances. *Azospirillum*, *Azotobacter*, Blue green algae, VAM and Phosphate solubilizing bacteria (PSB) can be used as bio-fertilizers to increase the crop production. Phosphate solubilizing bacteria (PSB) are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds. P-solubilization ability of the microorganisms is considered to be one of the most important traits associated with plant phosphate nutrition (Shilpa *et al.,* 2023) [9].

Soil application of organic manure such as FYM, Vermicompost, Neem cake and biodynamic manure has a positive effect on crop production. Vermicompost has all characteristics to use it as the most valuable organic manure. The *Azotobacter* and PSB are the main bio-fertilizers which are biologically active products containing bacteria and they improve soil health and fertility. They liberate growth promoting substances and vitamins which may increase crop yield (Sharma *et al.,* 2013) [8].

Materials and Methods

The experiment was conducted at the field of Horticulture, School of Studies in Agricultural Sciences Samrat Vikramaditya Vishwavidhyalay, Ujjain (M.P) is situated at 23.17650 N latitude and 75.78850 E longitudes at an altitude of 494 m Mean Sea Level. The experiment was laid out at the crop cafeteria of the section Horticulture. Seed rate used during experiment 400-500 grams per acre and tested variety Ivory White. The experiment use Randomized Block Design with three replication in total 10 different treatment T_1- 100% Control,T_2-100% FYM (@ 20t ha^{-1}), T_3-100% Vermicompost (@ 5t ha^{-1}), T_4 -100% Poultry manure (@ 20t ha^{-1}),T_5- *Azotobacter* (@ 4.5 kg ha^{-1}), T_6- *Azotobacter* (@4.5kg ha^{-1}) + FYM (80%), T_7 - *Azotobacter* (@ 4 .5 kg ha^{-1}) + Vermicompost (80%), T_8 -9 *Azotobacter* (@ 4.5 kg ha^{-1}) + Poultry manure (80%), T_9 *Azotobacter* (@ 4.5 kg ha^{-1}) + FYM (75%) + Vermicompost (75%) and T_{10}- *Azotobacter* (@4.5 kg ha^{-1}) + FYM (50%) + Vermicompost (50%) + Poultry manure (50%).

As per treatments, full dose of N, P and K applied at the time of Sowing and FYM, Vermicompost, Poultry Manure, *Azotobactor* were applied as per treatments Combination in respective plot before sowing the seeds. NPK applied in form of urea, single super phosphate and Murate of potash respectively.

The fungicide treated seeds of radish were sown on 01 Dec. 2024 treatment wise by hand dibbling method on 22 cm high ridges to maintain row to row distance of 30 cm and plant to plant 10 cm. The seed sowing was done 1.25 cm deep on ridges to facilitate good root production. After sowing, the seeds were covered properly with soil, so that the seed may come in contact with the soil. The seeds were sown at the rate of 10 -12 kg ha^{-1}.

Results and Discussion

Growth parameters

The data regarding the effect of organic manures and biofertilizers on growth of radish maximum plant height 11.37 cm at 20 DAS, 27.95 cm at 40 DAS, and 36.40 cm at harvest, leaf length 10.56 cm at 20 DAS, 25.68 cm at 40 DAS, and 29.75 cm at harvest, number of leaves per plant (4.81, 10.45 and 14.13) at 20,40 DAS and at harvest, fresh weight of shoot 84.98 g at 20 DAS, 154.21 g at 40 DAS, and 213.59 g at harvest and dry weight of shoot, i.e., 8.21 g at 20 DAS, 10.19 g at 40 DAS, and 17.26 g at harvest were recorded in treatment T_9 (*Azotobacter* + FYM 75% + Vermicompost 75%. The significant effect on these parameters, as a consequence of inorganic fertilizers with organic manures and bio-fertilizer are attributed to the increased nutritional status of soil resulting into increased growth of the crop. The probable reason for increase in height of plant may be due to the combination of inorganic fertilizers with organic manures which increases the cation exchange capacity and water holding capacity. Vermicompost's nitrification inhibitory properties and improved soil structure in soil could also be associated with the increased plant height. The results corroborate with the findings of Bhattarai and Maharjan (2013) [3]. Similar results have also been reported by Basnet *et al*. (2021) [2] and Balbande *et al*. (2023) [1] in radish.

Enriching the available nutrient pool of the soil due to combined effect of slow release of nutrients through vermicompost and nitrogen availability through inorganic fertilizers, resulted in more number of leaves plant-1and higher leaf length. The result obtained is in harmony with results of Bhattarai and Maharjan (2013) [3], Kumar *et al*. (2014) [5] and Kushwah *et al*. (2020) [6] in radish.

Application of vermicompost enhanced the vegetative growth of radish and also stimulated the supply of plant nutrients during the course of microbial decomposition and enabled the crop to utilize nutrient and water more efficiently. It also releases macro and micronutrients during microbial decomposition which ultimately improved the vegetative growth. These results are in close agreement with the findings of Subedi *et al*. (2018), Meena *et al*. (2022) [7], Kaur *et al*. (2023) [4] and Balbande *et al*. (2023) [1] in radish.

Conclusion

It may be concluded that for higher growth of radish in T9 (*Azotobacter* + FYM 75% + Vermicompost 75% should prefer over other combination. The observations are based on one season data, to get more precise information, it is suggested that the experiment.

It can be concluded that the we can suggest to farmer use of T9 (*Azotobacter* + FYM 75% + Vermicompost 75% in organic manures and bio- fertilizers and improved soil nutrient status.

Table 1: Effect of different treatments on Plant Height, Leaf length and No of Leaves /plant

Treatment		Plant Height (cm)			Leaf length (cm)			No of Leaves /plant		
		20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest
T1	100% Control	7.80	17.85	25.86	6.32	15.74	22.25	3.25	8.55	10.23
T2	100% FYM (@20t ha^{-1})	8.60	20.94	27.42	7.55	17.88	25.07	3.73	8.97	10.54
T3	100% Vermicompost (@ 5t ha^{-1})	9.53	22.58	28.55	8.14	19.47	25.95	4.03	9.25	11.27
T4	100% Poultry manure (@ 20t ha^{-1})	8.81	21.98	28.43	7.83	19.14	25.62	3.96	9.16	10.73
T5	*Azotobacter* (@4.5 kg ha^{-1})	8.11	18.30	26.22	7.17	16.42	23.64	3.45	8.76	10.45
T6	*Azotobacter* (@4.5kg ha^{-1}) + FYM (80%)	9.84	25.24	32.54	8.84	22.72	27.46	4.18	9.39	13.41
T7	*Azotobacter* (@4.5 kg ha^{-1}) + Vermicompost (80%)	10.61	26.64	34.29	9.8	24.06	28.45	4.27	10.17	13.89
T8	*Azotobacter* (@4.5 kg ha^{-1}) + Poultry manure (80%)	10.24	25.97	33.43	9.26	23.8	27.99	4.52	9.84	13.66
T9	*Azotobacter* (@4.5 kg ha^{-1}) + FYM (75%) + Vermicompost (75%)	11.37	27.95	36.40	10.56	25.68	29.75	4.81	10.45	14.13
T10	*Azotobacter* (@4.5 kg ha^{-1}) + FYM (50%) + Vermicompost (50%) + Poultry manure (50%)	11.12	26.88	35.15	10.18	24.92	29.13	4.74	10.28	14.09
	S.E.M	0.29	0.58	0.85	0.29	0.58	0.87	0.15	0.29	0.44
	CD (5%) =	0.86	1.72	2.52	0.86	1.72	2.59	0.43	0.86	1.29

Table 2: Effect of different treatments on Fresh Weight of Shoot and Dry Weight of Shoot

Treatment		Fresh Weight of Shoot			Dry Weight of Shoot		
		20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest
T1	100% Control	74.23	133.56	193.27	6.32	7.71	14.72
T2	100% FYM (@20t ha^{-1})	76.38	135.21	197.33	6.84	8.06	15.46
T3	100% Vermicompost (@ 5t ha^{-1})	79.12	139.16	200.67	7.52	8.73	15.99
T4	100% Poultry manure (@ 20t ha^{-1})	78.94	135.98	199.51	7.14	8.56	15.83
T5	*Azotobacter* (@4.5 kg ha^{-1})	75.54	134.65	194.08	6.51	7.84	15.03
T6	*Azotobacter* (@4.5kg ha^{-1}) + FYM (80%)	80.29	140.88	203.62	7.75	9.13	16.08
T7	*Azotobacter* (@4.5 kg ha^{-1}) + Vermicompost (80%)	82.72	150.33	207.41	7.88	9.57	16.57
T8	*Azotobacter* (@4.5 kg ha^{-1}) + Poultry manure (80%)	81.25	148.67	205.57	7.81	9.38	16.32
T9	*Azotobacter* (@4.5 kg ha^{-1}) + FYM (75%) + Vermicompost (75%)	84.98	154.21	213.59	8.21	10.19	17.26
T10	*Azotobacter* (@4.5 kg ha^{-1}) + FYM (50%) + Vermicompost (50%) + Poultry manure (50%)	84.31	152.71	209.89	8.18	10.12	16.97
	S.E.M	13	0.57	0.74	0.11	0.23	0.28
	CD (5%) =	39	1.68	2.21	0.32	0.69	0.83

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