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ASSESSMENT OF DIFFERENT ORGANIC MANURES AND BIO-FERTILIZERS ON GERMINATION AND GROWTH OF RADISH (*Raphanus sativus* L.) UNDER BASTAR PLATEAU

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ABSTRACT

The present investigation entitled "Assessment of different organic manures and bio-fertilizers on germination and growth of Radish (*Raphanus sativus* L.) under Bastar plateau" was conducted during the *Rabi season* during 2025-26 at Department of Vegetable Science, Research-cum-Instructional Farm, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur. under Mahatma Gandhi Udhyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh. The experiment was laid out in a Randomized Block Design (RBD) comprising nine treatments with three replications. The study was undertaken to evaluate the effect of different organic manures and bio-fertilizers on the germination and growth of radish under the agro-climatic conditions of the Bastar Plateau. The results revealed significant differences among the treatments with respect to germination and growth parameters. The highest germination percentage (92.88%) and the minimum number of days required for 50 % germination (3.18 days) were recorded under T_9 (PSB @ 2 kg/ha + vermicompost @ 2.5 t/ha). The same treatment also exhibited superior growth performance by recording the maximum plant height of 12.14 cm, 25.64 cm, and 34.86 cm at 20 DAS, 40 DAS and at harvest, respectively. Similarly, the highest number of leaves per plant (5.74, 11.31 and 14.59) and the highest leaf length (11.63 cm, 23.67 cm and 31.26 cm) at 20 DAS, 40 DAS and at harvest, respectively, were also recorded under T_9. The minimum values for all growth parameters were observed in the control treatment (T_1). The enhanced growth observed under the integrated application of PSB and vermicompost may be attributed to improved nutrient availability, increased microbial activity and better soil conditions. Therefore, the combined application of PSB @ 2 kg/ha and vermicompost @ 2.5 t/ha was found to be the most effective treatment for improving the germination and growth performance of radish under Bastar Plateau conditions.

Keywords **:** Radish, Organic Manures, Bio-fertilizer, Germination and Growth.

Introduction

Radish (*Raphanus sativus* L.) is an annual, quick-growing root vegetable crop cultivated for its young, tender, edible roots. It belongs to the family Brassicaceae and the genus *Raphanus*, with a diploid chromosome number of 2n = 18 (Kumar *et al*., 2013). The term *Raphanus* is derived from a Latin word meaning "fast-growing plant," which gave the genus its name. Radish is an important root vegetable cultivated worldwide in both tropical and temperate regions. Although some sources trace its origin to the Mediterranean and Black Sea regions, it is more widely believed to have originated in central or western China and the Indo-Pak subcontinent (Aasim *et al*., 2018; Mehmood *et al*., 2022). Radish roots occur in different colours, including white, red and purple, with the red colour resulting from the presence of anthocyanin pigments (Sami *et al*., 2019).

In India, radish is mainly cultivated in the states of West Bengal, Madhya Pradesh, Bihar, Uttar Pradesh, Karnataka, Punjab, Maharashtra and Assam. The crop occupies an area of 214 thousand hectares with an annual production of 3,327 thousand metric tonnes (NHB, 2024–25). In Chhattisgarh, the major radish-producing districts include Kondagaon, Korba, Surguja, Kanker, Durg, Rajnandgaon, Raipur and Korea. The area under radish cultivation and its production in the state are 11.727 thousand hectares and 171.990 thousand metric tonnes, respectively (Anonymous, 2023–24).

Organic farming is increasingly being adopted in India through both individual and collective efforts aimed at protecting the environment and reducing contamination of agricultural produce caused by the excessive use of chemical fertilizers and pesticides. One of the fundamental principles of organic farming is the promotion of ecological balance, conservation of natural resources and maintenance of crop biodiversity. Organic agriculture primarily depends on the recycling and efficient utilization of crop residues, animal manures, farm wastes and other organic materials. For achieving high-quality and sustainable radish production, balanced nutrient management through the integrated use of organic manures, inorganic fertilizers and biofertilizers is essential (Choudhary *et al*., 2002).

Biofertilizers are preparations containing living microorganisms that, when applied to seeds, plant surfaces, or soil, colonize the rhizosphere or the internal tissues of plants and enhance plant growth by improving the availability and uptake of essential nutrients. They promote plant development through mechanisms such as biological nitrogen fixation, solubilization of insoluble soil phosphorus and the production of plant growth-promoting substances. Microorganisms such as *Azospirillum*, *Azotobacter* and phosphate-solubilizing bacteria (PSB) are commonly used as biofertilizers to improve crop productivity. Among these, PSB play an important role by converting insoluble forms of phosphorus into forms readily available for plant uptake. The phosphorus-solubilizing ability of these microorganisms is considered a key characteristic for improving phosphorus nutrition and enhancing plant growth (Shilpa *et al*., 2023).

Material and Method

The experiment was conducted during the rabi season of 2025–26 at the Department of Vegetable Science, Research-cum-Instructional Farm, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Chhattisgarh. The experiment was laid out in a Randomized Block Design (RBD) comprising nine treatments with three replications.

The treatments consisted of T_1 (Control), T_2 [FYM @ 20 t/ha], T_3 [Vermicompost @ 5 t/ha], T_4 [*Azotobacter* @ 4 kg/ha], T_5 [PSB @ 4 kg/ha], T_6 [*Azotobacter* @ 2 kg/ha + FYM @ 10 t/ha], T_7 [*Azotobacter* @ 2 kg/ha + Vermicompost @ 2.5 t/ha], T_8 [PSB @ 2 kg/ha + FYM @ 10 t/ha] and T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha].

The observations recorded for different parameters were subjected to statistical analysis following the procedure described by Panse and Sukhatme (1985). The significance of treatment effects was tested using the F-test at the appropriate level of significance.

Results and Discussion

Germination parameters

Days to 50% germination

The minimum number of days required to attain % germination (3.18 days) was recorded under T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha], whereas the maximum number of days (7.35 days) was observed in the control treatment (T_1). The earliest attainment of 50% germination under T_9 [PSB @ 2 kg ha^{-1} + Vermicompost @ 2.5 t ha^{-1}] may be attributed to the favourable soil environment created by the combined application of PSB and vermicompost. PSB enhances the solubilization of native soil phosphorus, making it readily available to germinating seeds during the initial stages of growth. An adequate supply of phosphorus promotes physiological processes such as respiration, energy metabolism and cell division, thereby accelerating seed germination. In contrast, the delayed germination observed in the control treatment may be due to inadequate nutrient availability and the absence of beneficial microbial activity, resulting in slower metabolic activation of seeds. Similar findings were reported by Singh *et al.* (2017) and Ahamad *et al.* (2023) in radish.

Germination percentage

The maximum germination percentage (92.88%) was recorded under T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha], whereas the minimum germination percentage (69.87%) was recorded in the control treatment (T_1). The higher germination observed under T_9 may be attributed to the synergistic effect of PSB and vermicompost, which enhanced phosphorus availability, microbial activity and nutrient supply, thereby promoting seed metabolic activities and early seedling establishment. Vermicompost further enhances the germination environment by

improving soil structure, porosity, aeration, water-holding capacity and cation exchange capacity, while simultaneously supplying readily available macro- and micronutrients, humic substances and beneficial microorganisms. The lower germination percentage recorded in the control treatment may be due to inadequate nutrient availability and poor microbial activity. Similar results were reported by Singh *et al.* (2017) and Biswas and Shivaprakash (2021) and Wani *et al.* (2023).

Table 1 : Effect of organic manures and biofertilizers on Germination parameters

Treatment		Days to 50 % germination	Germination %
T_1	Control	7.35[a]	69.87[b]
T_2	FYM (20 t/ha)	5.47[b]	82.68[a]
T_3	Vermicompost (5 t/ha)	5.13[c]	84.85[a]
T_4	*Azotobacter* (4 kg/ha)	6.30[b]	79.24[b]
T_5	Phosphate solubilizing bacteria (PSB) (4 kg/ha)	5.82[b]	80.91[b]
T_6	*Azotobacter* (2 kg/ha) + FYM (10 t/ha)	4.87[c]	86.42[a]
T_7	*Azotobacter* (2 kg/ha) +Vermicompost (2.5 t/ha)	3.87[d]	90.95[a]
T_8	PSB (2kg/ha) +FYM (10 t/ha)	4.32[c]	87.44[a]
T_9	PSB (2kg/ha) + Vermicompost (2.5 t/ha)	3.18[d]	92.88[a]
C.D. at 5%		**0.95**	**11.93**
S.E. m ±		**0.31**	**3.95**
C.V. (%)		**10.54**	**8.14**

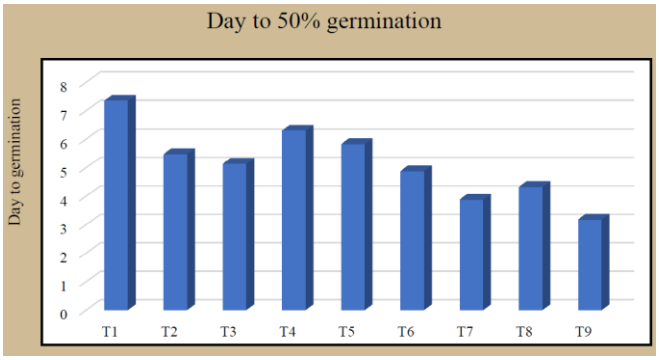

Fig. 1 : Effect of organic manures and biofertilizers on days to 50% germination

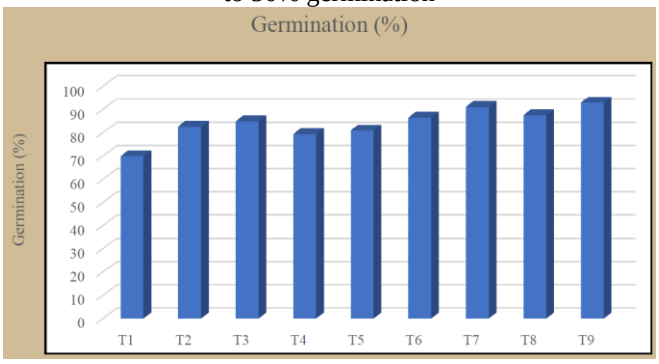

Fig. 2 : Effect of organic manures and biofertilizers on Germination %

Growth parameters

Plant height (cm)

The effect of different organic manures and bio-fertilizers on plant height was recorded at 20 DAS, 40 DAS and at harvest. The results revealed significant differences among the treatments. The maximum plant height (12.14 cm, 25.64 cm and 34.86 cm at 20 DAS, 40 DAS and harvest, respectively) was recorded under T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha]. In contrast, the minimum plant height (7.58 cm, 16.73 cm and 24.98 cm at 20 DAS, 40 DAS and harvest, respectively) was recorded in the control treatment (T_1).

The enhanced plant height under T_9 may be attributed to the synergistic effect of phosphate-solubilizing bacteria (PSB) and vermicompost, which improved nutrient availability, microbial activity and soil health. Vermicompost supplied essential nutrients and plant growth-promoting substances, whereas PSB enhanced phosphorus availability by solubilizing insoluble phosphate, thereby promoting cell division and vegetative growth. Vermicompost supplies balanced macro- and micronutrients, humic substances, enzymes and beneficial microorganisms that improve soil fertility, nutrient uptake and root activity. The combined application of PSB and vermicompost therefore enhances physiological and metabolic activities, resulting in increased plant height. The lower plant height recorded in the control treatment may be attributed to inadequate nutrient availability and reduced microbial activity. Similar findings were reported by Mali *et al.* (2018), Gyewali *et al.* (2020), Shrivastava *et al.* (2022), Kaur *et al.* (2023) and Kumar and Kumar (2024) in radish.

Number of leaves per plant

The effect of different organic manures and bio-fertilizers on the number of leaves per plant was recorded at 20 DAS, 40 DAS and at harvest. Significant differences among the treatments were observed for this parameter. The highest number of leaves per plant (5.74, 11.31 and 14.59 at 20 DAS, 40 DAS and harvest, respectively) was recorded under T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha]. The control treatment (T_1) recorded the minimum number of leaves per plant (3.07, 7.64 and 9.49 at 20 DAS, 40 DAS and harvest, respectively).

The increased number of leaves under T_9 may be attributed to the combined application of vermicompost and PSB, which enhanced nutrient availability, phosphorus uptake and microbial activity, thereby promoting vigorous vegetative growth.

Vermicompost also improved soil structure and supplied essential macro- and micronutrients, while PSB increased phosphorus availability, resulting in enhanced leaf development. The lower number of leaves observed in the control treatment may be due to inadequate nutrient availability and reduced microbial activity. Similar findings were reported by Mali *et al.* (2018), Gyewali *et al.* (2020), Shrivastava *et al.* (2022), Kaur *et al.* (2023) and Kumar and Kumar (2024) in radish.

Leaf length (cm)

The influence of different organic manures and bio-fertilizers on the leaf length of radish was assessed at 20 DAS, 40 DAS and at harvest. The treatments exhibited significant differences in leaf length throughout the crop growth period. The maximum leaf length (11.63 cm, 23.67 cm and 31.26 cm at 20 DAS, 40 DAS and harvest, respectively) was recorded under T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha]. In contrast, the minimum leaf length (6.32 cm, 15.04 cm and 21.54 cm at 20 DAS, 40 DAS and harvest, respectively) was recorded in the control treatment (T_1).

The maximum leaf length recorded under T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha] may be attributed to the enhanced availability and efficient utilization of phosphorus facilitated by PSB, which plays a key role in ATP production, enzymatic activity and carbohydrate metabolism. Improved phosphorus nutrition enhances the synthesis and translocation of photosynthates from source to sink, thereby promoting rapid leaf expansion.

Vermicompost further improves the soil environment by enhancing moisture availability, root proliferation and nutrient uptake efficiency, ensuring a continuous supply of essential nutrients throughout the vegetative growth period. The integrated application of PSB and vermicompost maintains better physiological activity and promotes vigorous canopy development, resulting in significantly greater leaf length. Similar results were reported by Mali *et al.* (2018), Gyewali *et al.* (2020), Shrivastava *et al.* (2022), Kaur *et al.* (2023) and Kumar and Kumar (2024) in radish.

Table 2 : Effect of organic manures and biofertilizers on plant height (cm)

Treatment		Plant height (cm)			Number of leaves per plant			Leaf length (cm)		
		20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest
T_1	Control	7.58^{c}	16.73^{c}	24.98^{b}	3.07^{d}	7.64^{c}	9.49^{b}	6.32^{d}	15.04^{c}	21.54^{b}
T_2	FYM (20 t/ha)	9.37^{b}	20.78^{b}	27.65^{b}	3.82^{c}	8.73^{b}	11.25^{b}	8.32^{c}	18.02^{b}	24.68^{b}
T_3	Vermicompost (5 t/ha)	9.61^{b}	21.43^{b}	28.51^{b}	3.95^{c}	8.91^{b}	11.28^{b}	8.68^{b}	19.57^{b}	24.94^{b}
T_4	Azotobacter (4 kg/ha)	8.50^{c}	18.48^{b}	26.38^{b}	3.34^{c}	8.31^{b}	10.25^{b}	7.81^{c}	16.75^{b}	23.39^{b}
T_5	Phosphate solubilizing bacteria (PSB) (4 kg/ha)	8.76^{c}	18.89^{b}	26.54^{b}	3.65^{c}	8.58^{b}	10.88^{b}	7.42^{c}	16.55^{b}	23.94^{b}
T_6	Azotobacter (2 kg/ha) + FYM (10 t/ha)	9.08^{b}	23.58^{a}	30.70^{a}	4.15^{b}	9.66^{b}	12.73^{a}	8.95^{b}	21.66^{a}	26.20^{a}
T_7	Azotobacter (2 kg/ha) +Vermicompost (2.5 t/ha)	10.79^{a}	24.64^{a}	32.14^{a}	4.65^{b}	10.12^{a}	13.92^{a}	9.72^{b}	22.91^{a}	29.38^{a}
T_8	PSB (2kg/ha) +FYM (10 t/ha)	10.40^{b}	23.84^{a}	30.18^{a}	4.45^{b}	9.89^{a}	12.81^{a}	9.07^{b}	21.67^{a}	27.81^{a}
T_9	PSB (2kg/ha) + Vermicompost (2.5 t/ha)	12.14^{a}	25.64^{a}	34.86^{a}	5.74^{a}	11.31^{a}	14.59^{a}	11.63^{a}	23.67^{a}	31.26^{a}
C.D. at 5%		**1.43**	**3.72**	**5.22**	**0.61**	**1.57**	**2.43**	**1.24**	**3.07**	**5.21**
S.E. m ±		**0.47**	**1.24**	**1.74**	**0.20**	**0.52**	**0.81**	**0.41**	**1.02**	**1.72**
C.V. (%)		**8.57**	**9.93**	**10.33**	**8.63**	**9.73**	**11.73**	**8.24**	**9.01**	**11.52**

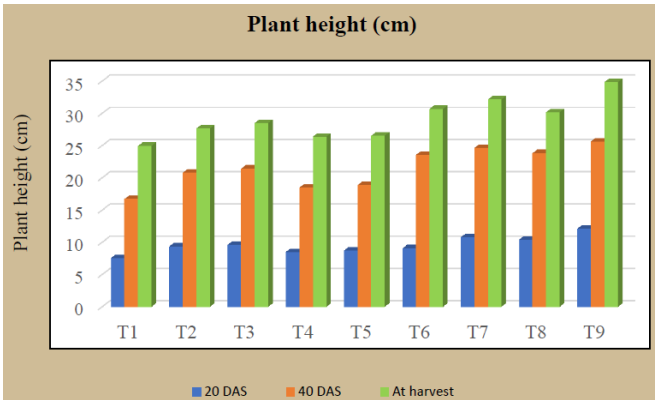

Fig. 3: Effect of organic manures and biofertilizers on plant height (cm)

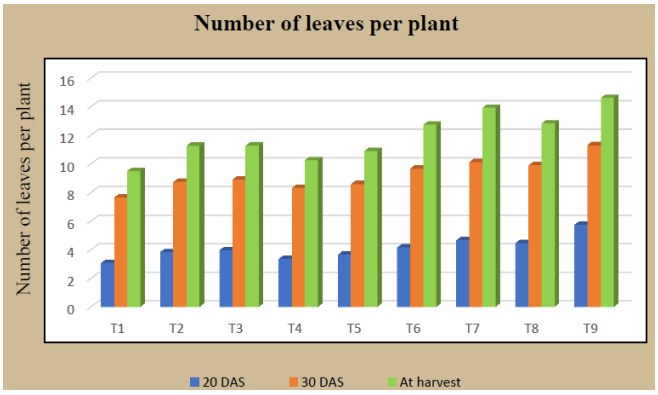

Fig. 4: Effect of organic manures and biofertilizers on number of leaves per

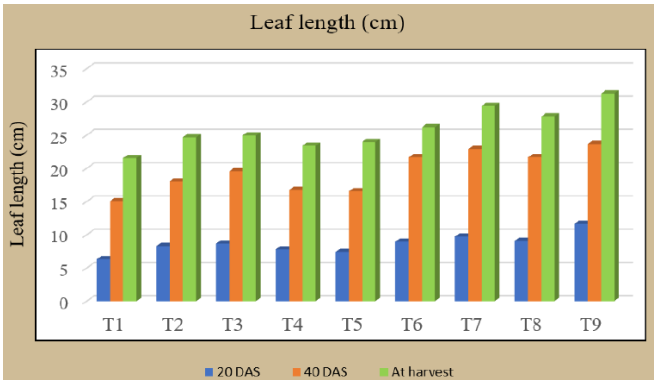

Fig. 5: Effect of organic manures and biofertilizers on leaf length (cm)

Conclusion

Based on the findings of the present investigation, it may be concluded that the integrated application of T_9 [PSB @ 2 kg/ha + Vermicompost @ 2.5 t/ha] was the most effective treatment for improving the germination and growth of radish under Bastar Plateau conditions. This treatment recorded the highest germination percentage, the minimum number of days to 50 per cent germination, the maximum plant height, the highest number of leaves per plant and the greatest leaf length at different growth stages.

The superior performance of T_9 may be attributed to enhanced nutrient availability, increased microbial activity, improved phosphorus solubilization and better soil physical conditions resulting from the combined application of PSB and vermicompost. The integrated use of these inputs created favourable conditions for plant growth and development, leading to better crop performance.

Therefore, the application of PSB @ 2 kg/ha in combination with vermicompost @ 2.5 t/ha is recommended for improving the germination and vegetative growth of radish under the agro-climatic conditions of the Bastar Plateau. This integrated nutrient management practice may also contribute to improved soil fertility and nutrient status, making it a suitable and sustainable recommendation for farmers adopting organic or integrated farming practices.

References

Aasim, M., Baloch, F. S., Nadeem, M. A., Bakhsh, A., Sameeullah, M. and Day, S. (2018). Fenugreek (*Trigonella foenum-graecum* L.): An underutilized edible plant of modern world. In *Global perspectives on underutilized crops* (pp. 381–408). Springer International Publishing.

Ahamad, S., Kumar, J., Silas, V. J., Lal, M., Kumar, Y. and Maurya, R. (2023). Effect of bio-fertilizer and micronutrient on growth and yield of radish (*Raphanus sativus* L.) var. Pusa Himani. *The Pharma Innovation Journal*, ***12***(7), 472–474.

Anonymous. (2025). *Area and production of horticultural crops: All India 2024–25*. Department of Agriculture & Farmers.

Anonymous. (2024). *Database*. Department of Agriculture Development, Farmers Welfare and Biotechnology, Government of Chhattisgarh, Raipur, Chhattisgarh.

Association of Official Analytical Chemists. (2005). *Official methods of analysis* (18th ed.). Association of Official Analytical Chemists.

Biswas, S. and Shivaprakash, M. K. (2021). Effect of biofertilizers on germination and seedling growth of radish, beetroot, carrot and lettuce under greenhouse condition. *Research Journal of Agriculture and Forestry Sciences*, **9**, 1–5.

Choudhary, B. R., Fageria, M. S. and Dhaka, R. S. (2002). Role of growth hormones in chillies: A review. *Agriculture Review*, ***23***, 145–148.

Gyewali, B., Maharjan, B., Rana, G., Pandey, R., Pathak, R. and Poudel, P. R. (2020). Effect of different organic manures on growth, yield and quality of radish (*Raphanus sativus*). *SAARC Journal of Agriculture*, ***18***(2), 101–114.

Kaur, L., Rattan, P., Reddy, A. H. and Sharma, A. (2023). Effect of organic manures and bio-fertilizers on growth and yield of radish (*Raphanus sativus* L.). *The Pharma Innovation Journal*, ***12***(7), 1249–1254.

Kumar, A. and Kumar, A. (2025). Effect of organic manures and bio-fertilizers on growth and yield characters of radish (*Raphanus sativus* L.) cv. Pusa Chetki. *International Journal of Advanced Biochemistry Research*, ***9***(1), 347–350.

Mali, D. L., Singh, V., Sarolia, D. K., Teli, S. K., Chittora, A. and Dhakar, R. (2018). Effect of organic manures and bio-fertilizers on growth and yield of radish (*Raphanus sativus* L.) cv. Japanese white. *International Journal of Chemical Studies*, ***6***(2), 1095–1098.

Mehmood, S., Ashfaq, M., Kapnick, S., Gosh, S., Abid, M. A., Kucharski, F., Batibeniz, F., Saha, A., Evans, K. and Hsu, H. H. (2022). Dominant controls of cold-season precipitation variability over the high mountains of Asia. *Nature Partner Journals Climate and Atmospheric Science*, ***5***(1), 65.

Panse, V. G. and Sukhatme, P. V. (1985). *Statistical methods for agricultural workers* (3rd enlarged ed.). Indian Council of Agricultural Research.

Sami, H. M., Dina, M. S., Ahmed, M. M. E.-T., Emad, H. and Abd El-Samad. (2019). Utilization of seaweed (*Sargassum vulgare*) extract to enhance growth, yield and nutritional quality of red radish plants. *Annals of Agricultural Sciences*, ***64***, 167–175.

Shilpa, D., Sharma, M., Kaur, M., Kumar Sharma, A., Sharma, P. and Chauhan, M. (2023). Soil fertility, growth, yield and root quality of radish (*Raphanus sativus* L.) as influenced by integrated nutrient management practices. *Communications in Soil Science and Plant Analysis*, ***54***(10), 1316–1333.

Shrivastava, R., Bisen, R. K., Verma, S. K., Agrawal, H. P., Keshry, P. K., Chaure, N. K. and Thakur, S. (2022). To study the effects of integrated nutrient management on the growth and yield of radish (*Raphanus sativus* L.). *Journal of Pharmacognosy and Phytochemistry*, ***11***(5), 120–123.

Singh, D. P., Verma, S. C., Sharma, H. K., Mehta, D. K., Thakur, K. S. and Bharat, N. K. (2017). Effect of different organic inputs and transplanting dates on seed quality parameters of radish (*Raphanus sativus* L.). *Journal of Applied and Natural Science, **9***(2), 1203.

Wani, I. M., Narayan, S., Magray, M. M., Khan, F. A., Mir, S. A., Yaseen, I. and Khurshid, A. (2023). Effect of organic manures and biofertilizers on seed quality of radish (*Raphanus sativus* L.) under temperate conditions of Kashmir. *The Pharma Innovation Journal, **15***, 315–319.