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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 472-474

www.thepharmajournal.com
Received: 18-04-2023
Accepted: 29-05-2023

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Effect of bio-fertilizer and micronutrient on growth and yield of radish (*Raphanus sativus* L.) var. Pusa Himani

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Abstract
The experiment 'Effect of bio-fertilizer and micronutrient on growth and yield of radish (*Raphanus sativus* L.) var. Pusa Himani' was conducted on radish crop at Agriculture Research Farm of Rama University, Mandhana, Kanpur, U.P, India, during rabi season of 2022-2023. There was 15 treatments *viz.*,T_1 (Control), T_2 (PSB @ 4 kg/ha), T_3 (Neem cake @ 2.5 ton/ha), T_4 (Azotobacter @ 4 kg/ ha), T_5 (PSB @ 4 kg/ha + $ZnSO_4$ @ 10 kg/ ha)), T_6 (Neem cake @ 2.5 ton/ha + $ZnSO_4$ @ 10 kg/ ha), T_7 [Azotobacter @ 4 kg/ hac + + $ZnSO_4$ (10 kg/ ha) + Borex (8 kg/ha)] and T_8[PSB @ 4 kg/ha) + Borex (8 kg/ha)], T_9 [Neem cake @ 2.5 ton/ha) + Borex (8 kg/ha)], T_{10} [Azotobacter @ 4 kg/ hac) + Borex (8 kg/ha)], T_{11} [PSB @ 4 kg/ha + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)], T_{12} [Neem cake @ 2.5 ton/ha + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)], T_{13} [Azotobacter @ 4 kg/ hac + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)], T_{14} [PSB + Azotobacter + Neem cake + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)] and T_{15} [PSB + Azotobacter + Neem cake + $ZnSO_4$ (10 kg/ ha) + Borex (8 kg/ha)]. All the 15 treatments were replicated thrice in Randomized Block Design. The *Azotobacter* fixes the atmospheric nitrogen to nitrate form, PSB changes the unavailable phoaphorus to available form, zinc sulphate and borex improves the quality of radish roots. The biofertilizers and micronutrients improves the plant height, number of leaves per plant, root diameter, root length, root yield, TSS, vitamin-'C' and minimized the days taken to harvest.

Keywords: PSB, *Azotobacter*, neem cake, Borex, radish, Pusa Himani

Introduction
Radish botanically known as *Raphanus sativus* L. native to Europe or Asia. The family of radish *Brassicaceae* (*Crusifereae*) and having chromosomes 2n=2x=18. It is one of the major edible root crop of India and commonly known as *Muli* or *Mula.* Radish contains protein (0.7%), fat (0.1%), minerals (0.6%), fibre (0.8%), calcium (50mg), phosphorus (22 mg), sodium (33 mg), potassium (138 mg), oxalic acxid (9 mg) and also good source of iron, thiamine, riboflavin, nicotinic acid, vitamin- 'A' and vitamin 'C'. Antioxidants including catechin, pyrogallol, vanillic acid, and other phenolic compounds are abundant in radishes. In addition, the vitamin C in these root vegetables functions as an antioxidant to guard your cells from oxidative stress (Dan Brennan, MD, 2020) [3]. Haryana is the leading state in production of 550.07 thousand metric tonnes followed by West Bengal. India is the second-largest radish producer in the world, occupying 211 thousand hectare with an output of 2743 thousand metric tonnes in 2021-22 (1st Advance Estimate). With the productivity of 22.4 metric tonnes/ha, Haryana leads the other states of Punjab, Bihar, Assam, Chhattisgarh, Odisha, and Andhra Pradesh. (National Horticulture Board).The key principle of the organic food movement is that it upholds crop diversity, encourages ecological soundness, and makes sustainable use of natural resources. Recycling of agricultural residues, animal manure, farm organic wastes, etc., is a key component of organic farming techniques (Choudhary *et al.*, 2002) [2]. The primary bio-fertilizers, which are biologically active compounds containing bacteria and promote soil health and fertility, are *Azotobacter* and PSB. They release vitamins and growth-promoting chemicals that could boost crop yield. (Sharma *et al.* 2013) [4]. For a dependable and affordable supply of nutrients, bio-fertilizers combined with organic manures have been proved to be a beneficial component in organic farming. These mixtures increase soil fertility by enhancing the physical, chemical, and biological properties of the soil and were ecologically safe. Microbial consortium is a carrier-based microbial product that combines bacteria that fix nitrogen (N), solubilize phosphorus and zinc (P & Zn), and stimulate plant development.

In plants, zinc is essential for their metabolic processes. Zinc's primary role in plants is as an enzyme metal activator. Contrarily, it is believed that boron is essential for the metabolism of hormones, photosynthetic processes, cellular differentiation, and water absorption in many plant sections. One of the key ways to boost output in any seed crop is using high-quality seed. (Deepika, C and Anita Pitagi, 2015) [5].

Materials and Methods

The present investigation on the experiment 'Effect of bio-fertilizer and micronutrient on growth and yield of radish (*Raphanus sativus* L.) var. Pusa Himani' was carried out during the October 2022-23 at Agriculture Research Farm of Rama University, Mandhana, Kanpur, which is located in the alluvial belt of Gangetic plains of central Uttar Pradesh. For this an experiment was planned using 15 treatments *viz.*,T_1 (Control), T_2 (PSB @ 4 kg/ha), T_3 (Neem cake @ 2.5 ton/ha), T_4 (Azotobacter @ 4 kg/ ha), T_5 (PSB @ 4 kg/ha + $ZnSO_4$ @ 10 kg/ ha)), T_6 (Neem cake @ 2.5 ton/ha + $ZnSO_4$ @ 10 kg/ ha), T_7 [Azotobacter @ 4 kg/ hac + + $ZnSO_4$ (10 kg/ ha) + Borex (8 kg/ha)] and T_8[PSB @ 4 kg/ha) + Borex (8 kg/ha)], T_9 [Neem cake @ 2.5 ton/ha) + Borex (8 kg/ha)], T_{10} [Azotobacter @ 4 kg/ hac) + Borex (8 kg/ha)], T_{11} [PSB @ 4 kg/ha + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)], T_{12} [Neem cake @ 2.5 ton/ha + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)], T_{13} [Azotobacter @ 4 kg/ hac + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)], T_{14} [PSB + Azotobacter + Neem cake + $ZnSO_4$ (5 kg/ ha) + Borex (4 kg/ha)] and T_{15} [PSB + Azotobacter + Neem cake + $ZnSO_4$ (10 kg/ ha) + Borex (8 kg/ha)] with three replication in a Randomized Block Design. The observations were recorded from each treatment of all three replication. Five plants of radish were selected randomly and tagged under each treatment for recording different growth parameters *viz.* days to 50% germination, germination percent, plant height at 45 days and harvest, number of leaves per plant, days taken to harvest, root length, root diameter, root weight, root fresh and dry weight, root yield. The quality parameters were recoded *viz*. TSS, acidity and vitamin-'C'.

Results and Discussion

The data on the 'Effect of bio-fertilizer and micronutrient on growth and yield of radish (*Raphanus sativus* L.) var. Pusa Himani' on characters *viz.*, gowth, yield and quality parameter of radish root

Growth parameters

The data on effect of biofertilizers and micronutrientson growth parameter *viz.*, days taken to 50 germination, germination percent, plant height (cm), number of leaves per plant and days taken from sowing to harvest. The data of growth parameters have been presented in the Table-1.

The significant germination percent (91.38%) and days taken to 50% germination (3.21 days) were recorded in the treatment T_{15} (PSB + Azotobacter + Neem cake + $ZnSO_4$ @10 kg/ ha + Borex @ 8 kg/ha) and minimum germination percent (82.58%) and days to 50% germination (6.74 days) were recorded in the T_1 (control). The maximum plant height at 45 days (25.98 cm), at harvest stage (36.28 cm) number of leaves per plant (11.58) and significant days taken from sowing to harvest (61.0 days) were found in the treatment T_{15} (PSB + Azotobacter + Neem cake + $ZnSO_4$ @10 kg/ ha + Borex @ 8 kg/ha) followed by plant height at 45 days (24.61 cm), harvest stage (34.91 cm), number of leaves per plant(11.51) and significant days taken from sowing to harvest (61.5 days) in treatment T_{14} (PSB + Azotobacter + Neem cake + $ZnSO_4$ @ 5 kg/ ha + Borex @ 4 kg/ha and T_7Azotobacter @ 4 kg/ hac + + $ZnSO_4$ (10 kg/ ha) + Borex (8 kg/ha). The lowest germination percent (82.58%), plant height at 45 days (12.28 cm), plant height at harvest (22.60 cm), number of leaves per plant (8.28), days taken to harvest (75.3 days) were recorded in the treatment T_1 (control).

Table 1: Effect of biofertilizers and micronutrients on growth parameters on radish

Treatments	Days to 50% germination	Germination (%)	Plant height(cm) at 45 days	Plant height(cm) at harvest	No. of leaves/plant
T_1	6.74	82.58	12.28	22.60	8.28
T_2	6.14	84.64	13.74	24.44	9.24
T_3	5.85	84.65	14.15	25.39	9.15
T_4	5.69	85.43	15.23	26.74	9.63
T_5	5.51	85.75	16.35	27.21	9.65
T_6	5.22	86.19	16.79	27.77	9.79
T_7	4.44	89.51	23.48	33.54	11.38
T_8	4.84	88.06	21.46	31.32	10.86
T_9	4.95	87.45	18.25	29.57	10.05
T_{10}	4.77	88.41	18.91	30.33	10.31
T_{11}	4.47	89.04	22.74	32.85	10.57
T_{12}	5.51	88.77	21.74	30.92	11.04
T_{13}	4.83	86.88	20.35	31.53	10.65
T_{14}	4.02	90.25	24.61	34.91	11.51
T_{15}	3.21	91.38	25.98	36.28	11.58
S.Em.±	0.197	0.363	0.508	0.389	0.171
CD (0.05)	0.574	1.058	1.478	1.133	0.497

Biomass characters

The highest root yield per plot and hectare were obtained with the application of biofertilizers (PSB, *Azotobacter*), and micronutrients (zinc sulphate and borex). These micronutrients provides the balanced amount of zinc and boron and biofertilizers helps in converting the soil and environmental nutrients to the appropriate form for plant uses. The data of biomass characters have been presented in the Table-2.

The remarkable increase in root length of radish (27.3 cm), root diameter (5.10 cm), root weight (106.08 g), root yield per plot (1101.88 g), root yield per hectare (304.18 q), fresh weight of root (100.73 g) and dry weight of radish root (6.12 g) were recorded in the treatment (PSB + Azotobacter + Neem cake + $ZnSO_4$ @10 kg/ ha + Borex @ 8 kg/ha). These findings follows the result of Ingole *et al.* (2018).

Table 2: Effect of biofertilizers and micronutrients on biomass characters on radish

Treatments	Root length (cm)	Root diameter(cm)	Root weight(g)	Root yield/plot(g)	Root yield/ha(q)	Root fresh weight(g)	Root dry weight(g)
T_1	15.2	2.06	62.28	590.08	196.58	56.37	2.62
T_2	17.5	2.11	69.64	650.14	208.74	64.03	2.87
T_3	18.3	2.30	72.15	709.85	215.45	66.83	3.09
T_4	19.7	2.36	74.63	720.03	220.63	69.13	3.27
T_5	20.6	2.14	76.35	752.85	226.25	71.03	3.17
T_6	21.4	2.93	79.29	784.89	235.49	73.93	3.34
T_7	25.5	4.46	98.87	966.17	285.78	86.83	5.64
T_8	22.6	4.11	87.86	853.40	270.70	73.33	4.91
T_9	22.9	3.33	81.15	801.95	250.55	75.73	3.88
T_{10}	23.4	3.57	83.61	819.11	259.71	78.03	4.23
T_{11}	24.8	4.21	92.48	887.05	289.77	92.23	5.02
T_{12}	23.8	3.76	86.74	859.14	262.44	81.13	4.49
T_{13}	24.2	3.90	90.45	884.18	270.85	84.93	4.79
T_{14}	25.9	5.07	100.60	1040.11	297.71	95.03	5.94
T_{15}	27.3	5.10	106.08	1101.88	304.18	100.73	6.12
S.Em.±	0.334	0.164	1.069	7.920	3.865	1.347	0.208
CD (0.05)	0.972	0.478	3.403	23.06	11.254	3.923	0.606

Quality parameters

The data of quality parameters have been presented in the Table-3.The application of biofertilizers and micronutrients in radish, theremarkable variation in result found in quality metrics. Significantly higher root TSS (5.34° Brix), acidity (0.59%) and vitamin-C (27.35 mg/100g) were found in the treatment application (PSB + Azotobacter + Neem cake + $ZnSO_4$ @10 kg/ ha + Borex @ 8 kg/ha). Whereas lower TSS (2.98° Brix), acidity (0.27%) and vitamin-C (13.33 mg/100gwere observed in the treatment control. This increased in TSS, ascorbic acid and sugar contributing to good quality of fruits. These result follows the findings of Khalid *et al.* (2016) [7] and Deepika *et al.* (2015) [5].

Table 3: Effect of biofertilizers and micronutrients on quality characters on radish

Treatments	TSS(° Brix)	Acidity (%)	Vitamin-C (mg/100g)
T_1	2.98	0.27	13.33
T_2	3.07	0.32	15.27
T_3	3.14	0.34	16.29
T_4	3.31	0.36	16.88
T_5	3.21	0.37	17.39
T_6	3.37	0.38	18.24
T_7	4.94	0.52	26.30
T_8	4.45	0.39	23.99
T_9	3.77	0.41	20.16
T_{10}	4.09	0.43	20.48
T_{11}	4.61	0.50	24.95
T_{12}	4.16	0.47	22.38
T_{13}	4.29	0.49	23.67
T_{14}	5.15	0.54	26.97
T_{15}	5.34	0.59	27.35
S.Em.±	0.167	0.007	0.581
CD (0.05)	0.485	0.020	1.692

Conclusion

Present investigation "Effect of bio-fertilizer and micronutrient on growth and yield of radish (*Raphanus sativus* L.) var. Pusa Himani" was conducted on Agricultural Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur during the Rabi season of 2022-23. The observation showed that the treatment combination of PSB, Azotobacter, neem cake, zinc sulphate and borex have superior results over all doses of treatments. The *Azotobacter*, PSB both are biofertilizers, they can't provide nutrients to plant directly but they make available the nutrients which are present in soil in unavailable forms. Zinc sulphate and borex are the main source of zinc and boron respectively. These biofertilizers and micronutrients significantly impact on growth of plant, root, yield and quality of radish. The combination of micronutrients and biofertilizers can be used for the profitable production of radish

Reference

1. Anon. National Horticulture Board (1st Advance Estimate; c2022.
2. Choudhary BR, Fageria MS, Dhaka RS. Role of growth hormones in chillies-A review. Agric. Rev. 2002;23(2):145-148.
3. Dan Brennan, MD Radish: Health Benefits, Nutrition, and Uses by WebMD Editorial Contributors; c2020.
4. Sharma JP, Rattan P, Kumar S. Response of vegetable crops to use of integrated nutrient management practices. ISABB Journal of Food and Agricultural Sciences. 2013;2(1):15-9.
5. Deepika C, Anita Pitagi. Effect of Zinc and Boron on Growth, Seed Yield and Quality of Radish (*Raphanus sativus* L.) cv. Arka Nishanth. Current Agriculture Research Journal. 2015;3(1):85-89.
6. Ingole VS, Wagh AP, Nagre PK, Bharad SG. Effect of biofertilizer and organic manure on yield and yield contributing characters of beetroot (*Beta vulgaris* L.). International Journal of Chemical Studies. 2018;6(5):1226-1228
7. Khalid M, Yadav BK, Yadav MP. Studies on the effect of integrated nutrient management on growth and yield attributes of radish (*Raphanus sativus* L.). Annals of horticulture. 2015;8(1):81-83.