WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Comperative Study of Physical and Chemical Properties of Agriculture Soil in Raghunathpur Area, Mainpat And Ajirma of Surguja Division

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ABSTRACT

Soil quality is a key determinant of agricultural productivity, influencing both crop yield and sustainability. This study presents a comparative analysis of the physical and chemical characteristics of agricultural soil samples collected from three locations within the Surguja division of Chhattisgarh—Mainpat, Ajirma, and Raghunathpur. Parameters such as pH, electrical conductivity, organic carbon content, and the availability of essential macro and micronutrients were analyzed. Results revealed that all three locations exhibited moderately acidic soil pH, with varying levels of nutrient content. Raghunathpur soil displayed the lowest organic carbon and nitrogen content, indicating the need for significant organic supplementation. Mainpat soil had the highest nutrient balance, while Ajirma showed moderate deficiencies. Recommendations for soil amendments have been proposed based on observed limitations, including the use of compost, lime, and nutrient-specific fertilizers. This comparative evaluation aims to guide localized soil management practices and enhance sustainable agriculture in the region.

1. INTRODUCTION

Soil health plays a foundational role in determining the success and sustainability of agricultural systems. In India, where agriculture supports the livelihood of a significant portion of the population, maintaining optimal soil conditions is vital for both food security and economic growth. Soil fertility is governed by a range of physical and chemical properties, including pH, organic matter content, and the availability of macro and micronutrients. Deficiencies or imbalances in these properties can adversely affect crop health and yield.

The Surguja division in the state of Chhattisgarh comprises diverse agro-climatic regions, where agriculture remains the primary occupation. Crops such as rice, wheat, maize, pulses, and oilseeds are commonly cultivated. However, declining soil fertility due to continuous cropping, limited organic input, and insufficient soil testing has become a growing concern. In this context, understanding the current status of soil health through scientific evaluation is essential for informed soil management.

This study focuses on a comparative assessment of soil samples collected from three locations in Srguja—Ajirma (Surajpur district), Raghunathpur, and Mainpat (both in Surguja district). The analysis aims to identify variations in key soil parameters and suggest appropriate corrective measures. By highlighting the specific needs of each region, the research seeks to promote targeted soil improvement strategies and support sustainable agriculture in the Sarguja division.

2. METHODOLOGY

This study was conducted to evaluate the physical and chemical properties of agricultural soils collected from three different locations within the Sarguja division of Chhattisgarh: **Ajirma (Surajpur District)**, **Raghunathpur**, and **Mainpat** (both in Surguja District). The soil sampling and analysis were performed under the supervision of the **Bio Laboratory Demonstration and Training Center, Collectorate Complex, Ambikapur, Surguja (CG)**.

2.1 Sample Collection

Soil samples were collected in early May 2025:

- Ajirma – 05-04-2025
- Raghunathpur – 05-02-2025
- Mainpat – 05-05-2025

Each sample was collected from the top 15–20 cm of agricultural land used for growing common crops such as **rice, wheat, maize, pulses, and jute**

2.2 Soil Characteristics

The samples were categorized by **soil color**:

- Ajirma: Black soil
- Raghunathpur and Mainpat: Brown soil

2.3 Parameters Analyzed

The following physical and chemical parameters were analyzed:

- **pH @ 25°C**
- **Electrical Conductivity (EC)**
- **Organic Carbon (%)**
- **Macronutrients**: Available Nitrogen (N), Phosphorus (P), Potash (K)
- **Secondary Nutrients**: Calcium, Magnesium, Sulphate
- **Micronutrients**: Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn), Boron (B), Molybdenum (Mo)
- **Temperature**
- **Compost Requirement (TON)**

2.4 Analysis and Correction Criteria

Critical values and limits were defined based on standard agronomic guidelines. Corrections were suggested for each sample based on the deviation from optimal ranges, with recommendations expressed in **kg/ha** or **ton/ha**.

3. RESULTS AND DISCUSSION

This section presents a comparative analysis of the three soil samples based on tested parameters.

3.1 Soil pH and Conductivity

All three samples were found to be **moderately acidic**, with pH values below the optimal range (6.5–8.5):

- Ajirma: 5.92
- Raghunathpur: 5.65
- Mainpat: 6.48

This acidity may negatively affect nutrient availability and microbial activity. pH correction using lime or organic matter is recommended, with **Raghunathpur** needing the highest correction (755 kg/ha).

Electrical conductivity (EC), which indicates salinity, was within safe limits for all locations:

- Ajirma: 0.34 dS/m
- Raghunathpur: 0.18 dS/m (lowest)
- Mainpat: 0.48 dS/m

3.2 Organic Carbon and Nitrogen

- Organic carbon was lowest in **Raghunathpur** (0.31%) and highest in **Mainpat** (0.84%).
- Available nitrogen was also lowest in **Raghunathpur** (117 kg/ha), indicating **poor organic matter and nitrogen deficiency**.

Location	Organic Carbon (%)	Available Nitrogen (kg/ha)
Ajirma	0.39	145
Raghunathpur	0.31	117
Mainpat	0.84	302

Mainpat's values suggest **well-maintained organic content**, while Ajirma and Raghunathpur require organic amendments such as compost and green manure.

3.3 Phosphorus and Potash

- Available phosphorus was lowest in **Ajirma** (15 kg/ha), needing 70 kg/ha correction.
- Available potash was sufficient in all locations but highest in Ajirma (305 kg/ha), indicating potential for **potash leaching** in future.

3.4 Secondary Nutrients

Due to the absence of values for calcium and magnesium, the comparison is limited. Sulphate was only present in Mainpat (2 kg/ha), requiring minor correction.

3.5 Micronutrient Analysis

All three soils showed **adequate levels of micronutrients** when compared to critical thresholds:

Micronutrient	Critical Level	Ajirma	Raghunathpur	Mainpat
Zinc (Zn)	< 0.6 mg/kg	0.20	0.21	0.26

Copper (Cu)	< 0.2 mg/kg	0.13	0.14	0.10
Iron (Fe)	< 4.5 mg/kg	0.7	0.8	1.8
Manganese (Mn)	< 2.0 mg/kg	0.7	0.9	1.8
Boron (B)	< 0.5 mg/kg	0.9	0.8	1.0
Molybdenum (Mo)	< 0.2 mg/kg	0.8	0.9	0.9

Although all values are above critical limits, the levels of **copper and iron** are low and should be monitored periodically, especially in Ajirma and Raghunathpur.

3.6 Temperature and Compost Requirements

- Soil temperature was nearly the same across all locations (approx. 28.7°C–28.8°C).
- Compost recommendations:
    - Ajirma: 1.5 ton/ha
    - Raghunathpur: 1.5 ton/ha
    - Mainpat: 1.5 ton/ha

This suggests a need for **uniform organic enrichment** across all three areas.

4. RECOMMENDATIONS

Based on the comparative analysis of soil samples from Ajirma, Raghunathpur, and Mainpat, several region-specific and general soil management strategies are suggested to improve agricultural productivity:

4.1 Ajirma

- **pH Correction**: Apply 425 kg/ha lime or organic amendments to raise pH towards the optimal range (6.5–8.5).
- **Nitrogen Deficiency**: Apply 80 kg/ha nitrogen (urea-based or organic alternatives like green manure).
- **Phosphorus Addition**: Apply 70 kg/ha phosphorus-based fertilizers (e.g., SSP).
- **Organic Carbon Improvement**: Incorporate 1.5 ton/ha of compost or farmyard manure.
- **Micronutrient Monitoring**: Regular testing of copper and iron due to low initial levels.

4.2 Raghunathpur

- **Highest Priority for pH Correction**: Apply 755 kg/ha lime or similar agents.
- **Organic Carbon & Nitrogen Poor**: Apply 90 kg/ha nitrogen and 1.5 ton/ha compost to restore fertility.
- **Balanced Phosphorus and Potash Levels**: No major correction needed except for nitrogen.
- **Micro-nutrients Caution**: Iron and copper levels are marginally low, requiring periodic re-evaluation.

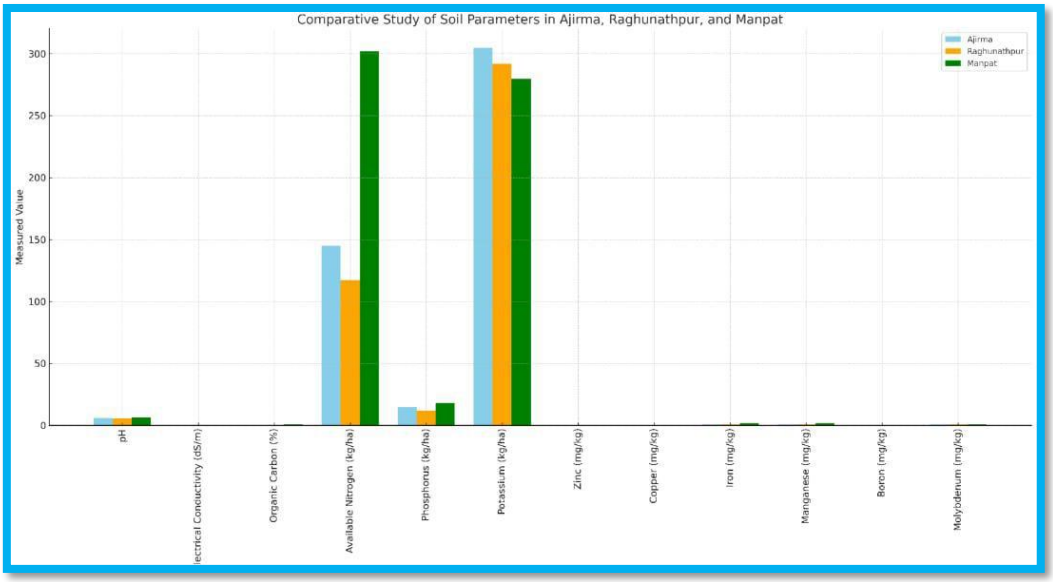
4.3 Mainpat

- **Relatively Balanced Soil**: Minor corrections required.
- **Nitrogen**: Apply 40 kg/ha to sustain levels.
- **Slight pH Correction**: Only 60 kg/ha amendment required.
- **Sulphate**: Add 2 kg/ha sulphur if necessary.
- **Organic Management**: Continue applying 1.5 ton/ha compost to maintain organic content.

Summary Table: Key Soil Parameters Comparison

Parameter	**Ajirma**	**Raghunathpur**	**Mainpat**	**Limit/Ideal Range**

pH	5.92	5.65	6.48	6.5–8.5
Electrical Conductivity (dS/m)	0.34	0.18	0.48	< 1.0
Organic Carbon (%)	0.39	0.31	0.84	0.50–0.75 (ideal)
Nitrogen (kg/ha)	145	117	302	280–560 (ideal)
Phosphorus (kg/ha)	15	24	40	12–24
Potash (kg/ha)	305	298	345	135–335
Zinc (mg/kg)	0.20	0.21	0.26	> 0.6
Copper (mg/kg)	0.13	0.14	0.10	> 0.2
Iron (mg/kg)	0.7	0.8	1.8	> 4.5
Manganese (mg/kg)	0.7	0.9	1.8	> 2.0
Boron (mg/kg)	0.9	0.8	1.0	> 0.5
Molybdenum (mg/kg)	0.8	0.9	0.9	> 0.2
Compost Recommendation (ton)	1.5	1.5	1.5	As per OC/N levels



General Recommendations

- Promote **integrated nutrient management** (INM) combining chemical, organic, and bio-fertilizers.
- Encourage **crop rotation** and **cover cropping** to naturally enhance soil structure and nutrient recycling.
- Conduct **seasonal soil testing** to monitor changes and guide precise input application.
- Raise farmer awareness on **soil pH correction** techniques and the importance of **micro- and secondary nutrients**.

5. CONCLUSION

This comparative study of agricultural soils from Ajirma, Raghunathpur, and Mainpat in the Sarguja division reveals significant variations in physical and chemical properties, particularly in terms of pH, organic carbon, and nitrogen content. While Mainpat exhibits relatively balanced fertility, Ajirma and especially Raghunathpur show clear signs of nutrient deficiency and acidity that require urgent corrective action. The study emphasizes the importance of localized soil management practices, including the use of lime for pH correction, organic amendments for carbon restoration, and balanced fertilization strategies.

The findings serve as a practical guide for farmers, agricultural officers, and policymakers aiming to enhance soil productivity and ensure sustainable farming in the region. Continuous monitoring, coupled with targeted interventions, can significantly improve the health of these soils and, by extension, the livelihoods of the communities that depend on them.

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