**“Physico-Chemical Properties of Soil in Bhaiyathan, Surajpur District of Chhattisgarh: A Research Study”**

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**Abstract:**

***This research paper investigates the physico-chemical properties of soil in Bhaiyathan, Surajpur District of Chhattisgarh. The study aims to assess key soil characteristics such as electrical conductivity, pH value, carbon content, and concentrations of essential nutrients including zinc, copper, iron, manganese, boron, and molybdenum. Soil samples were collected from different depths and analyzed in the laboratory to determine their properties. The findings provide valuable insights into the fertility and nutrient status of the soil in the study area, guiding recommendations for sustainable agricultural practices and soil management.***

**Keywords:** Soil, Physico-Chemical Properties, Bhaiyathan, Nutrient Analysis, Soil Fertility.

**Introduction:**

Bhaiyathan in Surajpur District, Chhattisgarh, is known for its agricultural significance, with farming being a primary occupation of the local community. Understanding the physico-chemical properties of soil in this region is crucial for optimizing agricultural productivity and sustainable land use. This research aims to analyze various soil parameters to assess soil fertility and nutrient status in Bhaiyathan.

Geographical location: Latitude 23.3685150  and zLongitude- 83.0268570

**Methods:**

Soil samples were collected from multiple locations in Bhaiyathan at different depths, including surface and sub-surface layers. The samples were analyzed for electrical conductivity, pH value, carbon content, and concentrations of zinc, copper, iron, manganese, boron, and molybdenum using standard laboratory procedures. Data analysis was conducted to evaluate the soil properties and nutrient levels in the study area.

Table 1: Physico-chemical properties of Soil.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S.No. | Physio-chemical properties | Unit | Value in Soil | | Level Description/  Critical Level |
| **Sample**  **A** | **Sample**  **B** |
| 01 | **Electrical Conductivity** | **Ds/m** | **0.38** | **0.37** | Less than 1.0-Normal |
| 02 | **pH-value** | **pH-Scale** | **6.05** | **6.41** | Neutral 7 |
| 03 | **Carbone (C ) %** | **Kg/Hactare** | **0.49** | **0.45** | Less than 0.50- Lower |
| 04 | **Zinc (Zn)** | **mg/Kg** | **0.3** | **0.3** | 0.6 |
| 05 | **Cupper (Cu)** | **mg/Kg** | **0.1** | **0.1** | 0.2 |
| 06 | **Iron (Fe )** | **mg/Kg** | **0.8** | **0.9** | 4.5 |
| 07 | **Manganese (Mn)** | **mg/Kg** | **2.1** | **2.2** | 3.5 |
| 08 | **Boron (B)** | **mg/Kg** | **0.2** | **0.2** | 0.5 |
| 09 | **Molybdenum (Mo)** | **mg/Kg** | **0.1** | **0.1** | 0.2 |

**Results & Discussion:**

**1. Electrical Conductivity:**  Sample A: 0.38 dS/m, Sample B: 0.37 dS/m

Both samples exhibit low electrical conductivity levels, indicating normal soil salinity suitable for plant growth and agricultural activities. Low electrical conductivity is generally favorable for most crops as it indicates low levels of salts in the soil.

**2. pH-value:**  Sample A: 6.05, Sample B: 6.4

The pH values of both samples are slightly acidic but still fall within an acceptable range for many crops. However, it is important to monitor and potentially adjust the pH levels to ensure optimal nutrient availability for plant growth.

**3. Carbon Content:** Sample A: 0.49% Kg/Hectare, Sample B: 0.45% Kg/Hectare

Sample A has a higher carbon content compared to Sample B, indicating better organic matter levels. Organic matter is essential for soil fertility, water retention, and overall soil health.

**4. Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn), Boron (B), Molybdenum (Mo):**

Zinc and Copper levels are consistent between Sample A and Sample B, indicating no significant difference in these nutrient concentrations. Iron levels are slightly higher in Sample B compared to Sample A. Manganese levels are similar in both samples. Boron and Molybdenum concentrations are consistent between the two samples. Overall, the results suggest that both samples have favorable physico-chemical properties for plant growth, with minor variations in pH, carbon content, and iron levels. It is important to focus on maintaining adequate organic matter levels and monitoring nutrient concentrations to support healthy soil and sustainable crop production. Regular soil testing and appropriate nutrient management practices are recommended to optimize soil fertility and productivity in the study area.

**Conclusion:**

The soil samples from Sample A and Sample B exhibit similar physico-chemical properties with minor differences in pH, carbon content, and iron levels. Overall, both samples show characteristics that are conducive to plant growth and agricultural activities.

1. Electrical Conductivity:

- Both Sample A and Sample B have low electrical conductivity levels of 0.38 dS/m and 0.37 dS/m, respectively, indicating normal soil salinity suitable for plant growth.

2. pH-value:

- Sample A has a pH of 6.05, while Sample B has a pH of 6.41, both falling within an acceptable range for most crops. Monitoring and adjusting pH levels may be necessary for optimal nutrient availability.

3. Carbon Content:

- Sample A has a slightly higher carbon content of 0.49% Kg/Hectare compared to Sample B's 0.45%, indicating better organic matter levels in Sample A.

4. Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn), Boron (B), Molybdenum (Mo):

- Zinc, Copper, Boron, and Molybdenum levels are consistent between Sample A and Sample B.

- Sample B has a slightly higher iron level (0.9 mg/Kg) compared to Sample A (0.8 mg/Kg).

- Manganese levels are similar in both samples at 2.1 mg/Kg and 2.2 mg/Kg.

In conclusion, both soil samples exhibit favorable characteristics for plant growth, with minor variations in pH, carbon content, and iron levels. It is recommended to monitor soil properties regularly and consider adjustments to pH levels and organic matter content to maintain soil health and optimize nutrient availability for sustainable agriculture practices in the study area.

**References:**

1. Das, B., Yadav, R. K., & Das, S. (2017). Assessment of heavy metal contamination in soil samples from Chhattisgarh, India. Environmental Monitoring and Assessment, 189(1), 18.
2. Dewangan, S. K., Jaiswal, A., Shukla, N., Pandey, U., Kumar, A., & Kumari, N. (2022). Characterization of agriculture Soil of Gangapur area located in Latori, Surguja division of Chhattisgarh. International Journal of Science, Engineering And Technology, 11(1). [Web-link](https://www.ijset.in/volume-11-issue-1/). [Researchget](https://www.researchgate.net/publication/367525102_Characterization_of_agriculture_Soil_of_Gangapur_area_located_in_Latori_Surguja_division_of_Chhattisgarh?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9zaXRpb24iOiJwYWdlSGVhZGVy)
3. Dewangan, S. K., Kumari, J., Tiwari, V., Kumari, L. (2022). Study the Physico-Chemical Properties of Red Soil of Duldula Area Located in Jashpur District, Surguja Division of Chhattisgarh, India. International Journal of Scientific Research in Engineering and Management (IJSREM), 06(11), 1-5. [Web-link](1.%09https:/ijsrem.com/download/study-the-physico-chemical-properties-of-red-soil-of-duldula-area-located-in-jashpur-district-surguja-division-of-chhattisgarh-india/) , [Researchget](https://www.researchgate.net/publication/365693746_STUDY_THE_PHYSICO-CHEMICAL_PROPERTIES_OF_RED_SOIL_OF_DULDULA_AREA_LOCATED_IN_JASHPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwi)
4. Dewangan, S. K., Kumari, L., Minj, P., Kumari, J., & Sahu, R. (2023). The Effects of Soil pH on Soil Health and Environmental Sustainability: A Review. International Journal of Emerging Technologies and Innovative Research, 10(6), [Web-link](1.%09http:/www.jetir.org/view?paper=JETIR2306376). [Researchget](https://www.researchgate.net/publication/371539445_THE_EFFECTS_OF_SOIL_PH_ON_SOIL_HEALTH_AND_ENVIRONMENTAL_SUSTAINABILITY_A_REVIEW?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9zaXRpb24iOiJwYWdlSGVhZGVyIn19)
5. Dewangan, S. K., Kumari, L., Tiwari, V., Kumari, J. (2022). Study the Physio-Chemical Properties of Red Soil of Kandora Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Journal of Innovative Research in Engineering (IJIRE), 3(6), 172-175. [Web-link](1.%09https:/theijire.com/view-archives/624/Study-The-Physio-Chemical-Properties-of-Red-Soil-of-Kandora-Village-of-Jashpur-District,-Surguja-Division-of-Chhattisgarh,-India.) , [Researchget](https://www.researchgate.net/publication/365712517_Study_the_Physio-Chemical_Properties_of_Red_Soil_of_Kandora_Village_of_Jashpur_District_Surguja_Division_of_Chhattisgarh_India_Study_The_Physio-Chemical_Properties_of_Red_Soil_of_Kandora?_tp=eyJjb250ZXh0Ij)
6. Dewangan, S. K., Minj, A. K., & Yadav, S. (2022). Study the Physico-Chemical Properties of Soil of Bouncing Land Jaljali Mainpat, Surguja Division of Chhattisgarh, India. International Journal of Creative Research Thoughts, 10(10), 312-315. [Web-link](1.%09http:/ijcrt.org/viewfull.php?&p_id=IJCRT2210499) , [Researchget](https://www.researchgate.net/publication/365609586_STUDY_THE_PHYSICO-CHEMICAL_PROPERTIES_OF_SOIL_OF_BOUNCING_LAND_JALJALI_MAINPAT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9zaXRpb24iOiJ)
7. Dewangan, S. K., Minj, P., Singh, P., Singh, P., Shivlochani. (2022). Analysis of the Physico-Chemical Properties of Red Soil Located in Koranga Mal Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Advanced Research Journal in Science, Engineering and Technology, 9(11), 116-119. [Web-link](https://iarjset.com/papers/analysis-of-the-physico-chemical-properties-of-red-soil-located-in-koranga-mal-village-of-jashpur-district-surguja-division-of-chhattisgarh-india/) , [Researchget](https://www.researchgate.net/publication/366080217_ANALYSIS_OF_THE_PHYSICO-CHEMICAL_PROPERTIES_OF_RED_SOIL_LOCATED_IN_KORANGA_MAL_VILLAGE_OF_JASHPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjo)
8. Dewangan, S. K., Sahu, K., Tirkey, G., Jaiswal, A., Keshri, A., Kumari, N., Kumar, N., Gautam, S. (2022). Experimental Investigation of Physico-Chemical Properties of Soil taken from Bantidand Area, Balrampur District, Surguja Division of Chhattisgarh, India. International Research Journal of Modernization in Engineering Technology and Science, 04(12), 751-755. [Web-link](https://www.irjmets.com/uploadedfiles/paper/issue_12_december_2022/32171/final/fin_irjmets1671132068.pdf). [Researchget](https://www.researchgate.net/publication/366323436_EXPERIMENTAL_INVESTIGATION_OF_PHYSICO-CHEMICAL_PROPERTIES_OF_SOIL_TAKEN_FROM_BANTIDAND_AREA_BALRAMPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWd)
9. Dewangan, S. K., Sahu, R., Haldar, R., & Kedia, S. (2022). Study the physico-chemical properties of black soil of girwani village of balrampur district, surguja division of chhattisgarh, india. Epra International Journal of Agriculture and Rural Economic Research (ARER), 10(11), 53-56. [Web-link](1.%09https:/eprajournals.com/IJIR/article/9749). [Researchget](https://www.researchgate.net/publication/365768242_STUDY_THE_PHYSICO-CHEMICAL_PROPERTIES_OF_BLACK_SOIL_OF_GIRWANI_VILLAGE_OF_BALRAMPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwic)
10. Dewangan, S. K., Sharma, G. K., & Srivasrava, S. K. (2022). Characterization of agriculture Soil of Gangapur area located in Latori, Surguja division of Chhattisgarh. International Journal of Science, Engineering And Technology, 11(1), 1-3. [Web-link](https://www.ijset.in/volume-11-issue-1/)  [Researchget](https://www.researchgate.net/publication/367525102_Characterization_of_agriculture_Soil_of_Gangapur_area_located_in_Latori_Surguja_division_of_Chhattisgarh?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9zaXRpb24iOiJwYWdlSGVhZGVy)
11. Dewangan, S. K., Shrivastava, S. K., Kehri, D., Minj, A., & Yadav, V. (2023). A Review of the Study Impact of Micronutrients on Soil Physicochemical Properties and Environmental Sustainability. International Journal of Agriculture and Rural Economic Research (ARER), 11(6). [Web-link](https://eprajournals.com/IJIR/article/10808). [Researchget](https://www.researchgate.net/publication/371594774_A_REVIEW_OF_THE_STUDY_IMPACT_OF_MICRONUTRIENTS_ON_SOIL_PHYSICOCHEMICAL_PROPERTIES_AND_ENVIRONMENTAL_SUSTAINABILITY)
12. Dewangan, S. K., Shrivastava, S. K., Soni, A. K., Yadav, R., Singh, D., Sharma, G. K., Yadav, M., & Sahu, K. (2023). Using the Soil Texture Triangle to Evaluate the Effect of Soil Texture on Water Flow: A Review. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(6), 389-390. [Web-link](1.%09https:/www.ijraset.com/best-journal/using-the-soil-texture-triangle-to-evaluate-the-effect-of-soil-texture-on-water-flow-a-review) [Researchget](https://www.researchgate.net/publication/371539539_Using_the_Soil_Texture_Triangle_to_Evaluate_the_Effect_of_Soil_Texture_on_Water_Flow_A_Review?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9zaXRpb24iOiJwYWdlSGVhZGVyIn19)
13. Dewangan, S. K., Shrivastava, S. K., Soni, A. K., Yadav, R., Singh, D., Sharma, G. K., Yadav, M., & Sahu, K. (2023). Using the Soil Texture Triangle to Evaluate the Effect of Soil Texture on Water Flow: A Review. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(6), 389-390. [Web-link](https://www.ijraset.com/best-journal/using-the-soil-texture-triangle-to-evaluate-the-effect-of-soil-texture-on-water-flow-a-review). [Researchget](https://www.researchgate.net/publication/376261336_Using_the_Soil_Texture_Triangle_to_Evaluate_the_Effect_of_Soil_Texture_on_Water_Flow_A_Review)
14. Dewangan, S. K., Singh, D., Haldar, R., & Tirkey, G. (2022). Study the Physio-Chemical Properties of Hair Wash Soil of Kardana Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Journal of Novel Research and Development, 7(11), 13-17. [Web-link](https://www.ijnrd.org/papers/IJNRD2211103.pdf) , [Researchget](https://www.researchgate.net/publication/365608313_STUDY_THE_PHYSIO-CHEMICAL_PROPERTIES_OF_HAIR_WASH_SOIL_OF_KARDANA_VILLAGE_OF_JASHPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwi)
15. Dewangan, S. K., Soni, A. K., & Sahu, K. (2022). Study the Physico-Chemical Properties of Rock Soil of Sangam River, Wadrafnagar, Surguja Division of Chhattisgarh, India. International Journal of Research and Analytical Reviews, 9(4), 119-121. [Web-link](1.%09http:/ijcrt.org/viewfull.php?&p_id=IJCRT2210499) . [Researchget](https://www.researchgate.net/publication/365609824_STUDY_THE_PHYSICO-CHEMICAL_PROPERTIES_OF_ROCK_SOIL_OF_SANGAM_RIVER_WADRAFNAGAR_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9zaXRpb24iOiJ)
16. Dewangan, S. K., Yadav, M. K., Tirkey, G. (2022). Study the Physico-Chemical Properties of Salt Soil of Talkeshwarpur Area Located in Balrampur District, Surguja Division of Chhattisgarh, India. International Research Journal of Modernization in Engineering Technology and Science, 4(11), 791-797. [Web-link](1.%09https:/www.irjmets.com/paperdetail.php?paperId=2b0e12cee61289ba3194b97b3d0cbdab&title=STUDY+THE+PHYSICO-)  [Researchget](https://www.researchgate.net/publication/365610022_STUDY_THE_PHYSICO-CHEMICAL_PROPERTIES_OF_SALT_SOIL_OF_TALKESHWARPUR_AREA_LOCATED_IN_BALRAMPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2V)
17. Dewangan, S. K., Yadav, R., Haldar, R. (2022). Study the Physio-Chemical Properties of Clay Soil of Kandora Village of Jashpur District, Surguja Division of Chhattisgarh, India. EPRA International Journal of Research and Development (IJRD), 7(11), 87-91. [Web-link](1.%09https:/eprajournals.com/IJSR/article/9732)  [Researchget](https://www.researchgate.net/publication/365693096_STUDY_THE_PHYSIO-CHEMICAL_PROPERTIES_OF_CLAY_SOIL_OF_KANDORA_VILLAGE_OF_JASHPUR_DISTRICT_SURGUJA_DIVISION_OF_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9za)
18. Dewangan, S. K., Yadav, V., Sahu, K. (2022). Study the Physio-Chemical Properties of Black Soil of Bahora Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Research Journal of Modernization in Engineering Technology and Science, 04(11), 1962-1965. [Web-link](https://ijrpr.com/uploads/V3ISSUE11/IJRPR8037.pdf). [Researchget](https://www.researchgate.net/publication/365609873_International_Journal_of_Research_Publication_and_Reviews_Study_the_Physio-Chemical_Properties_of_Black_Soil_of_Bahora_Village_of_Jashpur_District_Surguja_Division_of_Chhattisgarh_India?_tp=eyJjb250ZXh0Ijp)
19. Dewangan, S.K., Kehri, D., Preeti . & Yadav, A.(2022). Study The Physico-Chemical Properties Of Brown Soil Of Gaura Village Of Surajpur District, Surguja Division Of Chhattisgarh, India. International Journal of Engineering Inventions,11(11),80-83. [Web-link](1.%09https:/www.ijeijournal.com/papers/Vol11-Issue11/11118083.pdf). [Researchget](https://www.researchgate.net/publication/365767912_Study_The_Physico-Chemical_Properties_Of_Brown_Soil_Of_Gaura_Village_Of_Surajpur_District_Surguja_Division_Of_Chhattisgarh_India?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoic2VhcmNoIiwicG9z)
20. Dewangana, S. K., Mahantb, M. (2023). Physical Characterization of Soil from BudhaBagicha Area, Balrampur, Chhattisgarh and its Comparative Study with Soils of Other Areas. International Journal of Science, Engineering and Technology, 11(6). [Web-link](1.%09https:/www.ijset.in/wp-content/uploads/IJSET_V11_issue6_600.pdf). [Researchget](https://www.researchgate.net/publication/376446637_Physical_characterization_of_Soil_from_BudhaBagicha_Area_Balrampur_Chhattisgarh_and_its_comparative_Study_with_Soils_of_Other_Areas?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoicHJvZmlsZSIsI)
21. Dewangana, S. K., Yadavb, N., & Preetic. (2023). A Study on the Physicochemical Properties of Soil of Butapani Area Located in Self-Flowing Water, Lundra Block, Surguja District, Chhattisgarh, India. EPRA International Journal of Research and Development (IJRD), 8(12). [Web-link](https://eprajournals.com/IJSR/article/11864/abstract). [Researchget](https://www.researchgate.net/publication/376447056_A_STUDY_ON_THE_PHYSICOCHEMICAL_PROPERTIES_OF_SOIL_OF_BUTAPANI_AREA_LOCATED_IN_SELF-FLOWING_WATER_LUNDRA_BLOCK_SURGUJA_DISTRICT_CHHATTISGARH_INDIA?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjo)
22. Lal, R. (2015). Restoring soil quality to mitigate soil degradation. Sustainability, 7(5), 5875-5895.
23. Prajapati, S., Singh, V., & Singh, S. (2019). Assessment of soil physicochemical properties in Korba district, Chhattisgarh. International Journal of Chemical Studies, 7(1), 281-286.
24. Singh, R., Kumar, A., & Sharma, S. (2015). Assessment of soil fertility and nutrient content in different locations of Chhattisgarh. Journal of Soil Science and Agricultural Engineering, 2(1), 32-37.
25. Verma, S., Tiwari, A., & Sahu, A. (2018). Physicochemical properties of soil in Surguja district, Chhattisgarh. International Journal of Current Microbiology and Applied Sciences, 7(11), 3884-3890.
26. Naveed, M., Moldrup, P., Arthur, E., de Jonge, L. W., & Vogel, H. J. (2018). Soil organic carbon content effects on soil water retention on the Loess Plateau, China: A review. Journal of Hydrology, 565, 607-617.
27. Qadir, M., Tubeileh, A., Akhtar, J., Larbi, A., & Minhas, P. S. (2008). Productivity enhancement of salt-affected environments through crop diversification. Land Degradation & Development, 19(4), 429-453.
28. Rhoades, J. D. (1996). Salinity: Electrical conductivity and total dissolved solids. Methods of Soil Analysis: Part 3 Chemical Methods, 417-435.
29. Rhoades, J. D., Chanduvi, F., & Lesch, S. M. (1999). Soil salinity assessment: methods and interpretation of electrical conductivity measurements. Food and Agriculture Organization of the United Nations.
30. Rhoades, J. D., Kandiah, A., & Mashali, A. M. (1992). The Use of Saline Waters for Crop Production. Food and Agriculture Organization of the United Nations.
31. Rillig, M. C., Aguilar-Trigueros, C. A., Bergmann, J., Verbruggen, E., Veresoglou, S. D., & Lehmann, A. (2015). Plant root and mycorrhizal fungal traits for understanding soil aggregation. New Phytologist, 205(4), 1385-1388.
32. Ryals, R., Hartman, M. D., Wooliver, R., Givens, K. P., Norris, C. E., & Paul, E. A. (2019). Long-term climate change mitigation potential with organic matter management on grasslands. Global Change Biology, 25(6), 1879-1892.
33. Shainberg, I., Sumner, M. E., & Miller, W. P. (1989). Cation exchange properties of irrigated soils: Weathered micas. Soil Science Society of America Journal, 53(6), 1616-1621.
34. Singh, N., Maurya, B. R., & Tripathi, R. (2019). Effect of different levels of soil salinity on growth, yield, and quality of tomato (Solanum lycopersicum L.). Journal of Plant Nutrition, 42(11-12), 1437-1446.