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Evaluation of CropSyst Model for Simulating Green Area Index, Soil Water and Yield of Psyllium in Hyper Arid Partially Irrigated Zone of Rajasthan

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Abstract: Cropping systems model (CropSyst) was calibrated using the experimental data of crop parameters, soil profile data and observed daily weather data of experimental site for 2012-13 and validated the experimental data of crop growth, yield parameters and soil moisture for 2013-14 for psyllium crop grown at farmer's field in IGNP stage-II of Bikaner. The results of the present study showed that the CropSyst model calibrated seed yield, above ground biomass and soil moisture reasonably well. The simulated seed yield of psyllium (429 kg ha^{-1}) matched well with the observed yield (462 kg ha^{-1}) with relative error of 7.1%. The observed above ground biomass (AGB) at harvest (1085 kg ha^{-1}) also matched with simulated AGB (997 kg ha^{-1}) with relative error of 8.1%. During validation of the model during 2013-14, prediction of simulated seed yield (597 kg ha^{-1}) was very good and matched well with the observed seed yield (557 kg ha^{-1}) with relative errors of 7.3%. However, the simulated AGB (1894 kg ha^{-1}) of psyllium was over predicted as compared to observed AGB (1395 kg ha^{-1}) with relative errors of 35.8%. The simulated green area index (GAI) was not properly captured by the model. The simulated N-uptake (34.0 kg ha^{-1}) was moderately higher than observed N-uptake (26.0 kg ha^{-1}). Simulated soil moisture was well predicted and excellent matched with observed values in most of the layers. About half of total water applied lost by deep drainage with water productivity of 0.17 kg m^{-3}.

Key words: CropSyst model, calibration, validation, psyllium, IGNP stage-II.

Water is one of the most critical inputs to agriculture. However, the level of water use differs significantly across regions, farming systems, canal command areas and even farm plots (Molden *et al.*, 2001, 2003). Globally, agriculture accounts for 80-90% of all freshwater withdrawals by humans and most of it is used for food production (Shiklomanov, 2000; Wallace, 2000; Morison *et al.*, 2008). Still, water is the main factor of abiotic stress limiting crop production in several regions of the world (Araus *et al.*, 2002; Ali and Talukder, 2008). It is projected that 47% of the world population will be living in areas of high water stress by 2030 (WWAP, 2009). Even where water for irrigation is currently plentiful, there are increasing concerns about future availability (Falkenmark, 1997). Since it is hardly possible to withdraw more water from natural resources, future food production must focus on the improvement of crop water productivity i.e. 'more crop per drop' (IWMI, 2000) and crop diversification. Indira Gandhi Nahar Pariyojana (IGNP) is considered as the life line of *Thar* Desert. It occupies the north-western and far western parts of the Thar Desert in Rajasthan through its expansion in stage I and stage-II. The stage-I is almost stabilized but stage-II is still in quasi-equilibrium with respect to choice of crops and management practices. At present, the crops grown in IGNP stage-II are high water requiring and farmers use excess irrigation for growing the crops. Hence, technological interventions are required to improve water productivity of the area by promoting low water requiring, high value crops with efficient water management practices.

Simulation models are an important tool to understand soil-plant interactions on water balance components and their effects on yield and water productivity. The use of crop simulation models to evaluate crop responses to a wide range of management and

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