VALIDATION AND COMPARISON OF A PHYSICAL AND A STATISTICAL DYNAMIC CLIMATIC MODEL FOR A MEDITERRANEAN GREENHOUSE IN PORTUGAL

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Keywords: protected cultivation, modelling, climate, tomato, computer simulation, time series models, non-stationarity, non-linear estimation, forecast evaluation

Abstract

This study is based on the experiments with a tomato crop, carried out in a Mediterranean unheated greenhouse, located at Lisbon. The main objective is to study the comparative performance of a physical and a statistical model to explain and forecast the dynamic of the greenhouse climate, validating their results.
External and internal climatic data as well as information on the evolution of the crop were collected during the growing season. Several days in different months were chosen to validate the models and to simulate the environmental conditions inside the greenhouse, based on the climatic external data and parameters related with the growing medium, the covering material and the crop.
In the physical model, basically quasi-one-dimensional and single layer, the greenhouse is divided in process and boundary components. This model, developed in Spain, has been used and improved for the conditions of the greenhouse climate in Lisbon. Results show that the model can be used to predict the internal air temperature and relative humidity.
The statistical dynamic model was developed for predicting the internal air temperature and relative humidity of the greenhouse. The system is analysed with one hour time steps, by means of spectral and time series methods. The procedure develops sequentially the steps of statistical identification of the variables, the analysis of the dynamic relations between them, and the estimation of multiple transfer function models. To discriminate the different behaviour of the greenhouse climate between diurnal and nocturnal periods, intervention analysis was used. In spite of the high number of parameters, the model allows to give a good explanation and prediction of the dynamic of the system. The study reveals an important relationship between the internal air temperature and the solar radiation, the external air temperature and the ventilation rate.
Comparison of the measured and simulated data shows that the models predict internal conditions reasonably well. However, as it was expected, some adjustments are still necessary to improve the agreement.

1. Introduction

During the last years several models have been developed to predict internal environmental conditions based on external climatic characteristics, crop and greenhouse characteristics. However, most of them were developed and validated for northern