

Effect of Inorganic Fertilizers and Bio-fertilizers on Growth, Yield and Quality of Radish (*Raphanus sativus* L.)

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Abstract The present experiment was carried out during year of 2013-14. The experiment was laid out in randomized Block Design (RBD) with three replications. The row to row and plant to plant spacing were maintained at 30 × 10 cm respectively. The treatment combinations were control, Recommended Dose of Fertilizers (RDF), Azotobacter, Azospirillum, PSB, 50% RDF + 50% Azotobacter, 50% RDF + 50% Azospirillum, 50% RDF + 50% PSB, 50% Azotobacter + 50% azospirillum, 50% Azotobacter + 50% PSB, 25% PSB + 25% Azospirillum+ 25% RDF + 25% Azotobacter 50% PSB + 50% Azospirillum. The observations were recorded i.e. plant height (cm), number of leaves, length of leaves (cm), length of root (cm), root diameters (cm), fresh weight of leaves (g), dry weight

of leaves (g), root weight (q/ha), yield (t/ha), vitamin C (mg/100g), reducing sugar, non-reducing sugar, total sugar and T.S.S. (^oBrix). From the analysis of data, it can be concluded that the application of 25% PSB + 25% Azospirillum + 25% RDF + 25% Azotobacter (T₁₂) increased the growth, yield and nutritional quality of Radish under Lucknow condition.

Keywords Inorganic fertilizers, Biofertilizers, Yield, Growth, Quality.

Introduction

Radish is one of the important cool season and universally cultivated root crops belong to the family Cruciferae. Radish is growing for its young tender tuberous root which is used either raw as salad or cooked in the preparation of vegetables and pickles. The leaves of radish are good source for extraction of protein on a commercial scale and radish seed are potential source of nondrying fatty oil suitable for soap making illuminating and edible purpose. It is a good source of vit-c and minerals like calcium, potassium and phosphorus. It is also considered to be useful for patients suffering from neurological

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headache, sleeplessness, urinary complaints, chronic diarrhea, piles, liver trouble and jaundice. It has refreshing and diuretic properties. There are two distinct genetically groups i. e. Asiatic and European. The Asiatic varieties produce edible roots in the first season as a biennial crop, whereas the exotic or European varieties produce roots in the plains of tropical and sub-tropical and sub-tropical climate and seeds in the hills of temperate climate. Radish can be grown almost all the year round except for few month of summer. The radish is very useful as inter crops or companion crop between row and plant of slower growth. The yield of radish is governed by genetic and environmental factors apart from the agronomical approaches like optimum sowing time, optimum plant geometry, number and frequency of irrigation and integrated nutrient management such as organic matter like FYM, vermi-compost poultry manure uses has become necessary. The reduction of recommended doses of inorganic fertilizers without FYM exhibited depletion of total N, available P and available K in the sequence. Organic agriculture practices rely upon recycling of crop residues, animal manure, farm organic residues and wastes. Through a study it was seen that the plant height was significantly increased by the application of organic manures [1, 2]. In view of higher cost of fertilizers and its contribution to poor health of soil and water it becomes imperative for to go for alternative and cheaper source like organic manures, so as to partially reduce the cost and fulfill the crop requirement and ultimately for with this background the investigation was done to evaluate the influence of inorganic fertilizers and Bio-fertilizers on growth, yield and quality parameters of radish crop. Lamo [3] in a study with radish cv Chinese pink was also of the opinion that NPK combined with bio-fertilizers resulted into more seed yield per plant.

Materials and Methods

The present investigation was carried out at Horticulture Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow (UP) during winter season of 2013-14. The layout was under Randomized Block Design (RBD) with twelve treatments and randomized in three replications. There were alto-

gether thirty six plots each of 1.20×0.60 m size. Sowing was done on 25 November, 2013 with spacing 30×10 cm. During the life cycle of the plants, hoeing, weeding and irrigation were provided at proper time so as to facilitate better growth and development of crop. The observations were recorded i.e. plant height (cm), number of leaves, length of leaves (cm), length of root (cm), root diameters (cm), fresh weight of leaves (g), dry weight of leaves (g), root weight (q/ha), yield (t/ha), vitamin C (mg/100g), reducing sugar, non-reducing sugar, total sugar and T.S.S. ($^{\circ}$ Brix). The Treatment combinations were control. Recommended Dose of Fertilizers (RDF), Azotobacter, Azospirillum, PSB, 50% RDF + 50% Azotobacter, 50% RDF + 50% Azospirillum, 50% RDF + 50% PSB, 50% Azotobacter + 50% Azospirillum, 50% Azotobacter + 50% PSB, 25% PSB, 25% PSB + 25% Azospirillum + 25% RDF + 25% Azotobacter, 50% PSB + 50% Azospirillum. The variety of crop was Kashi Sweta (IIVR-1) collected from IIVR, Varanasi.

Results and Discussion

The radish was respond well to organics and their combination. In general, the treatment with 25% RDF + 75 % through FYM significantly greater number of leaves and leaf area followed by RDF during *rabi* seasons was observed. The treatment 25% RDF + 75% through FYM were recorded higher values for growth parameters followed by RDF application. The maximum length (23.92 cm) of leaves was also recorded under the treatment 25% RDF + 75% FYM (T_4) and minimum (19.39 cm) recorded in control. The data showed that the maximum number of leaves was recorded in T_4 (21.00 cm) followed by the treatment 25% RDF + 75% FYM and minimum under control (14.47 cm). The maximum rate of root development took place during maximum length (24.60) was obtained under the treatment 25% RDF + 75% FYM T_4 . The data showed that the maximum diameter of roots was recorded in T_4 (6.19 cm) and minimum diameter of roots was recorded in T_4 (6.19 cm) and minimum under control (3.47 cm). This is clearly that 25% RDF + 75% FYM dose produced the maximum yield of roots (138.20 q/ha) which was significantly higher than the values obtained under other

Table 1. Effect of different treatment combinations of chemical fertilizers along with biofertilizers on plant height (cm), number of leaves per plant, length of leaves (cm), root weight per plant (g), root length (cm), root diameter (cm), fresh weight (g), dry weight (g), yield (q/ha), ascorbic acid (mg/100g), reducing sugar (%), non-reducing sugar (%), total sugars and TSS of radish.

Sl. No.	Treatments	Plant height (cm)	Number of leaves per Plant	Length of leaves (cm)	Root weight per plant (g)	Root length (cm)	Root diameter (cm)	Fresh weight (cm)
1.	T ₁	31.32	13.32	13.87	140.78	14.32	3.98	69.31
2.	T ₂	33.32	15.11	16.00	165.14	16.21	3.22	94.25
3.	T ₃	35.12	15.32	16.25	163.32	15.43	3.59	98.44
4.	T ₄	32.23	15.22	17.11	168.34	14.94	3.11	74.23
5.	T ₅	34.22	14.11	17.20	186.26	16.94	3.61	98.32
6.	T ₆	33.11	14.32	16.94	148.39	16.49	3.21	78.84
7.	T ₇	32.11	13.87	16.11	149.39	15.43	3.11	86.32
8.	T ₈	34.12	14.12	17.25	169.21	16.16	3.25	85.94
9.	T ₉	35.22	14.99	18.31	146.28	17.11	3.46	112.21
10.	T ₁₀	34.11	13.32	17.12	156.35	16.45	3.11	82.32
11.	T ₁₁	33.58	13.75	14.84	194.26	15.32	3.88	88.89
12.	T ₁₂	37.21	17.42	18.35	140.78	18.77	3.94	82.12
SE±		0.6671	0.4147	0.3979	4.3339	0.5893	0.0707	2.9005
CD at 5%		1.9567	1.2162	1.1669	12.7144	1.7290	0.2075	8.5091

Table 1. Continued.

Sl.No.	Treatments	Dry weight (g)	Yield (q/ha)	Ascorbic acid (mg/100g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugars	T.S.S.
1.	T ₁	3.08	75.32	7.11	2.40	11.70	13.02	2.8
2.	T ₂	4.87	103.12	7.80	2.42	14.25	17.11	3.2
3.	T ₃	3.45	97.34	7.35	2.45	14.75	16.03	3.0
4.	T ₄	3.34	99.21	7.21	2.40	15.62	18.34	3.2
5.	T ₅	4.89	95.81	7.35	2.35	13.25	16.21	3.1
6.	T ₆	5.32	120.65	8.12	2.52	15.24	15.94	3.0
7.	T ₇	3.82	104.32	8.40	2.54	14.35	17.84	3.2
8.	T ₈	3.66	102.71	7.69	2.74	16.01	18.84	3.3
9.	T ₉	6.33	101.21	7.57	2.42	13.77	18.20	3.1
10.	T ₁₀	4.25	100.31	8.30	2.51	12.79	16.28	3.0
11.	T ₁₁	3.08	84.82	7.83	2.46	12.66	15.15	3.2
12.	T ₁₂	5.12	136.63	8.02	2.87	17.12	19.11	3.8
SE±		0.1461	3.2381	0.5100	0.0775	0.2983	0.6218	0.1653
CD at 5%		0.4269	9.4994	1.4957	0.2272	0.8749	1.8236	0.4848

treatments. The plants under control registered the minimum yield (76.67 t/ha). The yield of whole plants was analyzed statistically. It is evident from the mean values presented in that treatment of T₄ 25% RDF + 75% FYM dose exhibited the maximum values (138.20 q/ha) followed by T₇ 50% RDF + 50% FYM (121.11 q/ha) against the minimum values (76.67 q/ha) recorded under control. The present results are in conformity with the findings of Yadav et al. [4] Chemical composition and quality of radish

root as influenced by organic and inorganic fertilizers. The maximum reducing (2.87) and non-reducing sugars (17.12) observed under T₁₂ treatment followed by the treatment 25% RDF + 75% FYM and minimum to control. The maximum ascorbic acid (8.40) revealed that there was remarkable increase in under the treatment 50% RDF + 50% Azospirillum and minimum percent of ascorbic acid was recorded under control. The maximum plant height at 30, 45, 60 days after sowing (DAS) was

(16.26, 26.85, 37.21 cm) respectively observed in the treatment T₁₂ 25% PSB + 25% Azotobacter + 25% RDF + 25% Azospirillum. Improved seed germination by applying PSB has also been reported by Sharma et al. [5] in *Cicer arietinum*. The maximum number of leaves at 30, 45, 60 days after sowing (DAS) was (5.32, 15.22, 17.42) respectively observed in the treatment T₁₂ 25% PSB + 25% Azotobacter + 25% RDF + 25% Azospirillum. The maximum length of leaves at 30, 45, 60 days after sowing (DAS) was 8.44 cm, 18.20 cm, 18.35 cm) respectively observed in the treatment (T₁₂) 25% PSB + 25% Azotobacter + 25% RDF + 25% Azospirillum. Azospirillum also has found beneficial effects like fixation of atmospheric nitrogen and synthesis of various growth promoting, antibiotic and antifungal substances. [6].

The root length of radish was significantly increased by the application of 25% PSB + 25% Azospirillum + 25% RDF + 25% Azotobacter. Root diameter of radish, yield of radish, root weight, sugar of radish, non-reducing sugars and total sugar of radish variety kashi Sweta was increased by the application of 25% PSB + 25% Azotobacter + 25% RDF + 25% Azospirillum. Yadav and Vijayakumari [7] also reported result in respect to fresh weight and dry weight of plants was higher in vermicompost and NPK in chili. Total leaf weight, total dry weight and ascorbic acid of radish variety Kashi Sweta was increased by the application of 50% Azotobacter + 50% Azospirillum. Application of inorganic fertilizers might have helped in the plant metabolism through supply of certain micro nutrients in the early growth phase which might have produced vigorous seeds.

Almost identical results have been expressed by Birwa et al. [8].

Conclusion

On the basis of present investigation, it may be concluded that the application of 25% PSB + 25% Azospirillum + 25% RDF + 25% Azotobacter (T₁₂) increased the growth, yield and nutritional quality of Radish under Lucknow condition.

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