ABSTRACT

Precise information of microclimate variation in the greenhouse and application of optimum amount of water and nutrients to plants are crucial for enhancing crop production under the greenhouse. The present study aims to establish crop coefficient, irrigation and fertigation requirement of two varieties of Dutch rose crop (First red and Gold strike) under Greenhouse. The influence of cladding materials (UV stabilized diffused and clear poly films) on the microclimate in the greenhouse was investigated during all three seasons of the year 2011 to 2016. Simulation of greenhouse microclimate was done using Artificial Neural Network (ANN) model for prediction of greenhouse temperature and relative humidity. The inputs for model were maximum and minimum temperature (T), and relative humidity (RH) of greenhouse, outside average wind speed (WS) and solar radiation (RS). A greenhouse was designed using SAP2000 software and developed for year round cultivation of Dutch rose crop.

Microclimate in the greenhouse cladded with diffused film was found to be always favorable in comparison to that of greenhouse cladded with clear film. Diffused film cladded greenhouse observed 3 to 3.5 °C, 2 to 5 °C and 3 to 4 °C lesser air temperature than that of the greenhouse cladded with clear film during winter, summer and rainy seasons, respectively. The ANN model architecture 6-4-2 resulted in the best suited network architecture for prediction of inside mean temperature and relative humidity of greenhouse (R^2 = 0.980 & 0.967, RMSE = 0.711 ^oC & 2.514%, respectively for temperature and relative humidity). The Dutch rose crop evapotranspiration (ET_C) grown in the greenhouse was observed to be between 1.42 mm day^{-1} and 4.99 mm day^{-1} , which was always lesser than the open field (1.87 mm day^{-1} to 5.44 mm day^{-1}) cultivation. Total annual water requirement of rose plant was found as 1000.5 mm and 1237.0 mm under greenhouse and open field conditions, respectively. The average crop coefficient (K_C) for Dutch rose was 0.53 during initial stage ($K_{C\ In}$), 0.72 for development stage ($K_{C\ Dev}$), 0.92 for middle stage ($K_{C\ Mid}$) and 0.86 for late season ($K_{C\ Late}$) under greenhouse condition. The corresponding average K_C values were 0.59($K_{C\ In}$), 0.77($K_{C\ Dev}$), 0.97($K_{C\ Mid}$) and 0.89($K_{C\ Late}$) for open field condition. Fertigation of 120% of recommended dose of fertilizer application to Gold strike variety resulted in maximum number of shoots per plant (18), root length (43.8 cm), LAI (3.1) and number of flowers per m^2 per year (310). The maximum wind load acting on the wall of modified greenhouse of 100 m^2 floor area was obtained as 144.35 kN and (-)97.95 kN on the windward and leeward side of the wall, respectively. However, maximum wind load on the roof of the modified greenhouse is (-)164.97 kN. The outer diameter and thickness of side column is 60 mm and 2.5 mm, respectively and corresponding values for middle columns are 48 mm and 2.5 mm, respectively. The hoops, beams and trusses of 42 mm outer diameter with 2.0 mm thickness are adequate to bear the total load. Modified greenhouse maintained favorable microclimate for rose cultivation throughout the year.

Keywords: *Dutch rose, greenhouse, clear and diffused film, greenhouse microclimate, ANN, crop coefficient, crop water requirement, drip fertigation, fertilizer use efficiency, economic evaluation, wind load estimation, SAP2000, greenhouse design*