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Potassium Ions Release from Mica by Organic Acids Present in Potassium Solubilizing Bacteria

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Abstract

Plants require a variety of life-building ingredients to grow properly and optimally. Plants that lack essential nutrients are unable to reach their full potential, have lesser yields, and are more susceptible to diseases. The primary macronutrients are nitrogen (N), phosphorus (P), and potassium (K), which are the three most critical nutrients without which plants wouldn't survive. Fertilizers must be added to K-depleted soil to produce a feasible soil environment for plant growth. Chemical K fertilizers are costly and cause soil pollution. Bio-fertilizers gaining popularity because of their low harmful effects. In Sri Lanka, new ways of producing Bio K-fertilizer are convenient in the field of agriculture. Phlogopite mica is a natural mineral that contains K as a major component (7.22% of mass as K_2O) that can be used as the source of Bio-K fertilizer production. In this research, the solubilization of phlogopite mica (sample was obtained from Matale district, Sri Lanka) by major types of organic acids which are mainly released from bacteria was determined. In this study special attention was paid to the following main factors: Type of organic acids (Citric, Oxalic, Succinic and Tartaric acid), Acid concentrations (0.01 M, 0.02 M, 0.03 M, 0.04 M, and 0.05 M), Effect of ground mica particle sizes (0.300 mm-0.150 mm and <0.150 mm), the effect of time on solubilization in three shaking time intervals (1 hour, 2.5 hours, 4 hours) the indicated solubilization patterns and pH changes were observed. The current findings show that Citric acid is the most efficient K solubilizer because at 0.04 M, citric releases the 17.00 mg/L of K whereas the lowest value of released K 2.33 mg/L was observed for oxalic acid which is determined by Flame Photometer using 50.00 mg/L of standard K^+ solution. Therefore, Citric acid has a significant potential for the solubilization of K in mica. When particle size increases, the rate of solubilization appears to decrease with each acid. Also, when shaking time was increased the amount of soluble K released has been increased. Future studies of this research will be extended to find and isolation of citric acid-releasing bacteria for solubilizing mica to produce K Biofertilizer to improve soil fertility thereby increasing the crop yield in Sri Lanka.

Keywords: Phlogopite mica, Bioconversion, Bio-fertilizers, Chemical K-fertilizers