

ORIGINAL ARTICLE

Impact of Foggy Cooling on the Greenhouse Microclimate

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ABSTRACT

A study was carried out to investigate the impact of water spraying via nozzles (foggy cooling) on the cooling efficiency of greenhouses using evaporative cooling systems. Two 9 m × 35 m greenhouses, equipped with a cooling pads system (evaporative cooling), were selected for this study. One of the two greenhouses was equipped with an additional set of six spray nozzles distributed along the greenhouse with a separation distance of 5 m. Readings of air temperature and relative humidity (RH) were recorded at three different locations within the greenhouses (at 0.5m from the pads, at the center of the greenhouse and at 0.5m from the suction fans). Observations were recorded at three heights, namely, 30 cm, 60 cm and 100cm. The spray nozzles produced a good homogeneity in temperature across the greenhouse where they were fixed, with a mean temperature difference between the high and low values of 2.4°C, compared to 5.5°C in the greenhouse without the spray nozzles. The mean RH of 72% was observed in the spray nozzle-equipped greenhouse compared to a value of 63% in that without the spray nozzles. Results also indicated that the mean cooling efficiency of the standalone pads system was 63%, compared to 70% with the additional foggy cooling system. This demonstrates the ability of the spray nozzles to significantly improve the greenhouse microclimate.

Keywords: Greenhouse, evaporative cooling, spray nozzles, foggy cooling

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INTRODUCTION

Greenhouse cultivation is one of the best modern agricultural practices aiming at increasing agricultural production and improving the quality of the final product. Greenhouse technology have become necessary to overcome environmental problems, specially under arid regions of high temperatures and low relative humidity during summer. In general, greenhouses protect the plants against the changes of temperature, wind and rain [1].

By controlling the most important environmental factors for plant growth (e.g. temperature and relative humidity), the importance of greenhouses is to create an environment suitable for plant growth (especially vegetables and ornamental plants) during any season of the year, thus achieving the maximum possible return per unit area [2].

To overcome the problems of high temperature during the summer months, cooling has become the most vital requirement for the greenhouse plants. The development of an appropriate cooling system that provides the optimal climate for crop growth is a difficult task as the design is closely related to local environmental conditions. In addition, selection of an appropriate cooling system depends mainly on the cultivated crop, repair and maintenance, simplicity and economic feasibility of the system [3].

With the increasing demand for agricultural products such as vegetables (tomato, potato, etc.), the need has become urgent for their off-season production. Several attempts have been made in this regard, including the use of different types of evaporative cooling pads, to reduce the temperature and alter the relative humidity in greenhouses. However, their performance was not critically evaluated [4]. Evaporative cooling devices are highly efficient in arid regions during warmer times of the year [5]. The high efficiency of these devices in desert areas is due to the ability of hot and dry air to evaporate the