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STUDY THE IMPACT OF BIO-ENZYMES ON ENHANCING REGUR SOIL STRENGTH

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Abstract - *TerraZyme, an environmentally friendly liquid enzyme formulation derived from vegetable extracts, enhances various soil engineering properties, including workability and stability. It achieves this by catalyzing reactions between clay and organic cations, which accelerates the cation exchange process, leading to a reduction in the thickness of adsorbed layers. In a study, black cotton soil and red earth treated with TerraZyme underwent strength testing over a period of 7 to 60 days. The effectiveness of curing methods was validated through indices and compressibility assessments. Soil specimens, both stabilized and unstabilized, were subjected to air-dry and desiccator curing, followed by examination for parameters such as unconfined compressive strength, California Bearing Ratio (CBR), consistency limits, compressibility, and swelling. Air-dry curing, simulating natural field conditions, notably improved the unconfined compressive strength (UCS) and CBR of TerraZyme-treated expansive and non-expansive soils. TerraZyme contributed to enhancing index properties of both soil types, with similar effects observed for air-dry and desiccator curing methods.*

Comparatively, air-dry curing demonstrated superior performance over desiccator curing in terms of compressibility and edoema. The tests concluded that air-dry curing is the most effective method for stabilizing expansive and non-expansive soils treated with TerraZyme. The study also assessed the cost-effectiveness of air-dry and desiccator curing methods for stabilizing TerraZyme-modified soil.

Key Words: Terazyme, Black cotton soil, Soil improvement, Soil enzymatic activity, Soil amendment, Soil structure.

1.INTRODUCTION

Black cotton soil, commonly encountered in tropical and subtropical regions, presents formidable obstacles to agricultural productivity due to its distinct characteristics such as high clay content, limited nutrient availability, inadequate drainage, and susceptibility to erosion. In regions dominated by this soil type, establishing sustainable agricultural practices is imperative for ensuring food security and fostering economic growth. Various methods have been explored to address the challenges posed by black cotton soil, aiming to boost its fertility, structure, and overall suitability for crop cultivation. Among these methods, the utilization of enzymatic soil additives has emerged as a promising approach to alleviate the constraints associated with black cotton soil. Terazyme, a commercially available enzymatic product, has demonstrated potential in enhancing soil properties through its enzymatic action, which aids in organic matter decomposition, nutrient liberation, and improvement of soil structure. Nonetheless, the precise impacts of Terazyme on black cotton soil warrant further investigation. This research paper presents a comprehensive investigative study aimed at evaluating the effects of Terazyme on the enhancement of black cotton soil. Through controlled experiments and field trials, this study endeavors to assess the influence of Terazyme application on various soil parameters, encompassing nutrient availability, soil structure, microbial activity, and ultimately, crop yield. By conducting meticulous experimentation and analysis, this study aims to provide valuable insights into the efficacy of Terazyme as a soil amendment for black cotton soil, potentially paving the way for sustainable agricultural practices in regions characterized by this soil type. The outcomes of this study hold the promise of significantly contributing to the existing body of knowledge in soil science and agricultural sustainability. Moreover, the practical implications of utilizing Terazyme for enhancing black cotton soil could yield substantial benefits for farmers, agronomists, and policymakers, offering a viable strategy for improving agricultural productivity and resilience in regions where black cotton soil prevails.

Figure-01: Black Cotton Soil.

1.1.Main Component of Regur Soil

Black cotton soil, also known as regur soil, is primarily comprised of clay minerals, notably montmorillonite and

smectite. These soils are abundant in regions characterized by a semi-arid to sub-humid climate, including areas of India, Africa, and Australia. Renowned for their fertility, regur soils possess excellent moisture retention capabilities, rendering them ideal for agricultural purposes, particularly for crops such as cotton. Nevertheless, their propensity to shrink and swell poses challenges, often resulting in structural issues for constructions erected upon them.

2.TERAZYME FOR BLACK COTTON SOIL

Terazyme stands out as a groundbreaking bio-enzyme formulation designed to enhance soil quality, especially in challenging environments like black cotton soil. This soil type, also known as vertisol, presents numerous obstacles to agriculture due to its high clay content and tendency to expand and contract with changes in moisture levels. These characteristics often result in poor soil structure, limited fertility, and diminished crop yields. Terazyme provides a targeted solution to these issues by leveraging enzymes sourced from natural origins.

The enzymes within Terazyme work in harmony to enhance soil structure, increase nutrient availability, and improve water retention capacity, thereby revolutionizing the productivity of black cotton soil. A key component of Terazyme is cellulase, an enzyme crucial for breaking down cellulose, the primary component of plant cell walls. In black cotton soil, cellulose breakdown is vital for promoting soil aggregation, reducing compaction, and facilitating root penetration. By improving soil structure, Terazyme enhances aeration and drainage, allowing plant roots to access nutrients and water more effectively. Terazyme contains amylase and protease enzymes, which target starches and proteins, respectively. These enzymes aid in the decomposition of organic matter, releasing essential nutrients like nitrogen, phosphorus, and potassium, essential for plant growth. By accelerating the breakdown of organic residues, Terazyme boosts nutrient availability in black cotton soil, fostering healthier plant development and higher yields.

Terazyme exhibits bio-stimulant properties, stimulating microbial activity within the soil. Beneficial microorganisms play a vital role in nutrient cycling and maintaining soil health. By creating a conducive environment for microbial growth, Terazyme enhances the overall biological activity of black cotton soil, further enriching its fertility and productivity.

The application of Terazyme is simple, typically involving mixing the formulation with water and applying it to the soil through irrigation or spraying. Regular use of Terazyme can lead to significant enhancements in soil quality over time, making it an invaluable tool for farmers and agronomists striving to maximize yields in black cotton soil environments.

Terazyme represents an innovative solution for boosting the productivity of black cotton soil. By harnessing the power of enzymes and bio-stimulants, Terazyme addresses the specific challenges associated with this soil type, promoting better soil structure, increased nutrient availability, and improved crop yields. In an era of mounting agricultural challenges, innovative products like Terazyme offer sustainable and effective strategies for optimizing soil health and ensuring food security.

Figure-02: Terazyme for Regur Soil.

3.BEARING CAPACITY OF THE REGUR SOIL

The bearing capacity of regur soil, like any soil type, relies on various factors such as moisture content, compaction, clay mineral composition, and soil structure. Typically, regur soil boasts a high bearing capacity owing to its clayey nature, offering robust support for structures erected upon it. However, it's essential to acknowledge that despite its strong bearing capacity, regur soil is prone to significant shrink-swell properties when subjected to fluctuations in moisture levels. This characteristic can pose structural challenges for buildings and infrastructure unless appropriate engineering techniques are implemented to mitigate these effects.

In practical terms, determining the bearing capacity of regur soil necessitates site-specific geotechnical investigations and analysis to ensure the secure design and construction of structures on such soil. Engineering interventions such as meticulous foundation design, moisture regulation, and soil stabilization may be indispensable to address the distinctive traits of regur soil and optimize its bearing capacity while minimizing potential hazards.

4.WORKING MECHANISM OF TERAZYME FOR REGUR SOIL.

Terazyme employs a comprehensive strategy to enhance the vitality and fertility of regur soil. Through its enzymatic composition, Terazyme initiates a series of biochemical reactions within the soil, breaking down complex organic matter into simpler compounds readily absorbed by plants. This enzymatic activity also plays a role in restructuring the soil by breaking apart clay aggregates, thereby improving aeration and drainage—critical factors for the healthy development of plant roots. Moreover, Terazyme introduces beneficial microorganisms to the soil, establishing symbiotic relationships with plant roots and facilitating nutrient uptake. By expediting the decomposition of organic matter, Terazyme stimulates the release of vital nutrients such as nitrogen, phosphorus, and potassium, crucial for optimal plant growth. Additionally, certain formulations of Terazyme may regulate soil pH, ensuring an environment conducive to plant health. In essence, Terazyme's holistic approach addresses the distinct challenges presented by regur soil, ultimately enhancing soil fertility and fostering thriving plant ecosystems.

4.1.PROPERTY OF REGUR SOIL

Renowned for its high clay content, regur soil boasts remarkable moisture retention capabilities, making it highly favorable for agriculture, especially during periods of low rainfall. This soil type is distinguished by its deep, dark hue, indicative of its abundant organic matter content and exceptional fertility. However, its clayey texture poses challenges such as inadequate drainage and a propensity to compact, potentially hindering root growth and water penetration. Despite these challenges, regur soil's nutrient-rich composition and moisture-retaining ability render it ideal for cultivating a variety of crops including cotton, cereals, pulses, and oilseeds. Additionally, its resilience against erosion enhances its suitability for sustainable farming practices. In summary, the unique combination of properties exhibited by regur soil underscores its importance in agriculture, shaping cultivation methods and land management approaches in regions where it prevails.

5.DOSAGES OF TERRAZYME

It is important to note that the actual dosage required may vary depending on factors such as the type of soil, the climate, the intended use of the soil, and the desired level of soil stabilization or improvement. We can also use quantity of Terraztme according to the requirement for the black cooton soil.

Table-1: Dosages of TerraZyme in BCS.

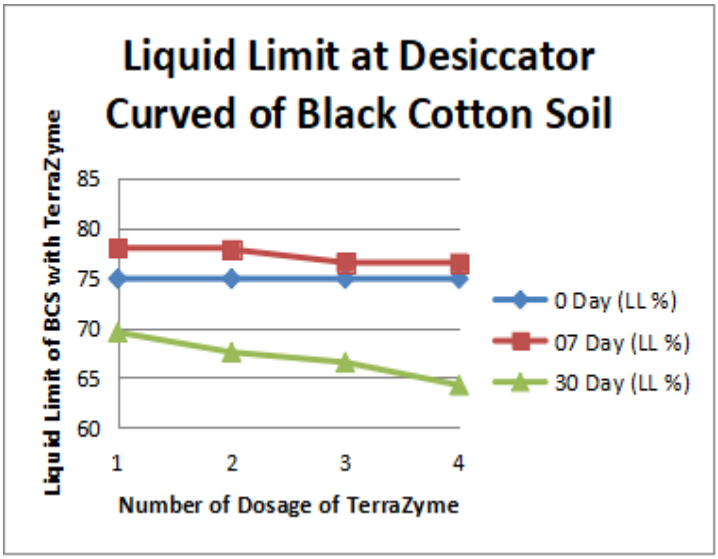
Serial Number	Dosage	200 ml/m³ of BCS.
1	D1	3.00
2	D2	2.50
3	D3	2.00
4	D4	1.50

6.RESULT AND ANALYSIS

In this sectio of the result and analysis, we will know the result which comes after the analysis of the black cotton soil with Terrazyme at different dosages such as D1, D2, D3, and D4. The limit, plastic limit, and Shrinkage limit of the soil, as also other results at different curing periods such as same day, 07, and 30 days are given below:

6.1.LIQUID LIMIT AT DESICCATOR CURVED OF REGUR SOIL

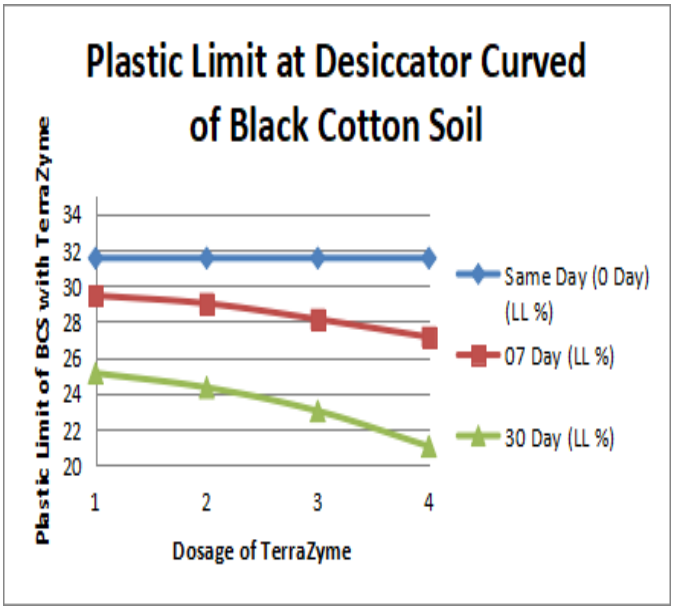
The liquid limit of black cotton soil can be determined using the desiccator method. The desiccator method involves drying a soil sample in a desiccator and monitoring its moisture content until it reaches the liquid limit.



Graph-1: Liquid Limit at Desiccator Curved of Regur Soil.

6.2.PLASTIC LIMIT AT DESICCATOR CURVED OF REGUR SOIL

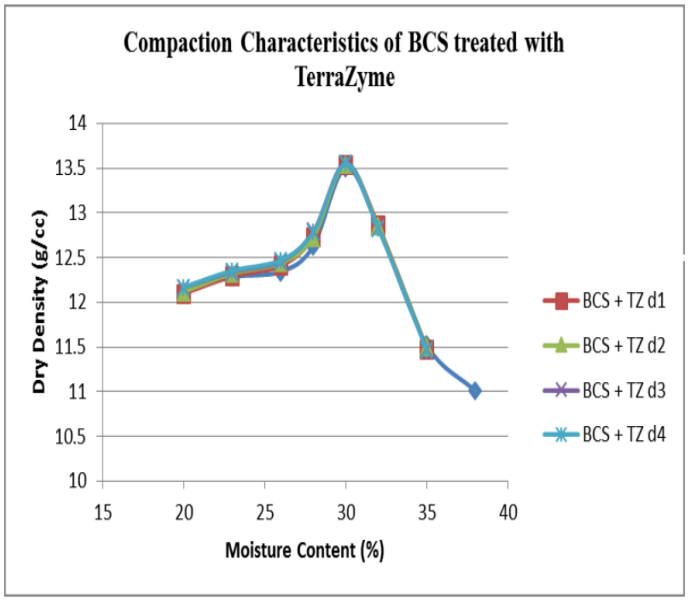
The plastic limit of black cotton soil can be determined using the desiccator method. The desiccator method involves drying a soil sample in a desiccator and monitoring its moisture content until it reaches the plastic limit.



Graph-2: Plastic Limit at Desiccator Curved of Regur Soil.

6.3.COMPACTION CHARACTERISTICS of REGUR SOIL

The Standard Proctor Test can also be used to determine the maximum dry density and optimum moisture content of Black Cotton Soil (BCS).



Graph-3: Standard Proctor Test of Regur Soil with TerraZyme.

7.CONCLUSION

TerraZyme's impact on the index and engineering properties of black cotton soil and red earth demonstrates its effectiveness in modifying the geotechnical characteristics of both expansive and non-expansive soils. The suitability of TerraZyme for soil remediation in field conditions was evaluated through air-dry curing and controlled laboratory desiccator curing.

The test results indicate that TerraZyme holds promise as a method for enhancing the engineering properties of black cotton soil. Following treatment with TerraZyme, the black cotton soil underwent drying and curing in a laboratory desiccator, resulting in a significant improvement in soil strength. Interestingly, the Atterberg Limits for black cotton soil did not affect either the drying process or the desiccator curing process. Subsequent testing revealed that the black cotton soil treated with TerraZyme had become hydrophobic after drying. In essence, TerraZyme shows potential for effectively altering the geotechnical properties of expansive and non-expansive soils, particularly black cotton soil, through various curing methods such as air-dry and desiccator curing.

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