

Performance of organic manures, inorganic fertilizers, and their combinations on growth, yield and quality of radish (*Raphanussativus* L.)

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ABSTRACT

The experiment entitled "Performance of organic manures and inorganic fertilizers and their combinations on growth, yield and quality of radish (*Raphanussativus* L.)" was conducted during the Kharif season of the year 2020 at the Instructional Farm of the Department of Horticulture, AKS University, Satna (M.P.). The experiment was laid out in a Randomized Block Design comprising of 12 treatments each replicated three times. T_1- Control (100% RDF), T_2- 100% N through FYM, $T_3$100% N through Vermicompost, T_4- 100% N through Poultry manure, 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, T_{11}- Cow Dung 100%, T_{12}- 75% NPK + Cow Dung 25%. The results revealed that the treatment T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha), has emerged as the most effective treatment. Specifically, this treatment has shown significant positive impacts on both the growth and yield of radish crops, particularly when cultivated in the specific conditions of Satna.

Keywords: Radish, Vermicompost, Poultry manure, FYM, NPK.

Introduction

Vegetables represent an abundant and cost-effective source of essential vitamins and minerals. Their consumption in adequate quantities ensures the intake of all vital nutrient components, such as carbohydrates, proteins, fats, vitamins, minerals, water, and dietary fibers. These elements collectively constitute the fundamental constituents of a well-rounded and wholesome diet. Presently, vegetables hold a significant status as a vital component in maintaining optimal health and serving as a defense against certain degenerative ailments.

Radish (*Raphanus sativus* L.), a root vegetable of utmost importance, thrives as both an annual and biennial herb. This member of the brassicaceae family, falling under the genus Raphanus and species sativus, traces its origins to Europe and Asia. Referred to as "Mooli" in

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Hindi, the term finds its roots in the Latin word "radix." Its enlarged edible roots, botanically described as fusiform, exhibit a spectrum of colors ranging from white to red. As a rapidly maturing and short-term vegetable crop, it finds cultivation primarily for its enlarged edible roots. Its reproduction involves cross-pollination, facilitated by a sporophytic system of self-incompatibility, with pollination occurring mainly through entomophily. The consumable root portion develops from both the primary root and hypocotyls, with its roots even suitable for raw consumption in salads. Accompanying this, the plant features a rosette leaf, whose size spans 10 to 45 cm, contingent on the variety being grown (Shweta *et al.*, 2018).

The organic form of nutrients emerges as a promising and renewable solution to address this challenge. Irrespective of circumstances, organic sources offer a dependable means of supplying nutrients to crops. While organic materials tend to be voluminous, their primary role lies in ameliorating the physical properties of the soil. They play a crucial role in restoring and preserving humus levels within the soil, ensuring the optimal environment for the thriving activities of soil microorganisms. Farmyard manure, being a substantial organic substance, not only mitigates soil compaction but also enhances aeration. Additionally, it provides crucial plant nutrients and organic material, fostering the proliferation of soil microbes and facilitating the accumulation of surplus humus content. The excretions of earthworms yield Vermicompost, a nutrient-rich blend containing plant growth enhancers, enzyme-abundant plant nutrients, beneficial bacteria, and mycorrhizal fungi. This Vermicompost is a potent amalgamation of major and minor plant nutrients, fostering an augmented population of nitrogen-fixing bacteria, actinomycetes, and symbiotic mycorrhizal connections within the plant root system. Likewise, the excrement of chickens is referred to as Poultry manure. It provides an ample supply of both macro-nutrients and micro-nutrients essential for the growth, yield, and quality of horticultural crops. Poultry manure has gained substantial significance in crop production practices, promising nutritional support for crops while preserving the soil's physical and chemical properties. Organic manure possesses the capacity to deliver a wide spectrum of nutrients and enhance the soil's physical and biological characteristics. However, when it comes to high levels of crop production, these nutrients fall short. Additionally, their action is gradual, rendering them effective over the long term. Conversely, inorganic fertilizers are required in minute quantities and exhibit rapid effects. Comparatively, the interaction between chemical fertilizers and the soil is considered less favorable for the soil environment when contrasted with organic sources of crop nutrients.

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Materials and Methods

The experiment entitled "Performance of organic manures and inorganic fertilizers and their combinations on growth, yield and quality of radish (*Raphanussativus* L.)" was conducted during the Kharif season of the year 2020 at the Instructional Farm of the Department of Horticulture, AKS University, Satna (M.P.). The experiment was laid out in a Randomized Block Design comprising of 12 treatments each replicated three times. T_1- Control (100% RDF), T_2- 100% N through FYM, $T_3$100% N through Vermicompost, T_4- 100% N through Poultry manure, 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, T_{11}- Cow Dung 100%, T_{12}- 75% NPK + Cow Dung 25%. The seeds were sown on 21th November 2019, germination started and the recording of observations was done 30 days after transplanting and subsequent readings were recorded after every 20 days interval. The crop was harvested on 5th January 2020. Observations recorded during 30, 45, and at harvest include: Plant height (cm), Number of leaves per plant, Leaf length (cm), root length, and root diameter recorded at 45 and 60 days after sowing (DAS). At harvesting time, the following measurements were taken for elongated roots: Root weight (g), root and shoot weights, root yield (q/ha), fiber content per 100 grams, T.S.S. (Total Soluble Solids), and ascorbic acid (mg/100g). To ensure adequate growth and development, a seed rate of 10-12 Kg/ha is employed. Radish seeds are directly planted in well-prepared fields or beds with ample soil moisture. The seeds are planted at a depth of 0.5-1cm, and after planting, they are appropriately covered with soil using a rake.

Result

The field experiment was investigated the impact of integrated nutrient management on the growth and yield of radish. Conducted at the Agriculture Farm of AKS University in Satna, the study took place during the rabi season of 2020. The results of the experiment revealed significant improvements in both growth, yield and quality attributes of radish. This suggests that the integrated nutrient management approach employed during the study given in table no. 1 had a noteworthy positive effect on the overall performance of radish cultivation.

The radish plants exhibited significantly greater height when subjected to the treatment T_1 - 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). This treatment resulted in plant heights of

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21.51cm, 36.30 cm and 40.12 cm at 30, 45 and at harvest, respectively. The maintaining optimal nutrient levels had a notable impact on the number of leaves per plant throughout various growth stages. The Radish plants demonstrated a significantly higher number of leaves per plant when subjected to a combination of treatments denoted as T_1 - 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). In this treatment, the number of leaves per plant was recorded at an impressive value of 7.13, 10.40 and 12.87 leaves at 30, 45 and at harvest, respectively which was significantly lower compared to the number of leaves per plant observed in all other treatment groups. The achieving optimal nutrient levels had a notable impact on enhancing leaf length (cm) throughout various growth stages. Specifically, the radish plants exhibited significantly greater leaf length (cm) when subjected to the treatment T_1 - 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). This treatment resulted in leaf length (cm) of 16.44cm, 25.72 cm and 28.04 cm at 30, 45 and at harvest, respectively. Similar findings have been reported by Chander *et al.* (2005), Mukharjee and Roy (2006), Nargave *et al.* (2011), Raj *et al.* (2016), Jat *et al.* (2017), Khatri *et al.* (2019), Pathak *et al.* (2020), .

The radish plants exhibited significantly longer roots (cm) when subjected to treatment T_1 - 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). This treatment resulted in root lengths of 29.26 cm and 33.80 cm at the 30 and 45 DAS, respectively. Increasing nutrient levels significantly boosted the root diameter of radish plants cm, at different growth stages. Notably, when exposed to treatment T_1 - 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha), radish plants displayed a notably greater root diameter (cm). This treatment yielded root diameters of 3.87 cm and 5.67 cm at 30 and 45 days after sowing (DAS), respectively. The maintaining optimal levels of nutrients had a noteworthy impact on the root weight (g) throughout various growth stages. Specifically, the Radish plants exhibited a significantly higher root weight (g) when subjected to a specific treatment denoted as T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). The recorded value for the root weight (g) in this treatment was 308.36g, which was significantly superior compared to the other treatments assessed in the study. Maintaining optimal nutrient levels had a notably positive impact on the root and shoot weights of radishes at all growth stages. Specifically, when applying the combined treatments T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha), there was a significant increase in both root and shoot weights of the radish. Under this specific treatment T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha), the combined root and shoot weight was measured at 14.30g, demonstrating a noteworthy increase compared to weights obtained in other treatment combinations. Optimal maintenance of nutrient levels greatly boosted root yield (q/ha) at all growth stages. Notably, radishes exhibited significantly higher root yield (q/ha) when treated with a specific combination of nutrients, termed T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). The recorded root yield (q/ha) stood impressively at 476.56 q/ha, a remarkable increase compared to yields obtained with alternative treatments. This discovery underscores the effectiveness and significance of employing this particular nutrient blend to maximize radish production. This finding is supported by Bilekudari *et al.* (2005), Karuppaiah *et al.* (2007), Vikram *et al.* (2014), Deepika and Pitagi (2015), Shruthi *et al.* (2016), Tripati *et al.* (2017), Hamayoun *et al.* (2018), Ghimire *et al.*(2020.

Maintaining the ideal nutrient levels greatly increased the fiber content per 100 grams in different growth stages. In particular, the radish crop showed a significantly higher fiber content per 100 grams when exposed to T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). Under this treatment, the fiber content per 100 grams reached 761.21 mg, a value considerably higher than that of any other treatment examined in the study. The maintaining optimal nutrient levels had a substantial positive impact on the total soluble solids (^{o}Brix) throughout the various growth stages of the radish plants. Specifically, the utilization of a specific combination of fertilizers and organic matter demonstrated a significantly higher radish crops. This particular combination, denoted as T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha), resulted in an impressive 5.80 ^{o}Brix. This yield was notably higher compared to the yields obtained from other treatments, highlighting the efficacy of this nutrient regimen in maximizing radish crop productivity. Maintaining the ideal nutrient levels greatly increased the ascorbic acid (mg/100g) in different growth stages. In particular, the radish crop showed a significantly higher ascorbic acid (mg/100g) when exposed to T_1- 100% RDF (120: 80: 50 N, P_2O_5 and K_2O kg/ ha). Under this treatment, the ascorbic acid (mg/100g) reached 761.21 mg, a value considerably higher than that of any other treatment examined in the study. Thapa *et al.* (2003), Zhou-Dong-Mai *et al.* (2005), Yawalker *et al.* (2007), Ghani *et al.* (2013), (Baloch *et al.*, 2014), Vikram *et al.* (2016), Kumar and Gupta (2018) and Anayat *et al.*(2020) .

The results revealed that treatment T_1 - 100% RDF (120:80:50 N:P2O5:K2O kg/ha) has emerged as the most effective. Specifically, this treatment has shown significant positive impacts on both the growth and yield of radish crops, particularly when cultivated in the specific conditions of Satna. These results suggest the promising potential of this treatment

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regimen in enhancing the productivity and overall success of radish cultivation in the Satna region.

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Table.1: Effect of organic manures and inorganic fertilizers and their combinations on growth, yield and quality of radish.

Treatment	Plant height (cm)	Number of leaves per plant	Leaves length (cm)	Root length (cm)	Diameter of root (cm)	Average weight of root per plant (g)	Root weight + shoot weight (g)	Root yield q/hectare	Fiber content mg/100g	Total Soluble Solids (ºBrix)	Ascorbic Acid (mg/100g)
T_1	40.12	12.87	29.21	33.80	5.67	308.36	14.30	476.56	761.21	5.80	32.77
T_2	32.03	11.07	23.03	28.17	3.52	242.85	12.54	418.11	540.40	3.72	28.08
T_3	32.45	11.13	23.11	28.55	3.75	254.40	12.73	424.44	554.16	3.91	28.17
T_4	35.68	11.20	23.64	29.87	4.10	260.71	12.86	428.56	565.86	4.02	28.86
T_5	37.40	12.13	26.84	33.46	5.18	285.58	13.99	466.33	661.53	4.51	31.7
T_6	37.50	12.41	27.43	33.41	5.43	289.95	14.11	470.33	671.48	5.14	31.89
T_7	38.81	12.53	28.04	33.51	5.54	290.97	14.19	473.11	675.92	5.51	32.22
T_8	36.74	11.27	25.2	32.76	4.75	273.46	13.47	449.11	624.60	4.29	30.38
T_9	37.46	11.33	25.48	32.99	4.95	278.10	13.69	456.44	644.38	4.33	30.6
T_{10}	37.37	11.40	25.91	33.41	5.02	280.23	13.84	461.44	650.23	4.42	30.89
T_{11}	28.84	10.93	22.72	23.71	3.17	203.19	11.91	396.67	495.22	3.66	27.91
T_{12}	36.41	11.27	24.56	32.25	4.48	271.19	13.32	443.89	606.03	4.23	29.88
F-test	**1.87**	**0.29**	**1.20**	**0.93**	**0.20**	**0.45**	**0.05**	**1.99**	**2.57**	**0.22**	**0.21**
S.Ed(±)	**3.86**	**0.61**	**2.47**	**1.92**	**0.42**	**0.92**	**0.12**	**4.09**	**5.29**	**0.45**	**0.44**
CD at 5%	40.12	12.87	29.21	33.80	5.67	308.36	14.30	476.56	761.21	5.80	32.77