ABSTRACT

The reported study was undertaken to evaluate the various existing evapotranspiration estimation methods, to determine the crop coefficient of potato crop grown on sandy loam soil in a subtropical sub-humid region and to formulate efficient strategies for the irrigation water management.

Daily reference crop evapotranspiration (ET_o) was measured with a weighing type lysimeter. Ryegrass was used as the reference crop for observing the actual ET. Ten climatological methods such as: Penman, FAO-Penman, FAO-Corrected-Penman, 1982-Kimberley-Penman, Penman-Monteith, Turc-Radiation, Priestley-Taylor, FAO-Radiation, Hargreaves and FAO-Blaney-Criddle were selected for estimating reference crop evapotranspiration on a daily basis. The Penman-Monteith equation gave the best results followed by 1982-Kimberly-Penman, FAO-Penman, Turc-Radiation and FAO-Blaney-Criddle on the basis of root mean square error.

Field experiments were also conducted on potato crop cultivar *Kufri-Jyoti*, at the same location, during the winter seasons of 1995-96 through 1998-99. Five irrigation treatments were maintained based on the maximum allowable depletion (MAD) of available soil water (ASW). The treatments were 10% (T_1), 30% (T_2), 45% (T_3), 60% (T_4) and 75% (T_5) maximum allowable depletion of ASW.

Crop coefficients (K_c) were estimated for potato crop at different stages of growth, at the same location, based on lysimeter measured actual ET and the reference crop evapotranspiration estimated by various methods. The measured values of crop coefficient for potato crop at four stages of growth such as: initial, crop development, reproductive and maturity were 0.42, 0.85, 1.27 and 0.57 respectively. The K_c value at the maturity stage was found to be higher than the corresponding FAO recommended K_c value.

The SUBSTOR-Potato model was used to simulate the potato crop growth. The calibrated model performed well in simulating various yield parameters of potato crop and soil water balance. However, it overestimated the crop ET. The simulated cumulative crop ET was found to be always higher than the measured cumulative crop ET throughout the crop season. A relationship between the measured cumulative crop ET and simulated cumulative crop ET was described by the Gaussian equation.

In order to assess the depth and time variation of soil moisture under different scheduling of irrigation, soil moisture was measured periodically in 15-30, 30-45, 45-60 and 60-90 cm soil profiles using a neutron probe, while the soil moisture in 0-15 cm soil profile was determined by gravimetric method. It was observed that the plants did not extract much soil moisture from 30-45 and 45-60 cm soil profiles. Therefore, it was recommended that only 0-30 cm of soil profile is to be considered for scheduling of irrigation for potato crop grown in sandy loam soils in the subtropical regions. The sensitivity analysis revealed that the soil moisture content in the root zone at the time of sowing should not be less than 70% of available soil water.

The crop water use efficiency (Crop-WUE) and field water use efficiency (Field-WUE) of the potato crop were found to be the highest when irrigation was scheduled at 45% depletion of ASW. Weather data of 20 crop seasons (1975-95) were used for the risk analysis through multiple year simulation. The crop yield was found to be higher at higher levels of risk. A sharp decline was observed with the decrease in risk levels below 50% for all crop parameters and treatments. It was therefore recommended that under water scarcity conditions, plant extractable soil water depletion more than 45% of ASW must be avoided even during the non-critical stages of the potato crop grown in medium sandy loam soils in subtropical regions.

Keywords: Potato, Evapotranspiration, Crop coefficient, Lysimeter, Water balance, SUBSTOR-Potato, Water use efficiency.