

## Impact of innovative Solar Heating Systems on Greenhouse Microclimates: A Case Study with Zucchini (Cucurbita pepo)

**Authors :** Ilham Ihoume, Rachid Tadili, Nora Arbaoui

**Abstract :** Recent innovations in economical heating systems have significantly boosted agricultural production by effectively managing temperature drops in greenhouse microclimates. These advancements enhance product profitability in terms of quality, quantity, and growth duration. This study experimentally investigates the impact of a solar heating system on the microclimate of an agricultural greenhouse, focusing on zucchini (Cucurbita pepo). The System comprises a copper tube placed between double roof glazing and a sensible heat storage system, converting solar energy during the day and storing it for night-time release. A second control greenhouse without heating allows for comparative analysis at various growth stages. During the cold season, the experimental greenhouse showed a temperature increase of 3°C compared to the control greenhouse and 5°C above external ambient air. The relative humidity in the experimental greenhouse ranged from 69% to 70%, whereas the control greenhouse recorded 68% to 86%, and ambient air was between 94% to 99%. The heating systems achieved an efficiency of 73%, and zucchini plants in the experimental greenhouse developed fruit 13 days earlier than those in the control greenhouse.

**Keywords :** solar energy, storage, energy management, heating system

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