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Effect of Organic, Inorganic and Bio-Fertilizers on Growth, Yield and Quality of Turnip (*Brassica rapa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was carried out with title "Effect of organic, inorganic and bio-fertilizers on growth, yield and quality of Turnip (*Brassica rapa* L.) cv. Purple Top White Globe" at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Science, Prayagraj (U.P) During October 2021 to December 2021. The experiment was laid out in RBD with 9 treatments with 3 replications. The results revealed that Treatment T8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) performed the best in terms of days to Plant Height (44.44 cm), No. of Leaves (22.26), Leaf length (30.08 cm), shoot weight (23.93 g), root length (8.19 cm), root diameter (6.62 cm), root yield per plant (117.25 g), root yield per hectare (234.51 q/ha), TSS °Brix (5.5), B:C Ratio (4.46:1). Therefore, the Treatment T8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) is the best when compared to other treatments. As the highest benefit cost ratio was observed in treatment T8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) i.e., (4.46:1) which states that it is economically profitable compared to all other treatments.

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1. INTRODUCTION

Turnip (*Brassica rapa* L.) is a member of the cruciferous family of vegetables. *Brassica rapa* L. commonly known as field mustard or turnip mustard is a plant widely cultivated as a leaf vegetable, a root vegetable, and an oilseed [1]. It has a crisp white flesh and a zesty mustard-like flavor and a rapidly maturing crop **(**Choudhary 2015). Its root is called underground modified root, which is napiform in shape. The stem is short at vegetative stage but elongated at the reproductive stage. A decoction of the leaves or stems is used in the treatment of cancer [1]. The powdered seed is said to be a folk remedy for cancer [2]. The crushed ripe seeds are used as a poultice on burns **(**Foster and Duke 1990). The root when boiled with lard is used for breast tumors [2]. A salve derived from the flowers is said to help skin cancer [2]. Moreover, turnip extract is also useful for lowering uric acid and extracting renal stones. It increases visual keenness and is used to treat night blindness. Turnip syrup strengthens the memory (Khashayar 2007). Turnip root peelings contain a natural insecticide [3]. In india Turnip cultivation is mostly confined to north-western parts of the country like Punjab, Haryana, Rajasthan and Western U. P. as an early winter season crop. Green Top, Purple Top and .'Kenshin-Kaba'are important varieties of Turnip for fodder production. Although many agronomic factors affect its production but the optimum date of sowing and nitrogen dose are the most important factors affecting the production and productivity of fodder Turnip of its shorts duration and its effect on the crop growth and green fodder and root yield. (Turk *et al.,*2009, Sarhan *et al.,*2003, Smart *et al*., 2004). There is a great scope to increase the production and productivity of fodder Turnip by selecting the optimum date of sowing and nitrogen requirement for getting higher yield, higher benefit cost ratio and better quality of fodder Turnip.

Organic manures comprise of a variety of plant-derived materials that range from fresh or dried plant material to animal manures and litters to agricultural by-products. The nutrient content of organic fertilizers varies greatly among source materials, and readily biodegradable materials make better nutrient sources. Nitrogen and Phosphorus content is lower, often substantially lower, in organic manures compared to chemical fertilizers. Moisture content is another factor that reduces or dilutes the nitrogen and phosphorus concentrations of organic fertilizers. Thus, it can be cost ineffective to transport high moisture organic manures long distances. The bio-fertilizers are organic in origin and thus are absolutely safe. Therefore, it is essential to adopt a strategy of integrated nutrient management using combination of chemical fertilizers, organic manures and bio-fertilizers so as to minimize the cost of production and to maintain biological productivity of soils. The interactive advantages of combining inorganic and organic sources of nutrient generally provide superior status to use of each component separately. The judicious application of organic and inorganic fertilizers have maintained long term soil fertility and sustained higher level of productivity.

This study aims to determine the effect of organic, inorganic and bio-fertilizers on growth, yield and quality of Turnip.

2. MATERIALS AND METHODS

- The field experiment entitled "Effect of organic, inorganic and bio-fertilizers on growth, yield and quality of Turnip (*Brassica rapa* L.) was conducted in winter season adapting randomized block design consisting of 9 treatments and three replications during October 2021 to december 2021. Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The experiment includes the following treatments T_0 RDF (Control 60:40:40 NPK + FYM 25 t/ha), T_1 75% RDF Through chemical fertilizer + 25% through FYM, T_2 75% RDF Through chemical fertilizer + 25% through vermicompost, T_3 75% RDF Through chemical fertilizers + 25% through FYM + PSB, T_4 75% RDF Through chemical fertilizer + 25% through Vermicompost + PSB, T_5 75% RDF Through chemical fertilizer + 25% through FYM + Azotobacter, T_6 75% RDF Through chemical fertilizer + 25% through vermicompost + Azotobacter, T_7 75% RDF Through chemical fertilizer + 25% through FYM + PSB + Azotobacter, T_8 75% RDF Through chemical fertilizer + 25% through Vermicompost + PSB+ Azotobacter. The mean (maximum and minimum)

temperature was 35.77°C and 8.28°C respectively, mean (maximum and minimum) relative humidity was 93.5% and 43.71% during the crop growing season. The experimental soil was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.318%), medium in available N (87 Kg/ha), medium available P (375 Kg/ha) and medium available K (50 Kg/ha). Fertilizers were applied in the form of urea, single super phosphate and murate of potassium, respectively.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The maximum Plant Height of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 13.46 cm, 24.23 cm and 44.44 cm in 15, 30 and 50 DAS and minimum Plant Height was found in T0 RDF (Control 60:40:40 NPK + FYM 20 t/ha.) which was 7.93 cm, 18.03 cm and 36.63 cm in 15, 30 and 50 DAS respectively.

The mean value of plant height was found significant at different levels of NPK, Vermicompost, PSB and Azotobacter. Increase in plant height is due to adequate supply of nutrients which turns helps in vigorous vegetative growth of plants and subsequently increase the plant through cell elongation, cell division, phytosynthesis and turbidity of plant cells. The increase in nodulation and nitrogen fixation leads to more plant height. Similar findings were reported by Chavan et al.,[4], Deshmukh et al., (2014), Ayubet et al., (2012), Sajid et al., (2009).

The maximum Number of leaves per plant of Turnip was found in T8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 6.52, 11.51 and 22.26 in 15, 30 and 50 DAS and minimum Number of leaves per plant was found in T_0 RDF (Control 60:40:40 NPK + FYM 20 t/ha.) which was 3.47, 6.78 and 13.89 in 15, 30 and 50 DAS respectively.

The bio-fertilizers lead to good root development,better water absorption and high uptake of nutrients from the soil body, which ultimately enhance number of leaves per plant similar observation have been reported by Chattoo et al.,[5].

The maximum Leaf length of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 30.08 cm in 50 DAS and minimum Leaf Width was found in T_0 RDF (Control 60:40:40 NPK + FYM 25 t/ha) which was 20.94 cm in 50 DAS respectively.

The bio–fertilizer increase the leaf length similar results were reported by Ingole et al., (2018).

3.2 Yield and Quality Parameters

The maximum Shoot Weight of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 23.93 in 50 DAS and minimum Shoot Weight was found in T_0 RDF (control 60:40:40 NPK + FYM 20 t/ha.) which was 18.96 in 50 DAS respectively.

Organic, inorganic and bio-fertilizers played a pivotal role in improving shoot weight of Turnip. Similar findings have been reported by Pimpini et al., [6].

The maximum Root Length of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 8.19 in 50 DAS and minimum Root length was found in T0 RDF (control 60:40:40 NPK + FYM 20 t/ha.) which was 5.66 in 50 DAS respectively.

Increase in root length may be due to more organic matter added in the soil would be helped better penetration roots in the soil and thereby better root length. Similar reports have been given Abbey et al., [7].

The maximum Root Diameter of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 6.62 in 50 DAS and minimum Root Diameter was found in T_0 RDF (Control 60:40:40 NPK + FYM 20 t/ha.) which was 4.74 in 50 DAS respectively.

The root diameter of Turnip is increase with the increase the photosynthetic activity and higher nutrients uptake that results the increasing the root diameter similar finding have been reported by Manivannan et al., [8].

The maximum root Yield plant of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB +

Table 1. Effect of organic, inorganic and bio-fertilizers on growth parameters of Turnip

Treatments	Treatment combination	Plant height			Number of leaves			Leaf length
		15 DAS	30 DAS	At Harvest	15 DAS	30 DAS	50 DAS	
T_0	RDF (C ontrol 60:40:40 NPK + FYM 25 t/ha)	7.93	18.03	36.63	3.47	6.78	13.89	20.94
T_1	75% RDF + 25% FYM	8.85	18.89	37.72	4.17	8.12	17.70	23.50
T_2	75% RDF + 25% vermicompost	9.42	19.49	38.14	4.49	8.26	18.57	24.49
T_3	75% RDF + 25% FYM + PSB	8.37	18.54	37.13	3.88	7.35	16.60	21.49
T_4	75% RDF + 25% Vermicompost + PSB	9.93	19.32	39.32	4.84	8.78	19.55	25.05
T_5	75% RDF + 25% FYM + Azotobacter	11.97	21.44	41.15	5.59	9.68	20.75	27.40
T_6	75%RDF + 25% vermicompost + Azotobacter	10.96	20.83	40.34	5.09	9.27	20.01	26.42
T_7	75% RDF + 25% FYM + PSB + Azotobacter	12.70	23.21	41.33	6.02	10.56	21.69	28.81
T_8	75% RDF + 25% Vermicompost + PSB + Azotobacter	13.46	24.23	44.44	6.52	11.51	22.26	30.08
	F-Test	S	S	S	S	S	S	S
	SEd(±)	1.19	0.17	0.23	6.77	5.64	4.34	3.31
	C.D. 0.05%	0.57	0.52	0.68	0.19	0.29	0.48	0.48
	CV	3.18	1.48	0.99	0.57	0.87	1.43	1.45

Table 2. Effect of organic, inorganic and bio-fertilizers on yield and quality parameters on Turnip

Treatments	Treatment combination	Shoot weight(g)	Root length(cm)	Root diameter(cm)	Root weight(g)	Root weight(q/ha)	TSS (°Brix)	B:C Ratio
T_0	RDF (control 60:40:40 NPK+FYM 25 t/ha)	18.96	5.66	4.74	84.42	168.85	4.8	1.44
T_1	75% RDF + 25% FYM	20.94	6.17	5.31	105.28	210.56	5.1	3.43
T_2	75% RDF + 25% vermicompost	21.23	6.58	5.52	111.83	223.65	5.1	4.36
T_3	75% RDF + 25% FYM+PSB	20.00	6.10	5.06	96.65	193.31	4.9	3.14
T_4	75% RDF + 25% Vermicompost + PSB	22.30	6.94	5.63	113.16	226.31	5.2	4.34
T_5	75% RDF + 25% FYM + Azotobacter	23.36	7.52	6.11	115.31	230.62	5.3	3.73
T_6	75% RDF + 25% vermicompost + Azotobacter	22.84	7.10	6.04	114.76	229.51	5.3	4.39
T_7	75% RDF + 25% FYM + PSB + Azotobacter	23.54	7.79	6.30	116.10	232.21	5.4	3.74
T_8	75% RDF + 25% Vermicompost + PSB + Azotobacter	23.93	8.19	6.62	117.25	234.51	5.5	4.46
	F-Test	S	S	S	S	S	S	
	SE (d)±	3.87	6.44	5.91	1.77	1.77	1.81	
	C.D. 05	0.49	0.26	0.19	1.11	2.22	0.05	
	CV	1.47	0.77	0.58	3.32	6.65	0.16	

Azotobactor) which was 117.25 g in 50 DAS and minimum root Yield per plant was found in T0 RDF (Control 60:40:40 NPK + FYM 20 t/ha.) which was 84.42 g in 50 DAS respectively.

The higher root weight and root yield may also be attributed to the readily availability of organic manures and bio-fertilizers to the plant. These findings are well collaborated with the results of Abbey et al., [7].

The maximum root Yield hectare of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 234.15 q/ha in 50 DAS and minimum root Yield per hectare was found in T0 RDF (Control 60:40:40 NPK + FYM 20 t/ha.) which was 168.85 q/ha in 50 DAS respectively.

The higher root weight and root yield may also be attributed to the readily availability of organic manures and bio-fertilizers to the plant. These findings are well corroborated with the results of Abbey et al., [7].

The maximum TSS (°Brix) of Turnip was found in T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) which was 5.5 in 50 DAS and minimum TSS (°Brix) was found in T0 RDF(Control 60:40:40 NPK + FYM 20 t/ha.) which was 4.8 in 50 DAS respectively.

Manoj et al., [9] observed that treatment with high as well as low content of total nutrient resulted in significantly lower TSS and soluble carbohydrates. Whereas higher sugar content was obtained with application of higher dose of nutrient and vermicompost.

4. CONCLUSION

The present investigation entitled “Effect of organic, inorganic and bio-fertilizers on growth, yield and quality of Turnip (*Brassica rapa* L.)” it was concluded that the treatment T_8 (75% RDF through chemical fertilizers + 25% through vermicompost + PSB + Azotobactor) was found best in plant height, number of leaves, leaf length, shoot weight, root weight, root length, root diameter, root yield, TSS, net return of 364052 Rs/ha with cost benefit ratio of 4.46.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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