

Investigation of Climate Control Techniques in Lowland Greenhouses of Malaysia

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Successful greenhouse production depends on growers providing a suitable environment for the plants. The efficiency of greenhouse production in lowland Malaysia is reported to be low (Hawa Jafar, 2005) mainly due to the inefficiency of current greenhouse technology. Investigation of some major greenhouse sites in lowland Malaysia (MARDI, Seremban and UPT) showed that technologies from western countries are imported and widely utilized without being modified to be efficient for an environment where relative humidity in some particular days is over 90% with ambient temperature equal to 38 to 40°C. Air conditioners which have been successfully utilized in residential buildings in tropical climates could not be recommended as an alternative method due to the very high cost of operation and investment.

The low efficiency and failure of such systems was first confirmed mathematically. Considering limitations and respecting the potentials of tropical lowland environments, a ventilation system combined with a modified evaporative cooling technique was designed and automated. Instead of temperature and relative humidity alone, the vapor pressure deficit (VPD) was applied as the control parameter since it has been reported to better reflect plant response. In addition, swamp coolers were introduced as an alternative for pad-and-fan and misting systems which were both expensive and of very low efficiency. Several considerations such as a dehumidification method had to be applied for the swamp cooler. To validate the performance of this modified evaporative cooling technique, an automation system with a closed loop on/off control algorithm was designed and installed on a lab scale greenhouse especially made for this purpose. The results showed significant difference between the mean of the VPDs resulted from the modified swamp cooling system and the custom evaporative cooling. It is concluded that the simple structure of this system, in addition to lower costs of energy consumptions and investments, maximizes the potential use of the natural environment and reduces the cost of greenhouse production in tropical lowland Malaysia.

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