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Short Communication

Comparative study of estimated and simulated reference evapotranspiration of black gram and wheat crops in mollisol of Uttrakhand

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Evapotranspiration is the combination of soil evaporation and crop transpiration. Weather parameters, crop characters, management and environmental factors affect evapotranspiration. Reference evapotranspiration (ET_0) is an important agrometeorological parameter for climatological and hydrological studies. The reference evapotranspiration concept has been gaining significant acceptance by scientists throughout the world since its introduction. ET_0 can also be estimated from pan evaporation. Pans have proved their practical value and have been used successfully to estimate ET_0 by observing the water loss from the pan and using empirical coefficients to relate pan evaporation (FAO-24 pan method). The rate of evapotranspiration is usually expressed in millimetres per unit time. Estimates of evapotranspiration from cropped land surfaces are vital for agricultural water management. ET_0 values estimated or calculated at different locations or in different seasons are comparable as they refer to the evapotranspiration from the same reference surface. ET_0 is an agro-climatic parameter and can be computed form the weather data. ET_0 express evaporating power of the atmosphere at specific location and time (Allen *et. al.,* 1989*)*. Through crop models, it became possible to simulate a living plant through the mathematical and conceptual relationship which governs its growth in the soil atmospheric continuum (Thornley 1976). Crop models can help researchers, policymakers, and farmers to make correct decisions on crop management practices, and also for marketing strategies and food security of a country with a deterministic view on the import-export market.

Pantnagar is situated at Tarai belt, foothills of the Shivalic range of Himalayas at 29°1'N, latitude, 79.28°E longitude and at an altitude of 215.00 m above the mean sea level. The climate of Pantnagar is temperate with severe cold winter and hot summer. Generally, the monsoon sets around the third week of June and last up to September end. Regarding spatial variability annual rainfall varies between 1200-1500mm and distribution over 55 to 60 rainy days.

Estimation of reference ET through USWB pan evaporation (FAO-24 pan method)

Pan evaporation data were used to estimate reference evapotranspiration (ET_0).

Reference evapotranspiration obtained by the application of FAO-24 pan method from the following equation:

$$ET_0 = Kp \cdot Epan$$

where ET_0 = reference evapotranspiration (mm day^{-1}),

kp = pan coefficient,

Epan = pan evaporation (mm day^{-1}).

Values of the pan coefficient for the class A pan are presented in Allen *et al.* (1997).

CERES wheat and CROPGRO urd model (DSSAT model v4.5) were used in this study for assessment of ET_0. The model requires a set of minimum data pertaining to daily weather, soil genotype characters and crop management details. These data are provided to the model through different data file. The data base included all relevant information including the different management practices adopted, location specific soil and weather conditions obtained from field experiment conducted during *kharif* and *rabi* seasons at N.E. Borlaug, Crop Research Center, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttrakhand. In the present study replicated data of 2007-08 and 2008-09 of wheat and blackgram were used in the model calibration and validation processes. In the present study replicated data were used in the model calibration and validation process.

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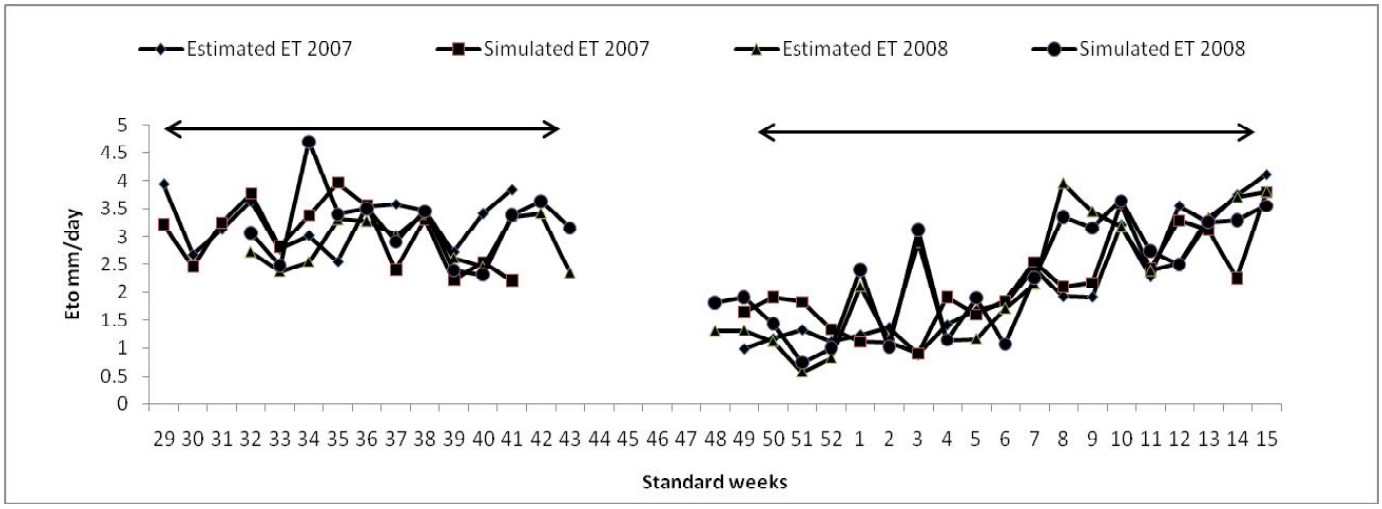

Fig.1. Comparison of estimated and simulated reference evapotranspiration (ET_0) for black gram and wheat (mm day^{-1})

Urd (*Vigna mungo* L. Hepper) variety Pant Urd- 31 and Wheat *(Triticum aestivum* L.) UP-2565 were used in this study.

Simulated and estimated ETo in blackgram

Urd crop were sown on 7 July, 2007 and 20 July, 2008, the observations of plant height and number of leaves were recorded at different weeks after sowing. The crop took 40-45 days for anthesis. Flowering occurred during last week of August. Average crop duration was 89. The average daily rate of ET_0 estimated by DSSAT model (3.06 mm day^{-1}) was slightly less than in comparison to estimated rate of ET_0 (3.20 mm day^{-1}) in 2007 while in 2008 simulated ET_0 (3.10 mm day^{-1}) was less than the estimated ET_0 (3.90 mm day^{-1}). The DSSAT underestimated ET_0 for black gram crop. The weekly values of estimated ET_0 were in between 2.55 to 3.94 mm day^{-1} while the simulated ET_0 values oscillated between 2.40 to 3.77 mm. Estimated ET_0 in 2008 ranged between 2.35 to 3.41 mm day^{-1} while the simulated values ranged between 2.32 to 4.7 mm day^{-1} (Fig.1.).

Simulated and estimated Eto in wheat

Wheat crop were sown on 18 November, 2007 and 1 November 2008, nitrogen were applied in two split doses. The crop took 70-73 days for jointing stage. Flowering occurred mostly in the last week of February. The average crop duration was 144 days. The average daily rate of ET_0 estimated by DSSAT model (2.03 mm day^{-1}) was more in comparison to estimated rate of ET_0 (1.96 mm day^{-1}) in 2007 while in 2008 simulated ET_0 (2.19 mm day^{-1}) was slightly more than the estimated ET_0 (2.10 mm day^{-1}) for wheat crop. The ET_0 values was recorded comparatively less at starting stage, while as the crop got maximum vegetative stages the values showing a high rate of ET_0. These results are in the close agreement with the findings of Fedrico *et al.* (2004). Weekly ranges of estimated ET_0 in 2007 were 0.99 to 4.11 mm day^{-1} while the simulated ET_0 oscillated between 1.09 to 3.78 mm day^{-1}. The estimated ET_0 in 2008 ranged between 0.58 to 3.96 mm day^{-1} while the simulated ET_0 values ranged between 1.0 to 3.55 mm day^{-1}. Zhang *et al.* (2002) observed that the theoretical relationship of evaporation fraction is highly correlated to soil water content. Thus the study revealed that the DSSAT model would be a use tool for estimation of reference evapotranspiration (Fig.1.).

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