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RESEARCH ARTICLE

Effect of inorganic fertilizers and bio-fertilizers on growth, yield and quality of radish (*Raphanus sativus* L.)

■ **SHANI KUMAR, SANJAY KUMAR, SUTANU MAJI AND VIJAY KUMAR PANDEY**

SUMMARY

The present experiment entitled studies on effect of inorganic fertilizers and bio-fertilizers on growth, yield and quality of radish (*Raphanus sativus* L.) was carried out at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.) during year of 2013-14. The experiment was laid out in Randomized Block Design with three replications. The row to row and plant to plant spacing were maintained at 30 x10 cm, respectively. The treatment combinations were control, recommended dose of fertilizers, *Azotobacter*, *Azospirillum*, PSB, 50 per cent RDF + 50 per cent *Azotobacter*, 50 per cent RDF + 50 per cent *Azospirillum*, 50 per cent RDF + 50 per cent PSB, 50 per cent *Azotobacter* + 50 per cent *Azospirillum*, 50 per cent *Azotobacter* + 50 per cent PSB, 25 per cent PSB+25 per cent *Azospiriluum* + 25 per cent RDF+25 per cent *Azotobacter*, 50 per cent PSB + 50 per cent *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. (^{0}Brix). From the analysis of data, it can be concluded that the application of 25 per cent PSB + 25 per cent *Azospirillum* + 25 per cent RDF+ 25 per cent *Azotobacter* (T_{12}) increased the growth, yield and nutritional quality of radish under Lucknow condition.

Key Words : Inorganic fertilizers, Biofertilizers, Yield, Growth, Quality

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Radish is one of the important cool season and universally cultivated root crops belong to the family Cruciferae. Probably it is native of Europe or Asia (Thompson and Kelly, 1957). 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 non drying fatty oil suitable for soap making illuminating and edible purpose. It is a good source of vitamin C and minerals like calcium, potassium and phosphorus. It is also considered to be useful for patients suffering from neurological headache, sleeplessness, urinary complaints, chronic diarrhea,

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piles, liver trouble and jaundice. Radish has cooling effect, prevents constipation, increases appetite and is tasteful when roots and leaves are cooked together Purewal (1957). 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 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 etc. and integrated nutrient management such as organic matter like FYM, vermi-compost and 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. This is in agreement with the findings of Madhu *et al*. (1997). Organic agriculture practices rely upon recycling of crop residues, animal manure, farm organic residues and wastes etc. (Choudhary *et al.*, 2002; Stockdale *et al.*, 2001 and Bhuma, 2001). Through a study it was seen that the plant height was significantly increased by the application of organic manures. Kumar *et al.* (2014) and Thanunathan *et al*. (1997) also related the good root length of onion with vermicompost application. 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.

MATERIAL 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 (U.P.) during winter season of 2013-14. The layout was under Randomized Block Design with twelve treatments and randomized in three replications. There were altogether thirty six plots each of 1.20 x 0.60 m size. Sowing was done on 25th November, 2013 with spacing 30 x10 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. (^{0}Brix). The treatment combinations were control, recommended dose of fertilizers, *Azotobacter*, *Azospirillum*, PSB, 50 per cen RDF + 50 per cent *Azotobacter*, 50 per cent RDF + 50 per cent *Azospirillum*, 50 per cent RDF + 50 per cent PSB, 50 per cent *Azotobacter* + 50 per cent *Azospirillum*, 50 per cent *Azotobacter* + 50 per cent PSB, 25 per cent PSB+25 per cent *Azospiriluum* + 25 per cent RDF+25 per cent *Azotobacter*, 50 per cent PSB + 50 per cent *Azospirillum.* The variety of crop was Kashi Sweta (IIVR-1) collected from IIVR, Varanasi. The data on the growth and yield were statistically analyzed according to the method suggested by Fisher and Und (1963).

Statistical analysis:

The obtained data was analyzed by statistical significant at P<0.05 level, S.E. and C.D. at 5 per cent level by the procedure given by (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The radish was respond well to organics and their combination. In general, the treatment with 25 per cent RDF + 75 per cent through FYM significantly greater number of leaves and leaf area followed by RDF during *Rabi* seasons was observed. The treatment 25 per cent RDF + 75 per cent FYM were recorded higher values for growth parameters followed by RDF application. The maximum length (18.35 cm) of leaves was also recorded under the treatment PSB (T_{12}) and minimum (13.87 cm) recorded in control. The data showed that the maximum number of leaves was recorded in T_{12} (17.42) and minimum under control (13.32). The maximum rate of root development took place during maximum length (18.77) was obtained under the treatment 25 per cent RDF +75 per cent FYM $T_{12.}$ The data showed that the maximum diameter of roots was recorded in control (3.98 cm) and minimum (3.11cm) in T_4, T_7 and T_{10}. The

plants under control registered the minimum yield (75.32 q/ha). The yield of whole plants was analyzed statistically. It is evident from the mean values presented in that treatment of T_{12} and its dose exhibited the maximum values (136.63 q/ha) followed by T_6 (120.65 q/ha) against the minimum values (75.32 q/ha) recorded under control. 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 treatment T_{12} and minimum to control. The maximum ascorbic acid (8.02) revealed that there was remarkable increase in under the treatment T_7 (50% RDF +50% *Azospirillum*) and minimum per cent of ascorbic acid was recorded under control. The maximum plant height at 60 days after sowing (37.21 cm) was observed in the treatment T_{12} 25 per cent PSB + 25 per cent *Azospirillum* + 25 per cent RDF + 25 per cent *Azotobacter*. The maximum number of leaves at 60 days after sowing (17.42) was observed in the treatment T_{12}. The maximum length of leaves at 60 days after sowing was 18.35 cm in the treatment (T_{12}) 25 per cent PSB + 25 per cent *Azospirillum* + 25 per cent RDF + 25 per cent *Azotobacter*. The root length of radish was significantly

Table1: Effect of different treatment combinations of chemical fertilizers along with biofertilizers for height of plant (cm), number of leaves per plant, leaf length (cm), leaf width (cm), leaf weight per plant (kg), stem diameter (cm), curd diameter (cm), gross weight of plant (kg), net weight of curd (kg) and yield (plot/kg) of broccoli at various stages of crop growth

Sr. No.	Treatments	Plant height (cm)	Number of leaves	Length of leaves (cm)	Root weight per plant (g)	Root length (cm)	Root diameter (cm)
1.	T_1	31.32	13.32	13.87	92.54	14.32	3.98
2.	T_2	33.32	15.11	16.00	140.78	16.21	3.22
3.	T_3	35.12	15.32	16.25	165.14	15.43	3.59
4.	T_4	32.23	15.22	17.11	163.32	14.94	3.11
5.	T_5	34.22	14.11	17.20	168.34	16.94	3.61
6.	T_6	33.11	14.32	16.94	186.26	16.49	3.21
7.	T_7	32.11	13.87	16.11	148.39	15.43	3.11
8.	T_8	34.12	14.12	17.25	149.39	16.16	3.25
9.	T_9	35.22	14.99	18.31	169.21	17.11	3.46
10.	T_{10}	34.11	13.32	17.12	146.28	16.45	3.11
11	T_{11}	33.58	13.75	14.84	156.35	15.32	3.88
12	T_{12}	37.21	17.42	18.35	194.26	18.77	3.94
S.E. ±		0.6671	0.4147	0.3979	4.3339	0.5893	0.0707
C.D. (P=0.05)		1.9567	1.2162	1.1669	12.7144	1.7290	0.2075

Table 1 : Contd……..…

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Sr. No.	Treatments	Fresh weight (g)	Dry weight	Yield (q/ha)	Ascorbic acid (mg/100g)	Reducing sugar (g)	Non-reducing sugar	Total sugar	T.S.S.
1.	T_1	69.31	3.08	75.32	7.11	2.40	11.70	13.02	2.8
2.	T_2	94.25	4.87	103.12	7.80	2.42	14.25	17.11	3.2
3.	T_3	98.44	3.45	97.34	7.35	2.45	14.75	16.03	3.0
4.	T_4	74.23	3.34	99.21	7.21	2.40	15.62	18.34	3.2
5.	T_5	98.32	4.89	95.81	7.35	2.35	13.25	16.21	3.1
6.	T_6	78.84	5.32	120.65	8.12	2.52	15.24	15.94	3.0
7.	T_7	86.32	3.82	104.32	8.40	2.54	14.35	17.84	3.2
8.	T_8	85.94	3.66	102.71	7.69	2.74	16.01	18.84	3.3
9.	T_9	112.21	6.33	101.21	7.57	2.42	13.77	18.20	3.1
10.	T_{10}	82.32	4.25	100.31	8.30	2.51	12.79	16.28	3.0
11	T_{11}	88.89	3.08	84.82	7.83	2.46	12.66	15.15	3.2
12	T_{12}	82.12	5.12	136.63	8.02	2.87	17.12	19.11	3.8
S.E. ±		2.9005	0.1461	3.2381	0.5100	0.0775	0.2983	0.6218	0.1653
C.D. (P=0.05)		8.5091	0.4269	9.4994	1.4957	0.2272	0.8749	1.8236	0.4848

increased by the application of 25 per cent PSB+ 25 per cent *Azospirillum* + 25 per cent RDF+ 25 per cent *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 per cent PSB + 25 per cent *Azospirillum* + 25 per cent RDF + 25 per cent *Azotobacter*. Total dry weight and ascorbic acid of radish variety Kashi Sweta was increased by the application of 50 per cent *Azotobacter* + 50 per cent *Azospirillum* and T_7 *i.e.* 50 per cent RDF + 50 per cent *Azotobactor,* respectively.

Conclusion:

On the basis of present investigation, it may be concluded that the application of 25 per cent PSB + 25 per cent *Azospirillum* + 25 per cent RDF+ 25 per cent *Azotobacter* (T_{12}) increased the growth, yield and nutritional quality of radish under Lucknow condition.

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