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Research Article

Effect of Integrated Nutrient Management on Yield and Quality of Radish (*Raphanus sativus* L.) Cultivars

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ABSTRACT

The field experiment was conducted at Horticulture Research Farm-I, Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.) during the rabi season of 2021-22 to study the Effect of Integrated Nutrient Management on Yield and Quality of Radish (Raphanus sativus L.) Cultivars. Three varieties and thirteen nutrients with three replications were evaluated in a Factorial Randomized Block Design. The results revealed that the maximum TSS (4.14), ascorbic acid (33.78), pH juice (7.15), dry matter content in leaves % (7.93), and dry matter content in root % (7.32) were noted in variety Kashi Mooli-40. The maximum fresh weight of leaves (269.86g), length of root (21.59cm), weight of root (159.44g), root yield kg/plot (4.01kg) and root yield (533.84 q ha-1) is observed in variety Kashi Mooli-40 and in case of nutrients the TSS (5.11), ascorbic acid (33.74), pH juice (7.26), dry matter content in leaves % (8.80), and dry matter content in root % (10.04) was observed in treatments N_5 during growth characters. At the same time, the maximum fresh weight of leaves (272.50g), weight of root (171.23g) and root yield (572.93 q/ha) were recorded in treatments N_5 (RDF 75% + Azotobacter + PSB).

Keywords: *Azotobacter, PSB, FYM, radish, yield and quality.*

INTRODUCTION

Radish (*Raphanus sativus* L.) is a popular Brassicaceae vegetable in tropical and subtropical regions. It is grown extensively in India's northern and southern plains and hills. It can be grown under cover for early production, but large-scale cultivation in the field is more prevalent in India. Radish provides a cooling effect, avoids constipation, and stimulates hunger. It is advised for patients suffering from piles, liver issues, and jaundice.

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The Juice of fresh leaves is used as a 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. Trace elements in radish include aluminium, barium, lithium, manganese, silicon, titanium, fluorine and iodine. Pink-skinned radish is generally richer in ascorbic acid than white-skinned ones. The characteristics of the pungent flavour of radish are due to the presence of volatile isothiocyanates. The growth and yield of radish greatly depend on soil & climatic conditions. Varieties differ in their soil and climatic requirements for optimum performance. India is a vast country with varied agro-climatic regions; therefore, a single variety may or may not be suitable for all the agro-climatic regions. Hence, under these circumstances, a specific selection of varieties is needed. Radish is a short-duration and fast-growing crop. Therefore, the use of fertilizers in a judicious manner is essential to get good yield, excellent root quality, and higher fertilizer use efficiency. It requires sufficient and readily available plant nutrients.

Integrated nutrient management is the use of both chemical fertilizers and organic manures for crop productivity. The primary goal is to maintain soil fertility and provide enough levels of plant nutrients. It is ecologically, socially and economically viable. Nutrient management refers to the efficient use of crops to improve productivity. INM enables high crop yields that are agronomically possible, financially viable, environmentally sound, and sustainable (Kafle et al., 2019). Optimal crop output is achieved when nutrients are provided appropriately and in sufficient quantities. Farmyard manure improves crop growth by giving nourishment and enhancing the physical, chemical, and biological qualities of the soil (Mengistu & Mekonnen et al, 2012). The chemical analysis of Vermicompost reveals that the content of the N, P_2O_5, and K_2O was 0.8, 1.1, and 0.5, respectively. Biofertilizers are the natural fertilizer that may be used to supplement or replace chemical fertilizers in sustainable agriculture (Ebrahimpour et al., 2011).

MATERIALS AND METHODS

The experiments were conducted during the winter season of 2021-22 at Horticulture Research Farm-I, Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.), India. The experimental site is situated at 80° 92´'East longitude and 26° 76´' North latitude, and 123 meters above MSL (Mean Sea Level). The climate of Lucknow is characterized by sub-tropical conditions, with hot, dry summers and cool winters. The soil of the experimental field is sandy loam and slightly alkaline in nature with soil pH 8.2, 85.46 kg ha-1 available nitrogen, 16.62 kg ha-1 and 142.07 kg ha-1 available potash. In a Factorial Randomized Block Design with three replications, three varieties: V_1 (Kashi Aarorus), V_2 (Kashi Shweta) and V_3 (Kashi Mooli-40 with thirteen nutrients i.e. N_1-RDF 100%, N_2- RDF 75% + FYM, N_3- RDF 75% + Azotobacter, N_4- RDF 75% + PSB, N_5- RDF 75% + Azotobacter + PSB, N_6- RDF 50% + FYM, N_7- RDF 50% + Azotobacter, N_8- RDF 50% + PSB, N_9- RDF 50% + Azotobacter + PSB, N_{10}- RDF 25% + FYM, N_{11}- RDF 25% + Azotobacter, N_{12}- RDF 25% + PSB, N_{13}- RDF 25% +Azotobacter + PSB, respectively. Appropriate management practices have been used to raise the crop. Randomly five plants were selected in each plot, and data was recorded on the following quality and yield parameters viz.- TSS, ascorbic acid, dry matter content in leaves, dry matter content in root %, fresh weight of leaves (g), length of root (cm), weight of root (g), yield kg/plot and yield q/ha, (Anonymous, 1995). The observations on quality and yield parameters were statistically analyzed of the data obtained in different sets of experiments was calculated following the

standard procedure as stated by (Panse & Sukhatme, 1985). The data were analyzed and presented at the 5% significance level.

RESULTS AND DISCUSSION

The results obtained from the experimental study entitled "Effect of Integrated Nutrient Management on Yield and Quality of Radish (*Raphanus sativus* L.)" have been presented in this chapter.

Effect of varieties and nutrients on quality parameters

Quality parameters – There was a significant effect of varieties on total soluble solids content in radish at the harvesting stage. Variety V_3 (Kashi Mooli-40) registered maximum total soluble solids content, which was higher than all other varieties. Minimum total soluble solids were observed in case of variety V_1 (Kashi Aarorus). However, the difference between V_1 and V_2 was non-significant. Similar results have also been reported by Kumar et al. (2022) in radish. Fertility levels exhibited a significant effect on total soluble solids content. The highest total soluble solids content was found with a fertility level of N_5. Minimum total soluble solids were observed in case of fertility level N_1. The findings of the present experiment revealed a significant effect of varieties on ascorbic acid content in the roots. Among the varieties, maximum ascorbic acid content was recorded with V_3 (Kashi Mooli-40) followed by V_2 (Kashi Sweta). Minimum ascorbic acid content was noted with variety, V_1 (Kashi Aarorus). Their findings are in agreement with those of Kumar et al. (2022) and Rawat et al. (2014). Fertility levels also exhibited a significant effect on ascorbic acid content in radish. The highest ascorbic acid content was recorded with a fertility level of N_5, followed by a fertility level of N_9. Minimum ascorbic acid content was revealed under fertility level N_1. Similar results were obtained by Kumar et al. (2022) and Rawat et al. (2014).

The data indicated a significant influence of varieties on pH juice in radish. Variety, V_3 (Kashi Mooli-40) had recorded maximum pH juice followed by V_2 (Kashi Sweta). Minimum pH juice was recorded with variety, V_1 (Kashi Aarorus). Similar findings were obtained by Kumar et al. (2022). There was significant effect of fertility levels on pH juice. Fertility level N_5 had showed maximum pH juice. Minimum pH juice was observed in fertility level N_1.

The finding revealed a significant effect of variety and fertility levels on Dry matter in leaves (%) in radishes. Variety, V_3 (Kashi Mooli-40) had taken maximum leaf dry matter content. It was followed by V_2 (Kashi Sweta). Minimum dry matter content in leaves were taken by variety V_1 (Kashi Aarorus). Similar results have been reported by Rawat et al. (2014). N_5 has recorded maximum dry matter content in leaves among the fertility levels. Minimum dry matter content in leaves were recorded infertility level N_1.

Dry matter in root (%) was recorded after harvesting. The data exhibited a significant effect of varieties and fertility levels on the harvesting index. Among the varieties, V_3 (Kashi Mooli-40) recorded maximum dry matter in root (%), followed by V_2 (Kashi Sweta). Minimum Dry matter in root (%) was observed in case of variety, V_1 (Kashi Aarorus). Significant differences among varieties for dry matter in the root (%) have also been reported by Nargave et al. (2018). dry matter in the root (%) was significantly affected by nutrient levels. Maximum dry matter in the root (%) was found under nutrient level N_5, which N1 followed. The lowest dry matter in the root (%) was recorded under the fertility level. Similar results were obtained by Nargave et al. (2018).

Table No.-1 Effect of varieties and INM on quality parameters of radish during 2021-22

Symbol	(TSS) (^{0}Brix)	Ascorbic acid	pH of Juice	Dry matter in leaves (%)	Dry matter in root (%)
Varieties					
V_1	3.69	30.80	6.66	7.49	9.05
V_2	4.12	31.57	7.01	7.88	9.17
V_3	4.14	33.78	7.15	7.93	9.32
SE.m. ±	0.026	0.184	0.043	0.051	0.060
CD at 5%	0.073	0.518	0.121	0.144	NS
Nutrients					
N_1	3.15	30.98	6.67	7.25	8.98
N_2	3.85	32.27	6.73	7.78	9.06
N_3	4.04	32.16	6.86	7.34	9.53
N_4	4.05	32.13	6.93	7.61	9.24
N_5	5.11	33.74	**7.26**	**8.80**	10.04
N_6	4.20	31.67	6.88	7.52	9.08
N_7	3.91	31.53	7.24	7.92	8.98
N_8	4.39	32.28	6.94	8.08	9.15
N_9	4.22	32.56	7.10	7.81	9.22
N_{10}	3.60	31.69	6.68	7.67	9.24
N_{11}	3.90	32.31	6.95	7.93	9.30
N_{12}	3.86	32.10	7.18	8.53	9.56
N_{13}	3.51	31.25	6.82	7.73	9.00
SE.m. ±	0.054	0.382	0.090	0.106	0.125
CD at 5%	0.152	1.079	0.253	0.300	0.352

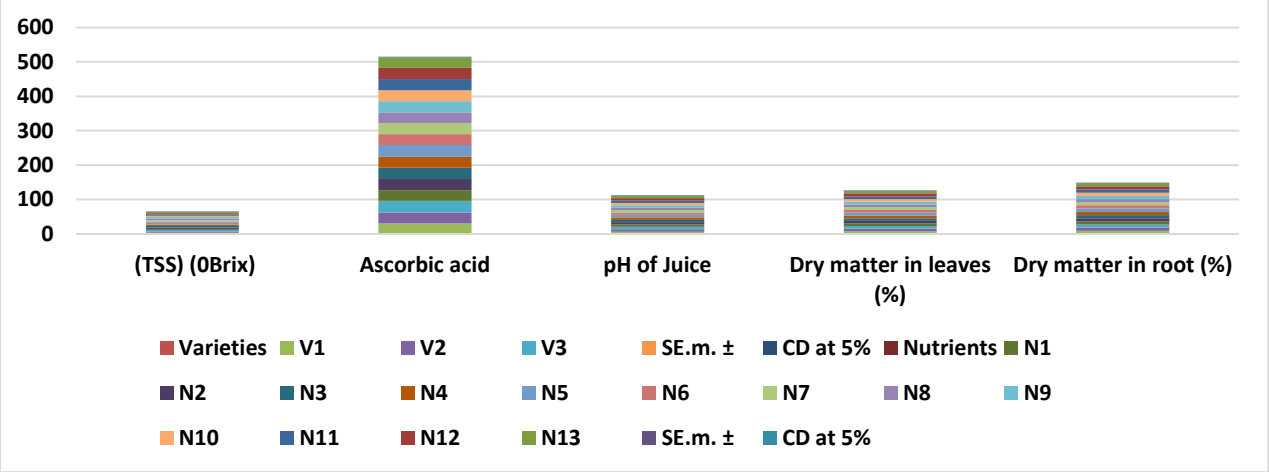


Fig No.-1 Effect of varieties and INM on quality parameters of radish during 2021-22

Effect of varieties and nutrients on yield parameters

The root length found at the time of the harvesting stage was significantly longer in variety V_3 (Kashi Mooli-40) (21.59cm), followed by variety V_2 (Kashi Sweta) (21.01cm). The analysis showed a significant difference between treatments for root length. The root weight found at the time of the harvesting stage was significantly highest in variety V_3 (159.44g), followed by variety V_2 (158.90g).

The finding about yield, viz. root length and weight of root nutrients N_5 (RDF 75%+ Azotobacter+ PSB) was recorded as the highest root length and root weight. The increase in length and weight of the root may be attributed to the solubilization of plant nutrients by adding FYM and bio-fertilizers, leading to increased uptake of azotobacter. The increased application of FYM increased the soil porosity and water-holding capacity while ultimately helping in root growth and development. Similar result was observed by Kumar et al. (2022) the maximum fresh weight of root obtained by application of inorganic fertilizers with organic manures to increase fresh weight.

Among the varieties, V_3 (Kashi Mooli-40) recorded the maximum fresh weight of leaves /plant (269.86g) at the harvesting stage and, followed by V_2 (Kashi Sweta) (260.41g). In contrast, the minimum fresh weight of leaves /plant was found with variety V_1 (Kashi

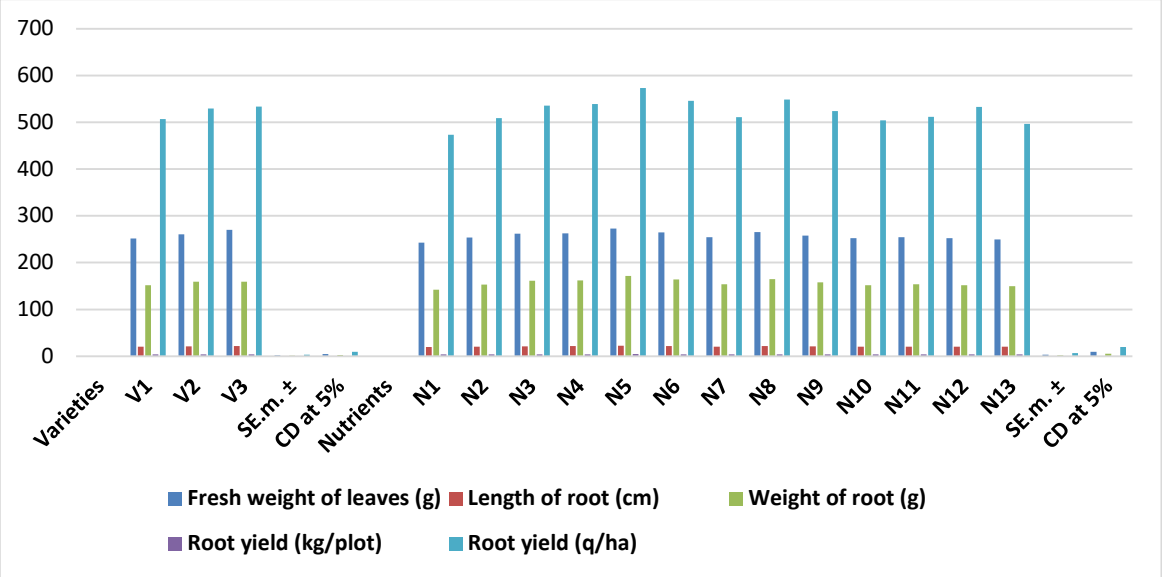
Aarorus). The variation in fresh weight of leaves /plant of radish varieties may be due to their genetic constituent. These findings agree with the findings of Rawat et al. (2014). The fresh weight of the leaves of the plants increased significantly with the different INM treatments. The significant fresh weight of leaves was recorded in nutrients N_5 (272.50g), and the minimum weight of fresh leaves was recorded under N_1 (242.55g). This is due to FYM also functioning as a source of food and energy for soil microflora, which transforms inorganic nutrients in the soil. The finding also agrees with the finding of Yawalkar et al. (2007).

Root yield per plot (kg) and q/ha The significant maximum root yield of the plant was recorded in variety V_3 (Kashi Mooli-40) (4.01kg and 533.84q), respectively, followed by variety V_2 (Kashi Sweta) (4.00kg and 529.45q) respectively. In the case of nutrients, the maximum root yield in treatments N5 (RDF 75%+ Azotobacter+ PSB) (was 4.35kg and 572.93q) respectively, and the minimum root yield in treatment N1 (3.57kg and 473.03q), respectively. Probable reason for increased root yield due to humus substance could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. The result of this results had been found similar with the results of Mehwish et al. (2016). This result revealed that incorporating INM in combination with FYM remarkably augmented the root yield of radish. This increment in root yield might be due to reduced nutrient losses, improved fertilizer use efficiency and increased crop yield. The remarkable increase in radish yields with INM practices has been reported by Sharma et al. (2012) and Kumar et al. (2017), which correspond to these findings. Similar results were also recorded by Kiran et al. (2019).

Table No.-2 Effect of varieties and INM on yield parameters of radish during 2021-22

Symbol	Fresh weight of leaves (g)	Length of root (cm)	Weight of root (g)	Root yield (kg/plot)	Root yield (q/ha)
Varieties					
V_1	251.54	20.20	151.87	3.80	506.63
V_2	260.41	21.01	158.90	4.00	529.45
V_3	269.86	21.59	159.44	4.01	533.84
SE.m. ±	1.64	0.132	0.889	0.026	3.351
CD at 5%	4.64	0.371	2.508	0.073	9.457
Nutrients					
N_1	242.55	19.45	142.37	3.57	473.03
N_2	253.73	20.55	153.16	3.84	508.97
N_3	261.55	21.25	161.06	4.04	535.32
N_4	262.75	21.52	162.13	4.07	538.87
N_5	272.50	22.56	171.23	4.35	572.93
N_6	264.73	21.65	164.27	4.12	546.00
N_7	254.20	20.54	153.69	3.86	510.74
N_8	265.55	21.81	165.02	4.14	548.52
N_9	258.02	21.01	157.58	3.95	523.72
N_{10}	252.28	20.41	151.69	3.81	504.08
N_{11}	254.46	20.67	154.00	3.86	511.77
N_{12}	252.49	20.54	152.02	3.82	532.79
N_{13}	249.70	20.18	149.35	3.75	496.26
SE.m. ±	3.42	0.27	1.850	0.054	6.975
CD at 5%	9.66	0.77	5.221	0.152	19.686

Fig No.-2 Effect of varieties and INM on yield parameters of radish during 2021-22



CONCLUSION

The findings of the present study may conclude that among the different varieties of radish, variety V_3 (Kashi Mooli-40) recorded superior performance for quality and yield attributes. Among the nutrients levels, application of N_5 (RDF75 + Azotobacter + PSB) is superior for quality and yield parameters of radish.

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Conflict of Interest:

There is no such evidence of conflict of interest.

Author Contribution

All authors have participated in critically revising the entire manuscript and approving the final manuscript.

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