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Estimation of Non-Linear Water Uptake Parameter using Genetic Algorithm for Sodic Soils

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In the plant water soil system, water plays a vital part in controlling the plant's growth. The plant fulfils its water demand from the soil water through root uptake. The pattern of water uptake by the plant through roots depends on the root geometry and the root density, which varies non-linearly with the depth. To quantify this non-linearity, it is essential to precisely determine the parameter accounting for this non-linearity in the water uptake. Moreover, it has also been observed in the literature that sodicity alters the root growth and thence the density. The current study is about identifying non-linear root water uptake parameter utilizing the Genetic Algorithm (GA) technique in Sodic soils. Different models have been proposed to predict root water uptake by the plants. The non-Linear nature of root water uptake has been confirmed from previous studies and observations. The non-linear root water uptake model named as O-R (Ojha and Rai, 1996) model combined with soil moisture flow or Richard's equation is developed to determine the pattern of root water uptake by the plants. Non-linear parameter β is incorporated in the O-R model to account for non-linearity in the uptake. In the current study, parameter β is determined through inverse modelling utilizing GA optimization procedure. For parameter optimization, the difference between model-predicted and experimentally observed percentage soil moisture depletion is minimized for soils of different salinity classes. To check the viability of the developed model, the optimization procedure is validated from hypothetically generated percentage soil moisture depletion corresponding to an assumed β value and salt concentration in the soil. This study considers the wheat crop (Triticum) to apply this model and estimate the non-linear root water uptake parameter β . The results obtained show that the linked simulation-optimization model based on GA procedure precisely determines the non-linear root water uptake parameter for the Wheat crop considered. Since Different crops follow different non-linear water uptake patterns and hence, have different values of β . Thus, an accurate estimation of β is necessary to analyze the root water uptake and plan the irrigation scheduling strategies for modern agriculture.