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Assessment of Ca, Mg, and K nutrition in cotton through the base cation saturation ratio approach in southern Turkey

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Abstract

Soil nutrient balance is a critical factor for ensuring optimal plant nutrition, yet fertilization strategies based solely on individual nutrient concentrations often overlook interactions among elements. This study evaluated cotton nutrition in the Ceyhan and Asagi Seyhan Plains of the Adana region, one of Türkiye's major cotton-producing areas, using the Base Cation Saturation Ratio (BCSR) approach. In this context, soil and cotton leaf samples were collected from 98 agricultural fields representing the region. The exchangeable concentrations of calcium (Ca), magnesium (Mg), and potassium (K) were determined in soil samples, while the foliar concentrations of these elements were measured in cotton plants. Soil analyses revealed elevated Ca and Mg levels, whereas K remained comparatively low. Accordingly, the mean soil cation ratios were 38.39 for Ca/K, 10.24 for Mg/K, and 4.14 for Ca/Mg, indicating a pronounced imbalance in the soil cation composition relative to the ideal cation balance. Foliar analyses revealed a significant negative correlation between K concentration and both Ca and Mg, whereas plant Ca and Mg concentrations were positively correlated. Principal component analysis (PCA) further supported these relationships, showing positive loadings of plant Ca and Mg and negative loadings of K on the first principal component. Spatial distribution maps confirmed that areas with elevated soil Ca/K and Mg/K ratios were associated with reduced foliar K concentrations. Moreover, concurrent increases in soil Ca and Mg were found to intensify potassium deficiency in cotton plants. Overall, the results demonstrate that elevated Ca and Mg levels in soils and plant tissues are closely linked to reduced K nutrition in cotton across both plains. These findings emphasize the importance of incorporating cation balance and nutrient interactions into soil fertility assessments to avoid underestimation of potassium limitations.

Keywords: foliar analysis, potassium deficiency, nutrient interaction, soil balancing, spatial distribution maps

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