Sarcouncil Journal of Agriculture

ISSN(Online): 2945-3631

Volume- 04| Issue- 02| 2025

Research Article **Received:** 05-02-2025 | **Accepted:** 20-02-2025 | **Published:** 10-03-2025

Assessment of Chemical Fertilizer and Biofertilizer of Agricultural Soil of Arni Region, Yavatmal District, Maharashtra (India)

Bhokare P.R.[1] and Wankhade R.R[2]

1Department of Chemistry,L.R.B.Arts, Comm.&S.S.R.B.Sci. College, Arni, Dist. Yavatmal. (MS)

2Department of Chemistry, B.B. Arts, B.N. Comm. & B.P. Sci. College Digras, Dist. Yavatmal. (MS)

Abstract: The present study evaluates the impact of chemical fertilizers and biofertilizers on the physico-chemical properties and correlation ofphysico-chemical properties of agricultural soils in the Arni region, Yavatmal district, Maharashtra, India. Soil samples were collected from three locations: Bhansara, Pangari, and Chikani, and analyzed for parameters such as pH, electrical conductivity (EC), organic carbon (OC), macronutrients (N, P, K), and micronutrients (S, Zn, B, Fe, Mn, Cu). The results indicated that soils treated with chemical fertilizers had higher electrical conductivity, with increased accumulation of soluble salts, and lower organic carbon content, particularly in Bhansara and Pangari. In contrast, biofertilizer-treated soils exhibited higher organic carbon, improved nutrient retention, and more balanced micronutrient availability, contributing to better soil health and sustainability. Although chemical fertilizers enhanced immediate nutrient availability, biofertilizers promoted long-term soil fertility by improving microbial activity and organic matter content. This study highlights the potential benefits of biofertilizers as an eco-friendly alternative to chemical fertilizers for sustainable agriculture in the region.

Keywords: Chemical Fertilizer, Bio-Fertilizers, Agriculture and Soil etc.

INTRODUCTION

Agricultural soil refers to the upper layer of the earth's surface used for cultivating crops. It is rich in nutrients and organic matter, essential for plant growth. This soil type is managed to optimize physical, chemical, and biological properties, promoting healthy and productive farming(Brady, *et al*. 2008 and Hillel, 2013).Agricultural productivity is pivotal in sustaining the global food supply, necessitating innovative approaches to enhance soil fertility and crop yield(Davis, *et al*., 2023). Traditional chemical fertilizers have long been the cornerstone of modern agriculture due to their immediate and substantial impact on crop production. However, their extensive use has raised significant concerns regarding soil health, environmental sustainability, and long-term agricultural viability. In contrast, biofertilizers, which utilize living microorganisms to enhance soil nutrient content and promote plant growth, present a promising alternative that aligns with sustainable agricultural practices(Pahalvi, *et al*., 2021 and Rehman, *et al*. 2022).

Biofertilizers improve nutrient availability, support root development, and enhance microbial activity, leading to healthier, more resilient plants. In contrast to chemical fertilizers, biofertilizers reduce environmental contamination and contribute to sustainable soil health by minimizing the buildup of harmful residues (Otley and Soin 2014 and Alnaass, *et al*. 2023). Biofertilizers can reduce environmental consequences, preserve water resources, and enhance biodiversity in agricultural systems by lowering reliance on chemical fertilizers (Atieno, *et al*., 2020). The excessive use of chemical fertilizers in agriculture has far-reaching consequences for soil health, environmental sustainability, and agricultural productivity. Addressing these challenges requires a shift towards integrated soil fertility management practices that combine the judicious use of chemical fertilizers with organic amendments and biofertilizers (Demir, *et al*. 2023). Such approaches can help restore soil health, enhance nutrient efficiency, and promote sustainable agricultural systems that are resilient to environmental changes. Biofertilizers play a multifaceted role in enhancing agricultural soil health(Smith and Gallaher, 2019). Their ability to improve nutrient availability, soil structure, microbial activity, organic matter decomposition, and reduce dependency on chemical inputs makes them invaluable for promoting sustainable agriculture(Nosheen, *et al*., 2021). The use of bio-fertilizers not only improves soil health but also promotes sustainable agricultural practices by utilizing agro-wastes effectively (Itelima, *et al*., 2018). This approach can lead to increased crop productivity and reduced dependency on chemical fertilizers, contributing to more environmentally friendly farming methods (Asadu *et. al*., 2018). Understanding the balance between enhancing agricultural productivity and maintaining soil health is critical in developing sustainable agricultural practices. This research contributes to the ongoing discourse (Bhardwaj, *et al*., 2014; Jacob and Paranthaman, 2023; Wei, *et al*., 2024) on optimizing fertilization methods to achieve both

***Corresponding Author:** Bhokare P.R

DOI- https://doi.org/ 10.5281/zenodo.14996572

high crop yields and ecological sustainability (Sparks, *et al.*, 2022 and Du, *et al.*, 2023).

The ranges of Nitrogen (N), Phosphorus (P), and Potassium (K) and micronutrients in soil are typically categorized as low, medium, or high based on their concentrations. Here's a general chart format representing the typical ranges of NPK levels in soil.

Table 1: The ranges of macronutrients in soil

Nutrient	Low (kg/ha)	Medium (kg/ha)	High (kg/ha)
Nitrogen (N)	< 280	280 - 560	> 560
Phosphorus (P)	< 11	11 - 22	> 22
Potassium (K)	< 110	110 - 280	> 280

Table 2: The ranges of micronutrients in soil

Micronutrient	Low (ppm)	Medium (ppm)	High (ppm)
Iron (Fe)	< 4.5	4.5 - 9.0	> 9.0
Manganese (Mn)	< 2.0	2.0 - 5.0	> 5.0
Copper (Cu)	< 0.2	0.2 - 1.0	> 1.0
Zinc (Zn)	< 0.5	0.5 - 1.0	> 1.0
Boron (B)	< 0.5	0.5 - 1.0	> 1.0
Molybdenum (Mo)	< 0.02	0.02 - 0.1	> 0.1

This research paper explores the comparative impacts of chemical fertilizers and biofertilizers on agricultural soil. By examining the effects of these two distinct fertilization methods, we aim to provide a comprehensive understanding of their respective advantages and drawbacks. The study investigates parameters such as soil nutrient contentand overall soil health to assess the long-term implications of each fertilization strategy (Huang, *et al.*, 2011; Smith and Mullins 2000).

MATERIALS AND METHODS

Study Area

The study focuses on the Arni region in the Yavatmal district of Maharashtra, India as shown in Fig.-1. This area is predominantly agricultural, with diverse crop cultivation and varying soil types. The region's climate is semi-arid, with moderate rainfall, making it suitable for both rainfed and irrigated farming practices. The selection of this area helps to assess the influence of chemical fertilizers and biofertilizers on soil health in a real-world farming scenario.

Sample Collection

Soil samples were collected from multiple agricultural fields across the Arni region, with each sample site chosen based on fertilizer usage. Samples were taken from the topsoil layer (0-15 cm depth) using standard soil sampling methods. Care was taken to ensure the samples represented different cropping patterns and soil types for a comprehensive analysis of the region's soil health under varied fertilizer applications(Pansu 2006). Soil samples were air-dried, ground, and sieved through a 2 mm sieve before chemical analysis.

Publisher: SARC Publisher

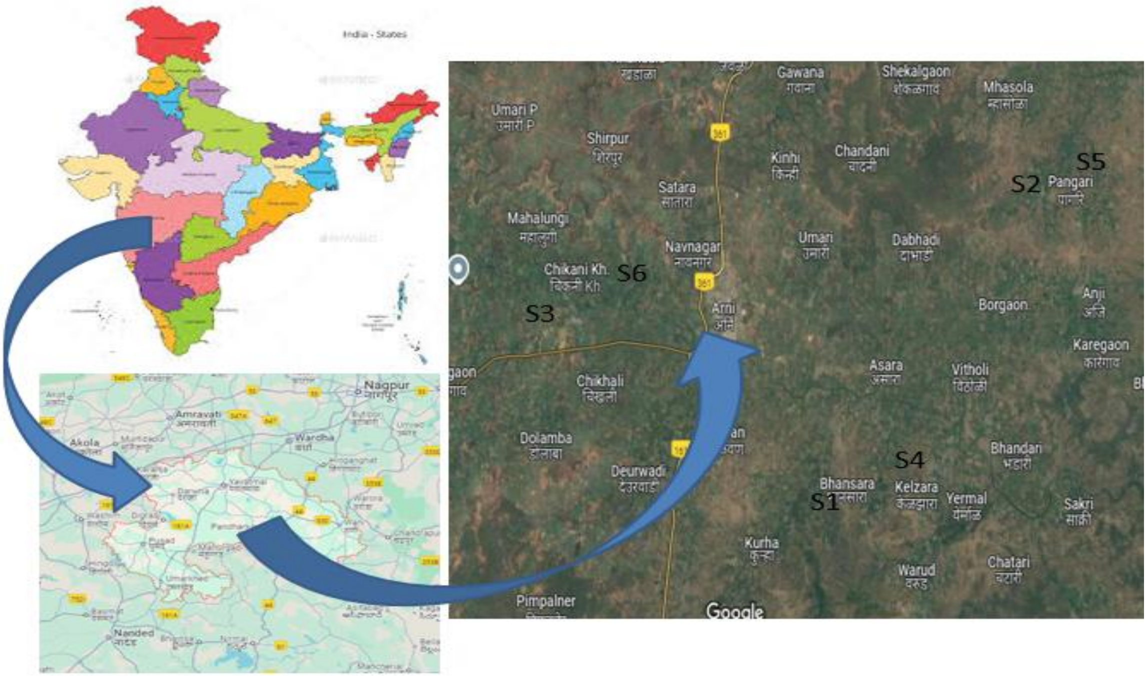


Figure-1: Map of Study Area Arni Region

Analysis of Soil Properties

Soil pH was determined by using a digital pH meter in a 1:2.5 soil-water suspension(Faria, Bertocco, *et al*. 2023). Electrical Conductivity (EC) by a conductivity meter.Organic Carbon (OC) Estimated by the Walkley-Black method, Nitrogen (N) ware determined by the Kjeldahl method, Phosphorus (P) measured by using the Olsen's method, Potassium (K) assessed using a flame photometer, Sulfur (S) determined by extracting soil with 0.15% calcium chloride and measuring using a turbidimeter and micronutrients (Zn, Fe, Mn, Cu) analyzed using an atomic absorption spectrophotometer (AAS) (Ammar, *et al*., 2024 and Jangir, *et al*., 2024).

Statistical Analysis

Correlation analysis is a powerful statistical tool used to identify these relationships, offering insights into nutrient availability and potential soil amendments (Javankhoshdel and Bathurst 2016).

RESULT AND DISCUSSION

The pH valuesin Table 3of the soil samples treated with chemical fertilizers ranged from 7.87 to 8.37. Similarly, soils treated with biofertilizers showed pH values between 7.78 to 8.2. Although both treatments resulted in slightly alkaline conditions, the chemical fertilizer-treated soils exhibited marginally higher alkalinity, particularly in the Pangari region (S2) with a pH of 8.37. This slight increase in alkalinity due to chemical fertilizers could be attributed to the presence of alkaline salts and the continuous use of fertilizers. Biofertilizer treatments helped maintain more stable pH levels, which is beneficial for maintaining nutrient availability and microbial activity in the soil.

The EC values in soils treated with chemical fertilizers ranged from 0.18 to 0.48 dS/m, while biofertilizer-treated soils exhibited slightly lower EC values, ranging from 0.14 to 0.43 dS/m. The higher EC in chemically treated soils, particularly in Bhansara (S1, 0.48 dS/m), indicates an accumulation of soluble salts, which could potentially affect soil structure and plant growth over time. On the other hand, the biofertilizer-treated soils maintained more balanced EC levels, reflecting less salt accumulation and healthier soil conditions for sustained plant growth.

Soils treated with biofertilizers showed higher organic carbon content (0.59% in Bhansara S4 and 0.47% in Pangari S5) compared to soils treated with chemical fertilizers (0.14% to 0.57%). The presence of higher organic carbon in biofertilizer-treated soils can be linked to enhanced microbial activity and organic matter decomposition. In contrast, chemical fertilizers tend to degrade organic carbon content over time, as observed in the low values for Bhansara (S1) and Pangari (S2) with 0.14% and 0.23%, respectively. The results suggest that biofertilizers play a critical role in

Publisher: SARC Publisher

enhancing soil organic carbon, which is vital for improving soil fertility and structure.

Chemical fertilizer-treated soils exhibited a wide range of nitrogen content, with the highest concentration in Chikani (S3) at 401.4 kg/ha. In biofertilizer-treated soils, nitrogen levels were similarly high in Chikani (S5), indicating that biofertilizers were effective in supplying nitrogen through natural processes like nitrogen fixation. However, biofertilizers showed a more gradual and sustained release of nitrogen, whereas chemical fertilizers caused a sharp increase in nitrogen availability. The results suggest that biofertilizers can provide sufficient nitrogen to plants without the risk of leaching or environmental harm associated with chemical fertilizers.

The phosphorus content in chemically treated soils ranged from 5.23 to 25.07 kg/ha, with Chikani (S3) showing the highest level. In biofertilizer-treated soils, phosphorus levels ranged from 10.75 to 22.59 kg/ha. Although the chemical fertilizers resulted in higher immediate phosphorus availability, a significant portion of it may become immobilized or fixed in the soil, reducing long-term bioavailability. Biofertilizers, particularly phosphate-solubilizing bacteria, increased the phosphorus availability in a more sustainable way, allowing plants to access it over time.

Potassium levels were relatively high across all samples, ranging from 377.44 to 607.04 kg/ha. Soils treated with chemical fertilizers exhibited higher potassium content, especially in Chikani (S3, 607.04 kg/ha), compared to biofertilizer-treated soils.

Sulfur (S) content was slightly higher in chemically treated soils (19.01 ppm in Bhansara S1), but biofertilizer-treated soils showed more balanced sulfur levels. This could be due to the reduced use of sulfur-containing chemical fertilizers in biofertilizer treatments.Zinc (Zn)andboron (B) concentrations were generally higher in biofertilizer-treated soils, indicating the improved availability of these micronutrients through microbial activity.Iron (Fe) and manganese (Mn) levels were higher in chemical fertilizer-treated soils, while biofertilizers maintained more stable concentrations of these micronutrients, reducing the risk of potential toxicity from excess accumulation.Copper (Cu) levels were well maintained in both treatments, with a slight increase in biofertilizer-treated soils, indicating that biofertilizers may enhance copper availability.

Table-3: Physico-chemical Parameter of soil samples

Fertilizer	**Chemical- Fertilizer**			**Boi- Fertilizer**		
Sample	**Bhansara**	**Pangari**	**Chikani**	**Bhansara**	**Pangari**	**Chikani**
	S1	**S2**	**S3**	**S4**	**S5**	**S6**
PH	7.9	8.37	7.87	7.78	7.93	8.2
EC dS/m	0.48	0.21	0.18	0.14	0.37	0.43
OC %	0.14	0.23	0.57	0.59	0.47	0.18
N (Kg/ha)	125.4	112.9	401.4	326.1	401.4	138
P (Kg/ha)	9.64	5.23	25.07	15.15	22.59	10.75
K (Kg/ha)	426.72	436.8	607.04	377.44	518.56	505.12
S (ppm)	19.01	16.67	13.08	15.95	10.19	16.17
Zn (ppm)	0.74	0.5	0.47	0.1	0.79	0.71
B (ppm)	0.41	0.79	0.9	0.11	0.62	0.3
Fe (ppm)	3.95	5.98	5.81	5.79	3.16	7.22
Mn(ppm)	15.09	11.27	16.02	12.45	4.91	3.84
Cu (ppm)	0.26	1.56	0.7	0.89	0.6	1.76

The correlation matrix (Table 4)shows the relationships between various soil physicochemical properties and available micronutrients.

Soil pH shows a negative correlation with organic carbon (OC) (-0.6419), nitrogen (N) (-0.6775), and phosphorus (P) (-0.6588). This suggests that as pH increases, the availability of these nutrients decreases. Conversely, a strong positive correlation is observed with copper (Cu) (0.7986) and iron (Fe) (0.4426), indicating that higher pH favors the availability of these micronutrients.

EC exhibits a strong negative correlation with organic carbon (-0.7264), nitrogen (-0.4424), and phosphorus (-0.2409), indicating that high salinity

Publisher: SARC Publisher

conditions might reduce the availability of these nutrients. However, EC shows a strong positive correlation with zinc (Zn) (0.8585), which implies that salinity might enhance Zn solubility.

Organic carbon (OC) has a strong positive correlation with nitrogen (0.9203) and phosphorus (0.7866), indicating that organic matter contributes significantly to soil fertility. On the other hand, it shows a strong negative correlation with sulfur (S) (-0.6451) and zinc (-0.6044), implying that organic matter might influence the mobility and retention of these elements.

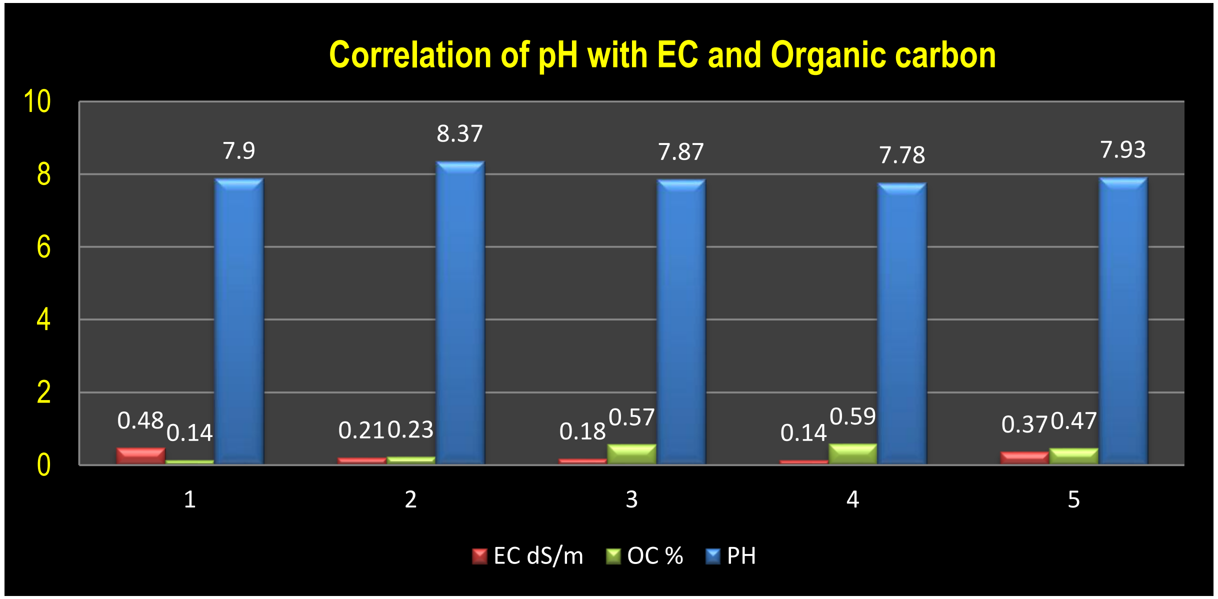
Nitrogen (N) Strong positive correlation with phosphorus (0.9497) and potassium (K) (0.4706), suggesting that N availability is associated with other macronutrients in the soil. It shows a strong negative correlation with sulfur (-0.8331), indicating an inverse relationship.Phosphorus (P) Highly correlated with potassium (0.6792), indicating the combined effect of these nutrients on plant growth.Potassium (K) Moderately correlated with boron (B) (0.6708), suggesting a possible interaction in soil nutrient dynamics.Sulfur shows a strong negative correlation with nitrogen (-0.8331) and phosphorus (-0.8191), suggesting a competitive relationship. It is positively correlated with manganese (Mn) (0.3778), which may indicate that sulfur affects Mn availability.

Zinc (Zn) Strongly correlated with EC (0.8585), indicating that Zn availability is influenced by soil salinity. It is negatively correlated with organic carbon (-0.6044) and sulfur (-0.1420), suggesting reduced Zn availability in high-organic-matter soils.Boron (B) Moderately correlated with potassium (0.6708) and phosphorus (0.2915), indicating its role in root development and nutrient transport.Iron (Fe) Shows a strong positive correlation with pH (0.4426) and copper (0.8077), which suggests that Fe availability increases in alkaline soils and is associated with Cu.Manganese (Mn) Negatively correlated with pH (-0.3901) and sulfur (-0.4388), suggesting Mn availability decreases with increasing pH and sulfur content.Copper (Cu) Strongly correlated with pH (0.7986) and iron (0.8077), indicating that Cu is more available in alkaline soils and shares a similar mobility pattern with Fe.

Publisher: SARC Publisher

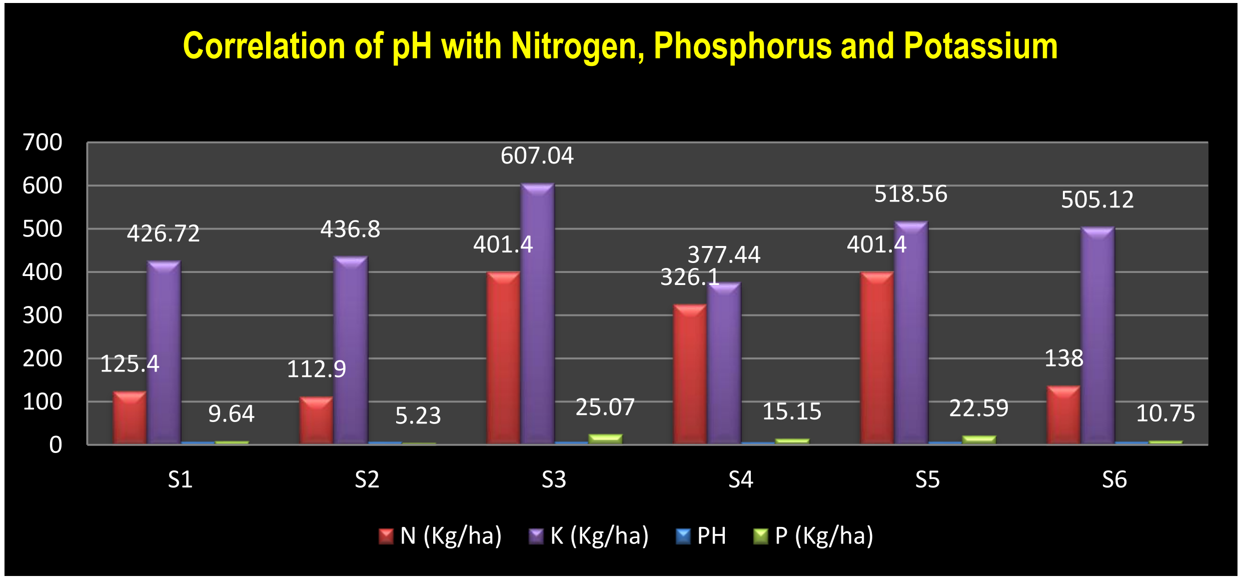
Table-4: Correlation table of Soil Parameter

	PH	EC dS/m	OC %	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	S (ppm)	Zn (ppm)	B (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
PH	1											
EC dS/m	0.12662	1										
OC %	-0.6419	-0.7264	1									
N (Kg/ha)	-0.6775	-0.4424	0.9203	1								
P (Kg/ha)	-0.6588	-0.2409	0.7866	0.94968	1							
K (Kg/ha)	-0.0239	0.02463	0.2425	0.47064	0.67919	1						
S (ppm)	0.23396	0.20969	-0.645	-0.8331	-0.8191	-0.6182	1					
Zn (ppm)	0.29867	0.85848	-0.604	-0.2481	-0.0259	0.3927	-0.142	1				
B (ppm)	0.29413	-0.2117	0.082	0.20194	0.29146	0.67085	-0.3963	0.2794	1			
Fe (ppm)	0.44261	-0.3238	-0.101	-0.3352	-0.3221	0.03774	0.3364	-0.3968	-0.1388	1		
Mn (ppm)	-0.3901	-0.4024	0.2071	0.05717	0.04918	-0.0756	0.37775	-0.4388	0.24623	-0.0718	1	
Cu (ppm)	0.79861	-0.1414	-0.302	-0.4503	-0.4817	-0.0347	0.14387	-0.0924	-0.0491	0.80768	-0.5122	1

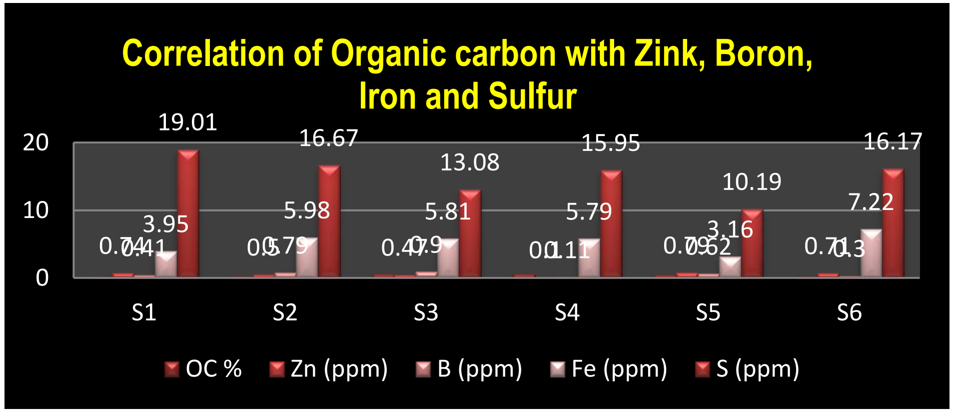


Graph 1: Correlation of pH with EC and Organic carbon

Publisher: SARC Publisher



Graph 2: Correlation with pH with NPK



Graph 3: Correlation of Organic carbon with Zink, Boron, Iron and Sulfur

Publisher: SARC Publisher

CONCLUSION

The negative correlation of pH with organic carbon, nitrogen, and phosphorus suggests that acidic conditions favor these nutrients, while alkaline conditions enhance the availability of micronutrients like Fe and Cu. Organic matter plays a crucial role in improving soil fertility, as evident from its positive correlation with nitrogen and phosphorus. The strong relationship between EC and zinc suggests that salinity affects micronutrient dynamics. Chemical fertilizers demonstrate a clear benefit in terms of rapid nutrient availability and immediate crop yield enhancement. However, their long-term use is associated with adverse effects, including soil degradation, reduced microbial diversity, and potential environmental pollution. In contrast, biofertilizers offer a sustainable alternative by improving soil structure, enhancing microbial activity, and promoting long-term soil fertility without the negative environmental impacts. The use of biofertilizers, either alone or in combination with reduced chemical fertilizer applications, is recommended to achieve sustainable agricultural practices. This integrated approach can help maintain soil health, ensure sustainable crop production, and protect the environment for future generations. Farmers should focus on developing effective strategies for the combined use of these fertilizers, along with policy measures to support farmers in adopting sustainable practices. This balanced approach is essential for ensuring the longevity and health of agricultural soils, safeguarding food security, and protecting the environment.

REFRENCES

1. Alnaass, N. S., Agil, H. K., Alyaseer, N. A., Abubaira, M. & Ibrahim, H. K. "The effect of biofertilization on plant growth and its role in reducing soil pollution problems with chemical fertilizers." *African Journal of Advanced Pure and Applied Sciences* (2023): 387-400.
2. Ammar, A., El Mouridi, Z., Nouira, A., Moustakim, M. & Boughribil, S. "Characterisation and analysis of soil properties and trace elements in agricultural soils of Rabat-Sale-Kenitra, Morocco: focus on stable strontium and caesium." *International Journal of Environmental Studies*, (2024): 1-19.
3. Asadu, C. O., Aneke, N. G., Egbuna, S. O. & Agulanna, A. C. "Comparative studies on the impact of bio-fertilizer produced from agro-wastes using thermo-tolerant actinomycetes on the growth performance of Maize (*Zea mays*) and Okro (*Abelmoschus esculentus*)." *Environmental Technology & Innovation*, **12**(2018): 55-71.
4. Atieno, M., Herrmann, L., Nguyen, H. T., Phan, N. N. K., Srean, P., Than, M. M., Zhiyong, R., Tittabutr, P. & Shutsrirung, A. "Assessment of biofertilizer use for sustainable agriculture in the Great Mekong Region." *Journal of Environmental Management*, **275**(2020): 111300.
5. Bhardwaj, D., Ansari, M. W., Sahoo, R. K. & Tuteja, N. "Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance, and crop productivity." *Microbial Cell Factories*, **13**(1)(2014): 66.
6. Brady, N. C. & Weil, R. R. *The nature and properties of soils.* Prentice Hall, Upper Saddle River, NJ (2008).
7. Davis, A. G., Huggins, D. R. & Reganold, J. P. "Linking soil health and ecological resilience to achieve agricultural sustainability." *Frontiers in Ecology and the Environment*, **21**(3)(2023): 131-139.
8. Demir, H., Sönmez, İ. & Akgün, İ. H. "Biofertilizers improve the plant growth, yield, and mineral concentration of lettuce and broccoli." *Agronomy*, 13 (8)(2023): 2031.
9. Du, T., Hu, Q., He, H., Mao, W., Yang, Z., Chen, H., Sun, L. & Zhai, M. "Long-term organic fertilizer and biofertilizer application strengthens the associations between soil quality index, network complexity, and walnut yield." *European Journal of Soil Biology*, 116 (2023): 103492.
10. Faria, M., Bertocco, T., Barroso, A., Carvalho, M., Fonseca, F., Delerue-Matos, C., Figueiredo, T., Sequeira Braga, A., Valente, T. & Jiménez-Ballesta, R. "A comparison of analytical methods for the determination of soil pH: case study on burned soils in Northern Portugal." *Fire*, **6**(6)(2023): 227.
11. Hillel, D. *Fundamentals of soil physics.* Academic Press (2013).
12. Huang, P. M., Li, Y. & Sumner, M. E. *Handbook of soil sciences: properties and processes.* CRC Press (2011).
13. Itelima, J., Bang, W., Onyimba, I., Sila, M. & Egbere, O. "Bio-fertilizers as key players in enhancing soil fertility and crop productivity: A review." *(2018).*
14. Jacob, S. M. and Paranthaman, S. "Biofertilizers: an advent for eco-friendly and

Publisher: SARC Publisher

sustainable agriculture development." *Vegetos* 36.4(2023): 1141-1153.

15. Jangir, C. K., Sangwan, P., Panghaal, D., Kumar, S., Meena, R. S., Bharti, R. D. and Singh, N. "Spatial variability and statistical analysis of soil properties in the rice wheat-based systems of North-West India." *Communications in Soil Science and Plant Analysis*. 55.8(2024): 1205-1223.
16. Javankhoshdel, S. and Bathurst R. J.. "Influence of cross correlation between soil parameters on probability of failure of simple cohesive and c-ϕ slopes." *Canadian Geotechnical Journal*, 53.5(2016): 839-853.
17. Nosheen, S., I. Ajmal and Song, Y. "Microbes as Biofertilizers, a Potential Approach for Sustainable Crop Production." *Sustainability*, 13.4 (2021): 1868.
18. Otley, D. and Soin, K. "Management control and uncertainty." *Springer* (2014):1-13.
19. Pahalvi, H. N., Rafiya, L., Rashid, S., Nisar, B. and Kamili, A. N. "Chemical Fertilizers and Their Impact on Soil Health. Microbiota and Biofertilizers." Vol 2: Ecofriendly Tools for Reclamation of Degraded Soil Environs. G. H. Dar, R. A. Bhat, M. A. Mehmood and K. R. Hakeem. Cham, *Springer International Publishing*, (2021): 1-20.
20. Pansu, M. "Handbook of soil analysis." *Springer*, (2006).
21. Rehman, A., Farooq, M., Lee, D.-J.and Siddique, K. H. M.. "Sustainable agricultural practices for food security and ecosystem services." Environmental Science and Pollution Research, 29.56(2022): 84076-84095.
22. Smith, K. A. and Mullins, C. E. "Soil and environmental analysis." *Marcel Dekker Incorporated*(2000).
23. Smith, S. and Gallaher, C. M. "Soil and Agriculture. Encyclopedia of Food and Agricultural Ethics. D. M. Kaplan." Dordrecht, *Springer Netherlands:* (2019):2211-2217.
24. Sparks, D. L., Singh, B. and Siebecker, M. G. "Environmental soil chemistry." *Elsevier* (2022).
25. Wei, X., Xie, B., Wan, C., Song, R., Zhong, W., Xin, S. and Song, K. "Enhancing Soil Health and Plant Growth through Microbial Fertilizers: Mechanisms, Benefits, and Sustainable Agricultural Practices." *Agronomy*, 14.3(2024): 609.

Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:

Bhokare, P.R. and Wankhade, R.R. "Assessment of Chemical Fertilizer and Biofertilizer of Agricultural Soil of Arni Region, Yavatmal District, Maharashtra (India)." *Sarcouncil Journal of Agriculture* 4.2 (2025): pp 1-9.

Publisher: SARC Publisher