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POTASSIUM SOLUBILIZATION BY BACTERIAL STRAIN IN WASTE MICA

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Abstract

The release of K from waste mica (muscovite and biotite) was tested with 4 K-solubilizing isolates collected from maize rhizosphere, for 7, 14 and 21 days of incubation at 28 ± 2°C. K-solubilization by different bacterial isolates showed significant change on muscovite and biotite powder supplemented plates and the amount of K released varied from 1.28 - 46.75 µg/ml. The soluble K contents in all isolated treatments were significantly higher than control. Herein, isolate KSB_2 had higher K-solubilization ability when compared with other isolates (KSB_1, KSB_3 and KSB_4) *in vitro.*

Average soil reserves of K are generally large, but most of it is not plant-available. Therefore, crops need to be supplied with soluble K fertilizers, the demand of which is expected to increase significantly, particularly in developing regions of the world (Meena *et al.,* 2013). Recent investigations have shown that organic exudates of some bacteria play a key role in releasing otherwise unavailable K from K-bearing minerals (Zob *et al.,* 2013). K-solubilization could be attributed to excreting organic acids which either directly dissolves rock K or chelate silicon ions to bring K into solution (Prajapati *et al.* 2013). Therefore, in this study, K-solubilizers isolated from maize rhizosphere were tested for their solubilizing ability from muscovite and biotite minerals.

Waste mica a potassium-bearing mineral, obtained from the surroundings of mica mines located at Koderma district of Jharkhand, India. It is a by-product of mica industry (Table 1). Serially diluted samples were plated on Aleksandrov medium containing (per l) 5 g glucose, 0.005 g $MgSO_4.7H_2O$, 0.1 g $Fe Cl_3$, 2.0g $Ca CO_3$, 3.0 Mica as a potassium mineral (2.0 g in original media), 2.0 g calcium phosphate and 20 g agar-agar Aleksandrov media (Sugumaran and Janartham 2007) to isolate the potassium solubilizing bacteria.

At 7 DAI maximum K-solubilization from muscovite by KSB_2 with 2 and 1 mm particle size (5.68 and 6.38 µg/ml, respectively) and this isolate was significantly at par with KSB_3. At 14 DAI maximum K-solubilizing capacity 15.05 and 28.50 µg/ml (KSB_3) with 2 and 1 mm, respectively. This isolate was significantly superior to all others isolates. The lowest value measured in control. However, at 21 DAI maximum K-solubilizing capacity (17.28 and 39.50 µg/ml with KSB_2) was recorded in the both particle size of mica (Fig. 1). Similar finding were also reported by Archana *et al.* (2013). KSB isolates produced organic acids that influenced mica and feldspar dissolution either by decreasing pH, forming frame work-destabilizing surface complexes, or by complexing metals in solution (Zhang *et al.* 2013). Maximum K-solubilization at 7, 14 and 21 DAI was observed with KSB_2. Similar inference was reported by (Archana *et al.* 2012). Solubilization generally increases with days of incubation, ranging from 1.28 to 46.75 µg/ml at 21st day of incubation (Fig. 2) and was maximum in all the isolates. This may be due to strong acidic conditions resulting from the metabolic processes (Liu *et al.* 2006).

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Table 1. Elemental composition (%) of biotite and muscovite.

Minerals	Si_2O_3	Fe_2O_3	K	MgO	Na_2O	MnO	P
Biotite	38.42	16.24	9.70	11.94	0.24	0.41	0.019
Muscovite	45.10	2.54	9.82	0.61	0.37	Traces	0.022

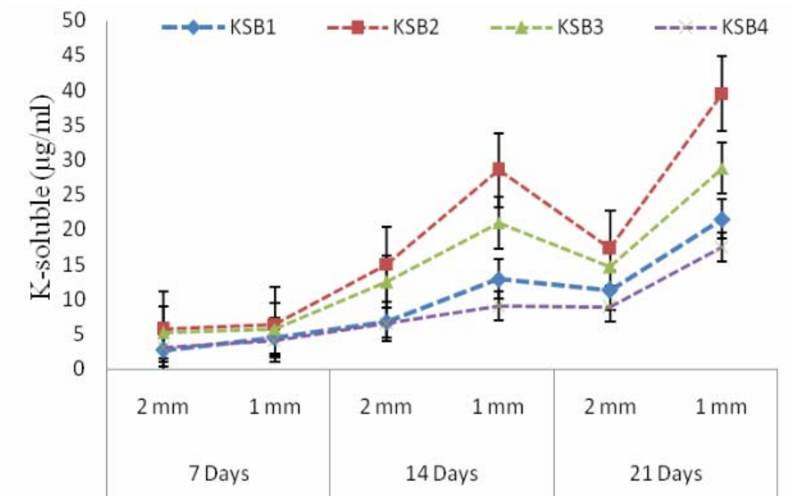

Fig. 1. Effect of inoculation periods and particle size of biotite on K-release by bacterial K-solubilizers.

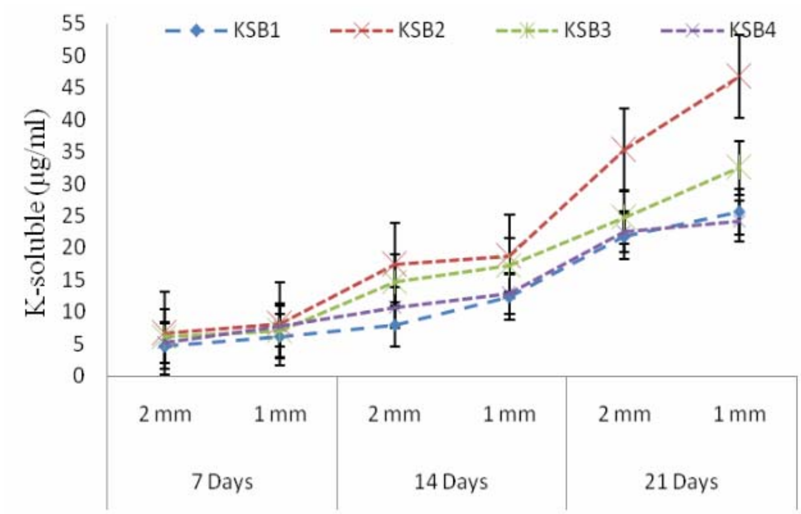

Fig. 2. Effect of inoculation periods and particle size of muscovite on K-release by bacterial K-solubilizers.

The results obtained from the current study concerning isolation, screening, and characterization of thirty isolates of KSB from Inceptisol revealed that KSB_2 can potentially enhance the dissolution of muscovite and biotite. Therefore, when used as K-biofertilizers, some of the isolates might contribute to K supply of crops with a high K demand. Strain showed that higher potential of K-solubilization with biotite in comparison to muscovite and rapid release of K occurred from 1 mm size particle in comparison to 2 mm.

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