EVALUATION OF A COOLING SYSTEM FOR GREENHOUSE

By

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B.Sc. Agric. Sc. (Agricultural Engineering), Faculty of Agriculture, Ain Shams University, 2012

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ABSTRACT

Amina Ahmed Mohamed Soliman: Evaluation of A Cooling System for Greenhouse. Unpublished M.Sc. thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2019.

This research aims to study the effect of using the cooling and ventilation system on the production and quality of lettuce and mint crops in autumn and winter season. Two poly-greenhouse models were constructed at the Agricultural Engineering Research Institute (AEnRI) , Al-Giza Governorate, Egypt (Latitude of 30.02˚ and longitude of 31.13˚). One of them was equipped with photovoltaic (pv) system to feed electrical load of greenhouse as cooling and ventilation control system (treatment) to control, the maximum and minimum temperature to control the interior climate and the other was a traditional greenhouse (control). The plants were planted in a greenhouse under an hydropinic system. Results of the experimental work shows that the specific approach of cooling and mechanical ventilation for lettuce and mint crop production enhances the rate of growth and increasing the fresh lettuce and mint yield by 52.88% and 49.91%, respectively comparing with control greenhouse.

Key words: Greenhouse, Evaporative cooling, Fan and pad cooling, Ventilation, Relative humidity, PV system, NFT system, crops lettuce and mint.

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INTRODUCTION

The greenhouse techniques are considered among the most important solutions of agriculture intensification. Due to the huge increase of Egyption population and its limited agricultural area, vertical-expansion of agricultural production is necessary. The main purpose of a greenhouse is to improve the environmental conditions in which plants are grown. Greenhouses are usually equipped with some environmental modification devices such as cooling, ventilation and heating systems. Ventilation can remove excess heat, increase air mixing, and reduce temperature stratification in the greenhouse **(Kumar., et al 2009)**. During autumn, in Egypt, ventilation alone is not enough to maintain optimum interior temperature. Therefore, water evaporative cooling systems and fans are usually used to reduce the interior air temperature to an acceptable level. The cooling of these systems is commonly accomplished by using an electrically driven fan, pad **(Marcel., et al 2006)**. The function of the fan and pad is to prevent greenhouse overheating and cool the plants during hot weather. Whereas, the function of the shading technique is to reduce the amount of solar thermal radiation and penetrates only the sunlight that is necessary for growing of plants. Therefore, to electrify the previously mentioned cooling equipment's that are used in remote area greenhouses it is necessary to use a well-designed stand-alone photovoltaic (PV) system. The main objective of this research is to introduce a proposed greenhouse cooling system, which uses a stand-alone PV system to feed the electrical load of the greenhouse. At the same time, it introduces the complete sizing procedure of the greenhouse PV system. This will enable Egypt to face the increase in foods, in addition to increase the yield product per unit area of land.

Generally, Climate control is of great importance for greenhouse production in order to achieve high yield and good quality crops that meet the demands of consumers, as well as for economical production. Temperature and relative humidity (RH) are two basic climatic

parameters usually controlled by cooling and ventilation equipment. It is more difficult to control RH than temperature because relative humidity not only relies on air exchange from the infiltration and ventilation, but also related to evaporation from growing media and transpiration of the plants. **(Gao 2012)**

Therefore, the present research is aimed to develop, construct, and test an experimental greenhouse that will be equipped with cooling and ventilation control system to maintain optimum growing environment for Lettuce and mint growth during summer and winter seasons through the following specific objective:-

1- Connecting the greenhouse to an adequate cooling system.

2- Supplying the designed system with environmental instruments to control the interior climate for plant growth under environmentally controlled high-yield conditions as well as offering an opportunity to reduce the electrical energy consumption.

3- Investigating the effect of adequate mechanical ventilation to adjust the relative humidity of air inside the constructed greenhouse.

4- Comparing the productivity of the designed system with a traditional greenhouse that has the same shape, dimensions, cover, and orientation with natural ventilation.

5- Evaluate the costs of the cooling process.