Abstract

Index No. 23/18/Life Sc./25

Title: Isolation and characterization of Potassium Solubilizing Bacteria from Mica contaminated soil in Giridih District, development of biofertilizer and its efficacy in crop production

Submitted by: Saibal Ghosh

The state of Jharkhand is rich in mineral resources, including mica and several other minerals.In this study, the effects of long-term mica waste with potentially toxic elements (PTEs-Cr, Ni, Cd, Pb, Cu, and Zn) dumped near mines near agricultural land and water resources are examined, as well as their effects on soil ecosystems and human health.Heavy metals from the mica waste not only deteriorate the soil quality but also results in the uptake metals in crop. The present investigation was conducted to evaluate the effects of different fractions of metals on uptake in rice, soil microbial and biochemical properties in mica waste contaminated soils of Jharkhand, India. From each active mine, soil samples were randomly collected at distances of < 50 m (zone 1), 50-100 m (zone 2), and >100 m (zone 3).The Ni, Cr, Cd and Pb in rice grain were 0.83±0.41, 0.41±0.19, 0.21±0.14 and 0.17±0.08 mg kg^{-1} respectively.The rapid mining activities of mica mines in Giridih district, have led to toxic metal pollution of agricultural soil. This is a key concern for environmental risk and human health.The mean concentration of total and bio-available potentially toxic elements (PTEs - Cr, Ni, Pb, Cu, Zn, and Cd) was higher in zone 1 across three zones.The Positive matrix factorization model (PMF) and Pearson Correlation analysis were used to identify waste mica soils with PTEs. Based on PMF results, Ni, Cr, Cd, and Pb were the most promising pollutants and carried higher environmental risks than the other PTEs. Using the self-organizing map (SOM), zone 1 was identified as a high-potential source of PTEs.Monte Carlo simulations (MCS) model and sensitivity analysis of total carcinogenic risk (TCR), children were more affected by Cr and Ni than adults through ingestion exposure pathways.The wastes from mica mines have the potential to pollute the food chain, degrade the quality of the soil, and harm natural systems over time.

On the other hand, muscovite and biotite are two forms of waste mica, which is a K-bearing mineral that is a waste product of the mica industry; although, it is not recognized that mica contributes to crop production with K.Potassium (K) is an essential component of plant nutrients, performing biological functions to maintain plant growth and yield.To feed the ~ 1.3 billion people, excessive application of chemical fertilizers in India has a negative impact on both the economy and environmental sustainability. It is necessary to introduce sustainable agents that promote evergreen agriculture, such as potassium- solubilizing rhizobacteria (KSB).A total of 30 potassium solubilizing rhizosphere bacteria (KSB) isolates, were collected from different mica-contaminated agriculture fields of Giridih district. Based on K solubilizing capacity, we selected four KSB strains (*Bacillus cereus* K5B, *Bacillus cereus* K6, *Bacillus sp.*GG6 (2015) K12, and *Bacillus cereus* K15) for bio-fertilizer preparation and evaluated their efficiency as K fertilizers on tomatoes grown under Giridih soil (Alfisol).

Abhishek Mukherjee, Ph.D.
Associate Professor
Agricultural and Ecological Research Unit
INDIAN STATISTICAL INSTITUTE
New Barganda, Giridih - 815 301
Jharkhand, India

Signature of Supervisor (1)

Saibal Ghosh.
Signature of Student
12/12/2022

Pradip Bhattacharyya, Ph.D.
Associate Professor
Agricultural and Ecological Research Unit
Indian Statistical Institute
New Barganda, Giridih-815301
Jharkhand, India

Signature of Supervisor (2)