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Potassium Exchange Isotherms as a Plant Availability Index in Selected Calcareous Soils of Western Azarbaijan Province, Iran

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Abstract: Potassium (K) exchange isotherms (quantity-intensity technique, Q/I) and K values derived from the Q-I relationship provide information about soil K availability. This investigation was conducted to study the relationships among K Q/I parameters, available K extracted by 1 N NH_4AOc (exchangeable K plus solution K), potassium saturation percentage (K-index, %), and the properties of 6 different calcareous agricultural soils. In addition, the relationship of tomato plant yield response to the K requirement test based on K exchange isotherms was investigated. The Q/I parameters included readily exchangeable K (ΔK^0), specific K sites (K_X), linear potential buffering capacity (PBC^K), and energy of exchange of K (E_K). The results of X-ray diffraction analysis of the oriented clay fractions indicated that some mixed clay mineral, some chlorite/illite clay minerals, along with palygorskite and kaolinite were present in the soils. The soil solution K activity ratio at equilibrium (AR^0) ranged from 0.0014 to 0.028 $(moles\ l^{-1})^{0.5}$. The readily exchangeable K (ΔK^0) was between 0.044 and 2.5 $(cmol_c\ kg^{-1}$ soil), which represented an average of 51% of the exchangeable K (K_{ex}). There was a significantly positive relationship between ΔK^0 and NH_4AOc-extractable K ($r = 98$, $P < 0.001$). The soils showed high capacities to maintain the potential of K against depletion, as they represented very high linear potential buffering capacities (PBC^K) [44-177 $cmol\ kg^{-1}/(mol\ l^{-1})^{0.5}$. The E_K values for the check treatments ranged from -2736 to -4117 calories M^{-1}, and, for the treatments in which 120 mg K l^{-1} was added, varied between -2193 and -2657 calories M^{-1}. The percentage of K saturation (K-index, %) ranged from 3.8% to 10.2%. Analysis of variance of the dry matter (DM), K concentrations, and K uptake of tomato plants indicated that there were no significant differences ($P < 0.05$) among the adjusted levels of K as determined by the exchange-isotherm curve.

Key Words: Readily exchangeable K, specific K sites, buffering capacity, energy of exchange, K-index, availability

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