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DEVELOPMENT OF A NOVEL VEGETABLE FARMING CHAMBER UTILIZING ZERO-WATER COOLING AND NATURAL LIGHTING

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Typical greenhouses are based on collecting maximum amount of light and eventually maximum heat accumulate inside and enormous cooling power is needed to optimize the microclimate especially under middle Eastern dry hot environment. Fadel et al (2013) have concluded that the water used in greenhouse cooling equals the amount of water consumed in the irrigation of organic tomatoes under UAE local conditions. Since the climatic conditions of this part of the world comprise an excessive amount of light and heat most of the year, a novel growth room is developed and tested under local conditions utilizing ground heating/cooling effect where the GHE was laid at 2.5 m depth. To eliminate using precious water in microclimatic cooling, the concept focused on blocking both light and heat where the growth room was made of insulated 10 cm thick sandwich panel equipped with two large automatically controlled windows to allow ambient air and light in when the surrounding conditions are within the set range of both temperature and humidity levels. A fuzzy logic controller was designed to control linear actuators to open the windows and in-line cooling fans to draw air into the growth room. To minimize energy consumption, natural light is collected using a sun tracking solar collector and transmit sunlight via fibre optics cables into the room while if the light is not enough additional LED is used and controlled by the Arduino microcontroller. Results showed that the controller can maintain the greenhouse temperature on most days of the year utilizing the combination of partially closed windows and cooling fans with zero water cooling at all. However, in summer the controller was working in pre-cooling mode and further cooling unit is needed to reduce the greenhouse temperature by about 6.8 ˚C amplitude on average compared to 10.8 ˚C when the GHE is not utilized.

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