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**Kemampuan Pelarutan Kalsium Karbonat oleh Empat Spesies Bacillus**
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# KEMAMPUAN PELARUTAN KALSIUM KARBONAT OLEH EMPAT SPESIES *Bacillus*

## INTISARI

Ketersediaan kalsium dan unsur hara lainnya pada lahan berkapur relatif rendah, sehingga diperlukan pendekatan biologis untuk meningkatkan kecukupan hara bagi tanaman. *Calsium Solubilizing-Bacteria* (CSB) merupakan kelompok bakteri yang berpotensi membantu meningkatkan ketersediaan hara melalui aktivitas pelarutan mineral dan karakter fungsional lainnya. Penelitian ini bertujuan untuk mengetahui potensi *Bacillus cereus* BK.06, *Bacillus proteolyticus* BK.07, *Bacillus albus* TAB.07, dan *Bacillus subtilis* TB.04 dalam mendukung pertumbuhan tanaman serta mengetahui pengaruh faktor lingkungan biotik dan abiotik terhadap pertumbuhannya. Pengujian potensi dilakukan melalui uji pelarutan kalsium, fosfat, kalium, penambatan nitrogen, produksi IAA, serta antagonisme terhadap patogen tanaman *Fusarium oxysporum*. Pengaruh lingkungan diuji melalui interaksi antar strain bakteri serta variasi sumber karbon, suhu, pH, salinitas, dan kebutuhan oksigen. Hasil penelitian menunjukkan bahwa seluruh isolat mampu melarutkan kalsium dengan konsentrasi Ca terlarut antara 14.44–80.94 mg/L, serta berkemampuan dalam melarutkan fosfat, menambat nitrogen, dan memproduksi IAA. Keempat strain tidak menghambat pertumbuhan patogen *F. oxysporum*. Pertumbuhan tiap strain dipengaruhi oleh sumber karbon, suhu, pH, salinitas, dan ketersediaan oksigen dengan tanggapan yang berbeda. Hasil-hasil tersebut menunjukkan bahwa keempat strain memiliki potensi sebagai bakteri pendukung pertumbuhan tanaman dengan karakter fungsional dan toleransi lingkungan yang berbeda antar strain.

Kata kunci: *Bacillus, Calcium Solubilizing Bacteria,* Fiksasi $N_2$, IAA

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# THE CAPABILITY OF CALCIUM SOLUBILIZATION BY FOUR SPECIES OF *Bacillus*

## ABSTRACT

The availability of calcium and other nutrients in calcareous soils is relatively low, necessitating a biological approach to improve nutrient sufficiency for plants. Calcium-solubilizing bacteria (CSB) are a group of bacteria with the potential to improve nutrient availability through mineral solubilization and other functional traits. This study aimed to evaluate the potential of *Bacillus cereus* BK.06, *Bacillus proteolyticus* BK.07, *Bacillus albus* TAB.07, and *Bacillus subtilis* TB.04 in promoting plant growth, as well as to examine the influence of biotic and abiotic environmental factors on their growth. The potential of these strains was assessed through tests for calcium, phosphate, and potassium solubilization, nitrogen fixation, indole-3-acetic acid (IAA) production, and antagonism against the plant pathogen *Fusarium oxysporum*. Environmental influences were evaluated by observing interactions between bacterial strains and their responses to variations in carbon sources, temperature, pH, salinity, and oxygen requirements. The results indicate that all isolates were capable of solubilizing calcium, with dissolved Ca concentrations ranging from 14.44 to 80.94 mg/L. They also demonstrated the ability to solubilize phosphate, fix nitrogen, and produce IAA. None of the four strains inhibited the growth of the pathogen *F. oxysporum*. The growth of each strain was influenced with varying responses by carbon sources, temperature, pH, salinity, and oxygen availability. These findings suggest that all four strains possess potential as plant growth-promoting bacteria, each exhibiting distinct functional traits and environmental tolerances.

Keywords: *Bacillus, Calcium-Solubilizing Bacteria*, IAA, $N_2$ fixation