Isolation of Strains of Potassium-Mobilizing Bacteria (KMB) for Sustainable Agriculture

Uday Patil, Jeetendra Kumar, Hemant Borse and Shubham Sabban

Rinati Crop Protection PVT. Ltd. Solapur (MS) India

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ABSTRACT

Potassium-mobilizing bacteria (KMB) are beneficial soil microorganisms that increase potassium availability by mobilizing immobile K-containing minerals, such as mica, feldspar, and potassium alumina silicates, through the production of organic acids, protons, and chelating agents. KMB also secrete metabolites that can enhance nutrient cycling, stimulate root growth, and interact synergistically with other beneficial microbes in the rhizosphere. The Soil samples (S1–S4) from Chincholikati, Solapur were screened for potassium-solubilizing bacteria. Sample S3 exhibited the highest activity with a halo zone of 6.0 mm, categorized as high K-solubilizing activity. Samples S1 and S4 showed moderate activity, forming halo zones of 4.0–4.2 mm, while S2 displayed low activity with a halo zone of 3.5 mm. These results indicate variability among KMB isolates in their ability to mobilize potassium compounds. The halo zone measurements provide a simple and reliable quantitative assessment of KMB activity for selecting potential strains for soil application. Their activity improves potassium uptake by plants, enhances soil fertility, may reduce application of chemical potassium fertilizers, contributing to sustainable and eco-friendly agricultural practices.

Keywords- Microbes, Potassium fertilizer, Potassium Mobilizing Bacteria,

INTRODUCTION

Soil is wonderful gift of nature that promote crop growth with the help of microbes. Due to decrease in beneficial microbial population from agricultural soil most of nutrient get stored in soil. (Getahun et.al. 2020). That result in increased in soil electrical conductivity that results in decrease in crop yield. The soil in maharashrastra is reach with potassium. Availability of potassium is decrease day by day therefore there is need to search efficient microbial strain to mobilize immobilized potassium to crop plant Potassium plays a key role in enzyme activation, osmoregulation, and photosynthesis. Both mobile and immobile potassium compounds are applied as fertilizers, but a significant portion of applied potassium becomes fixed in soil minerals and remains unavailable to crop plants. (Gupta, et.al 2000). Potassium-mobilizing bacteria (KMB) are beneficial soil microorganisms that increase potassium availability by mobilizing immobile K-containing minerals, such as mica, feldspar, and potassium alumina silicates, through the production of organic acids, protons, and chelating agents (Gurav, et.al 2019). KMB also secrete metabolites that can enhance nutrient cycling, stimulate root growth, and interact synergistically with other beneficial microbes in the rhizosphere. Their activity improves potassium uptake by plants, enhances soil fertility and reduces reliance on chemical potassium fertilizers, contributing to sustainable and eco-friendly agricultural practices (Pal, A.K. and Rout, K.K. (2009). Considering the importance of potassium in agriculture Rinati crop protection pvt. Ltd undertake a research program to isolate the local efficient strain from soil. The Isolation, characterization, and application of KMB from various soils provide a promising approach to optimize nutrient management and improve crop productivity.

MATERIALS AND METHODS

Sample Collection and isolation of KMB

Standard isolation methods were followed taking specimens randomly without any prior knowledge of the microbial composition at the source under investigation (Donaldio et al., 2002).

The rhizosphere soil samples were processed in the laboratory and microorganisms were isolated in-vitro in Aleksandrov's medium. Enumerations ofheterotrophic bacteria were conducted through serial dilution method and spread plate technique.

Sample Preparation and Extraction

Soil samples (S1–S4) collected from Chincholikati, Solapur, were processed to isolate indigenous microbial populations. For each sample, 10 g of soil was suspended in 50 ml of phosphate-buffered saline (10 mM K_2HPO_4–KH_2PO_4, 0.15 M NaCl, pH 7.2. To ensure thorough liberation of microbes from the soil matrix, the suspensions were agitated on a rotary shaker at 120 rpm for 45 minutes. (Donaldio et.al .2002)

Isolation and Screening

The resulting supernatants were subjected to serial dilution and inoculated onto PSB-selective agar medium. The plates were incubated at 28 °C and monitored over a period of 3–7 days. Microbial isolates demonstrating functional phosphate solubilization were identified by the formation of distinct halo zones (clearance zones) surrounding the colonies.

Purification and Preservation

Positive isolates were subcultured onto nutrient agar plates to ensure morphological purity. Once purified, the cultures were cryopreserved in 70% glycerol at −8 °C for long-term storage and use in subsequent experimental phases.

Screening and Quantitative Analysis of KMB from Soil Samples S1–S4

Soil samples (S1–S4) from Chincholikati, Solapur, were processed to isolate indigenous Potash Mobilizing Bacteria (KMB). Ten-gram aliquots of each sample were suspended in phosphate-buffered saline and subjected to serial dilution. To identify potassium-mobilizing potential, aliquots were inoculated into Aleksandrov's broth containing insoluble aluminosilicate (mica) as the sole potassium source. The cultures were incubated at 28 °C for 7 days with continuous agitation. Isolates demonstrating the ability to release soluble potassium into the medium were identified as KMB-positive.

RESULT

Quantitative Results of Potassium-Solubilizing Bacteria (KMB) from Soil Samples

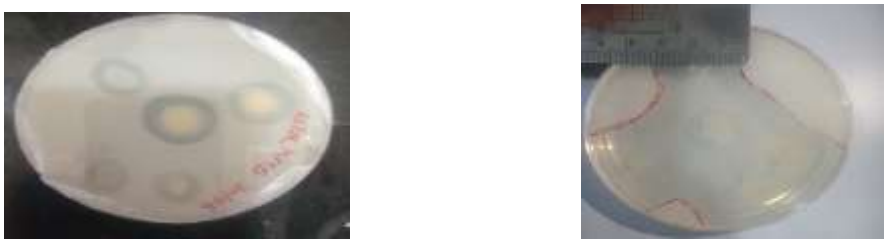
Sample ID	Location	KMB-Positive Colonies in (mm)	Halo Zone Diameter (mm)	K Solubilization Activity
S1	Chincholikati, Solapur	4	4.2 ± 0.3	Moderate
S2	Chincholikati, Solapur	3	3.5 ± 0.2	Low
S3	**Chincholikati, Solapur**	**6**	**6.0 ± 0.4**	**High**
S4	Chincholikati, Solapur	3	4.0 ± 0.2	Moderate

Screening and Quantification of Potassium-Mobilizing Bacteria (KMB) from S1–S4 Soil Samples

Soil samples (S1–S4) from Chincholikati, Solapur were suspended in potassium-buffered saline and serially diluted. Aliquots were inoculated into Aleksandrov's or modified Aleksandrov's broth containing insoluble

potassium minerals such as mica or feldspar as the sole K source. Cultures were incubated at 28 °C for 7 days with continuous shaking, and isolates that increased soluble potassium in the medium were considered.

Photo Plate :- Potassium Mobilizing Actovity of Isolated Strains



(a) (b)

Fig – (a) Zone of Inhibition S3 KMB on aleksandrow plate (48hrs)

(b) Zone of Inhibition S3 KMB on aleksandrow plate (96hrs)

KMB positive. The cell density of KMB-positive cultures was determined by serial dilution and plate counts, with sample S3 showing the highest density (8.2×10^8 CFU/ml)**,** S1 and S4 showing moderate densities ($5.5–6.0 \times 10^8$ CFU/ml), and S2 the lowest (3.8×10^8 CFU/ml). All KMB-positive isolates were subsequently purified on nutrient agar to obtain pure cultures. Purified isolates were preserved in 70% glycerol at −80 °C for further characterization and application in potassium solubilization studies.

Colony Forming Unit (CFU) Count for Potassium Mobilizing Bacteria

Sample ID	**KMB-Positive Colonies**	**Cell Density (CFU/ml)**	**Activity Level**
S1	4	5.5×10^8	Moderate
S2	3	3.8×10^8	Low
S3	**6**	**8.2×10^8**	**High**
S4	3	6.0×10^8	Moderate

Sample S3 has the highest potassium-mobilizing ability, followed by S1 and S4 with moderate activity, while S2 has the lowest activity.

CONCLUSION

Soil samples (S1–S4) from Chincholikati, Solapur were screened for potassium-solubilizing bacteria. The KMB isolates were evaluated on solid media for halo zone formation around colonies as an indicator of K solubilization. Sample S3 exhibited the highest activity with a halo zone of 6.0 mm, categorized as high K-solubilizing activity. Samples S1 and S4 showed moderate activity, forming halo zones of 4.0–4.2 mm, while S2 displayed low activity with a halo zone of 3.5 mm. These results indicate variability among KMB isolates in their ability to solubilize insoluble potassium compounds. The halo zone measurements provide a simple and reliable quantitative assessment of KMB activity for selecting potential strains for soil application.

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