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Estimation of Evapotranspiration in Mustard Using Campbell Diez Model

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Abstract

Evapotranspiration is most important component of water balance study, which is greatly influenced by environmental condition. It is measured by direct method through lysimeter or indirectly through empirical methods. Keeping in view of the importance of evapotranspiration, a field experiment was conducted in mustard crop during *rabi* seasons of 1999—2000 and 2000—01 in sandy loam soil. The study reveals that the simulated daily evapotranspiration by Campbell Diez Model follows the similar trends as observed evapotranspiration. Significant correlation was found between simulated and observed evapotranspiration with r = 0.86 during the crop season of 1999—2000. The relationship between simulated and observed evapotranspiration was found linear as Y = 0.79 + 0.85 X (simulated Et) with coefficient of determination (R^2 = 0.72).

Key words : Evapotranspiration, Mustard, Campbell Diez Model.

Crop consumptive water use is the amount of water transpired by the plants plus the water evaporated from the soil plus the fraction of water held by the plant tissue. The amount of water retained by plant metabolic activity is about 1% of the overall water taken up by the plants.Thus in practical term crop water consumption corresponds to crop evapotraspiration, which is important parameter is to be considered while planning and scheduling irrigation to improve the effectiveness of irrigation. According to Rosenberg et al. (1) the evapotranspiration (Et) is an important parameters related to crop production, due to its largely successful application of irrigation water as per actual requirement of the crop. Evapotranspiration is the main requirement which needs to be estimated on a scientific basis so that the required amount of water can be applied to the crop at the proper time, taking into the account the effective rainfall and irrigation efficiency. Most of the crop simulation models, GROWIT by Smith and Lowever (2), SPAW by Saxton et al. (3), Campbell and Diez (4), CERES-Wheat by Godwin et al. (5), use the information generated in a water balance model to estimate crop dry matter and yield. In the present study Campbell and Diez (4) model has been used to estimate the evapotranspiration in mustard crop under recommended agronomic package and practices in kandi belt of Jammu.

Methods

Campbell and Diez (4) model was written in BASIC computer program which is used empirical or mechanistic sub-model of the component of the soil water budget using daily maximum temperature, minimum temperature and rainfall data as input weather parameters. In this model the run off was calculated following Stewart et al. (6). In this model soil water contents at field capacity, permant wilting point and air dryness were assumed to be 0.25, 0.09 and .02, respectively. The maximum rooting depth and initial biomass were assumed as 1.0 meter and 0.003 kg/m^2, respectively. Average daily extinction cofficient was taken 0.7. To test the model lysimeters studies were

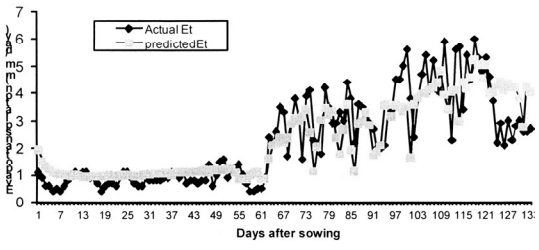

Figure 1. Variation in daily simulated and observed evapotranspiration (mm/day) in mustard during 1999-2000.

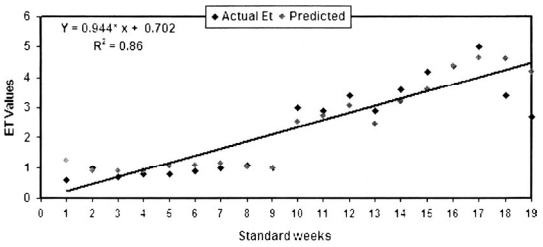

Figure 2. Scatter plot of observed and simulated evapotranspiration (mm) from mustard during (1999-2000).

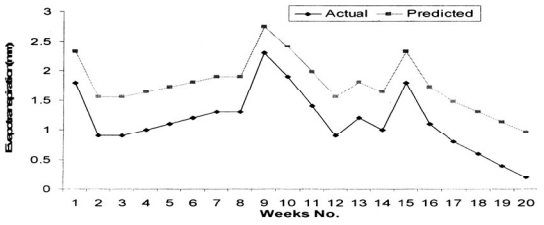

Figure 3. Weekly variation in simulated and observed evapotraspiration (mm) during 2000-01.

conducted on mustard (cv pusa bahar) at Dryland Agriculture Research Sub-Station, Dhiansar ($32^0 39'$ N latitude, $74^0 58'$ E longitude at an altitude of 332 m above mean sea level) during rabi seasons of 1999-2000 and 2000-01. This station represents the Kandi belts of Jammu region. The climate of station is influenced by southwest monsoon during *kharif* season and western disturbance in *rabi.* The soil of the farm is sandy loam in texture with slightly low retension capacity.

Results and Discussion

The daily estimate of evapotranspiration by summing up of transpiration from plants and evaporation from the soil estimated by Campbell Diez model is depicted graphically in Figure 1. The model simulated the daily evapotranspiration during 1999-2000 gave lower values, but it followed similar trend as actual evapotranspiration.

Significant correlation between the observed and simulated evapotranspiration were found with *r* value 0.85. The regression equation developed between observed and simulated is as follows.

$$Y = 0.79 + 0.85 \text{ x simulated Et} \text{———} R^2 = 0.72$$

The relationship developed between observed and simulated on weekly basis is depicted in Figure 2.

Testing of Model

The model was tested during 2000-2001 in mustard crop and it was found that the model over estimate evaporanspiration, however it followed similar trends on weekly basis and depicted graphically in figure 3. RMSF calculated were found 2.76 between simulated and observed value.

Conclusion

Inspite of under and over estimating values, the model can be used for water budgetary for mustard crop by developing some coefficients to made correlation in simulated values for accurate estimation of evapotanspiration.

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