

# An Analysis of Greenhouses Heat and Ventilation Requirements in Winter Arid Climate

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**Abstract.** This study investigates environmental conditions, and heat and ventilation requirements of greenhouses in winter arid climate. Simulation models for estimating greenhouse heating and ventilation requirements with five greenhouse-glazing systems in arid climate conditions were presented. All estimates were for the central region of Saudi Arabia for crop production requiring 22°C day temperature, and 10/18°C night temperatures. The estimated ventilation and heating requirements were calculated from weather data on single fiberglass, single polyethylene, single glass, single glass & thermal blanket and double glass. Also, measurements from a 39- × 9-m Quonset-style greenhouse planted with tomatoes and covered with a sheet of fiberglass-reinforced plastic and equipped with a heating unit with a perforated poly-tube were presented and discussed. Heating requirement using single fiberglass was predicted to be slightly the highest among all covers. The annual heating requirements should be increased by 65% with 18°C set point temperature at night compared to a set point temperature of 10°C. It was estimated that 35-41% of annual heating is required during the month of January. The model predicted an annual energy saving of 8-34% for the single glass and blanket covering system, and 50-56% for the double glass system. A comparison of greenhouse heat and ventilation requirements was also conducted for sunny and cloudy days. Vertical and horizontal distributions of temperature and relative humidity were also discussed. Ventilation load peaked at midday hours, and reached zero during nighttimes. Heating load peaked in the morning before sunshine. Ventilation and heating systems were capable of maintaining the inside conditions at permissible limits for plants growth. However, heating system was not capable to maintain the desired temperature of 18°C at a significant number of nights. Averages of inside temperature and relative humidity at daytime were 21.5°C and 51.7%, respectively, as compared to 16.5°C and 33.6%, respectively, outside the greenhouse. Whereas, nighttime inside averages were 13.7°C and 75.6%, respectively, while the outside averages were 11.3°C and 43.6%, respectively.