

# Farm Structures FACTSHEET



BRITISH  
COLUMBIA


Ministry of Agriculture, Food and Fisheries

Order No. 306.445-1

CPS: 6704

April 1990


## Greenhouse Ventilation



**CANADA  
PLAN SERVICE**

### GREENHOUSE VENTILATION

306.445-1  
NEW 90.04



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This leaflet provides ventilation information applicable to commercial greenhouses in Canada. Much of the information is extracted from the Agriculture Canada contract report Energy Efficient Greenhouse Design and Operation (Towning and Turkewitsch, 1980).

Ventilation of a greenhouse has several functions such as:

1. temperature control (cooling)
2. humidity control
3. CO<sub>2</sub> control

The ventilation system exchanges, circulates and mixes the greenhouse air for more uniformity of the greenhouse climate and also helps the heating system distribute heat. It is important the greenhouse be as airtight as possible so that air circulation and exchange is controlled by the ventilation system, not by uncontrolled air infiltration.

### 1. TEMPERATURE CONTROL (COOLING)

Greenhouse cooling reduces plant stress caused by high leaf and air temperatures. The root and stem system may not be able to supply adequate water to the leaves, thereby limiting transpiration, the plant cooling mechanism. Also, hot and humid air around the leaves will reduce the effectiveness of transpiration at the leaf surface.

Transpiration makes it possible for photosynthesis to take place on bright days without the plant overheating. Light the leaf absorbs increases its temperature and without transpiration, this temperature could become much higher than the surrounding air. However, by vaporizing water within the leaf and diffusing this vapor through the stomata, about 70% of the energy absorbed by the leaf is released. The amount of water transpired is directly proportional to the temperature difference between the surface of the leaf and the air. If the plant can supply the necessary water, the leaf surface temperature ranges from 1°C above air temperature on low-light days to almost 10°C on bright days.

As the air temperature rises on a sunny day, more and more demand is placed on the root system to supply water for transpiration. If the demand becomes too high, the plant becomes overheated and the stomata close to prevent further and damaging water loss. This is undesirable because stomatal closure prevents assimilation of CO<sub>2</sub> and consequently, photosynthesis. The efficient operation of a greenhouse requires a controlled environment to induce maximum growth. Optimal conditions for an actively growing plant are an air temperature of 20-25°C, 60-80% relative humidity, 800-1500 ppm CO<sub>2</sub> level, 20-100 W/m<sup>2</sup> photosynthetically active radiation (PAR), and an adequate supply of water and nutrients for the plant.

Greenhouse temperature control can be accomplished a number of ways:

- 1.1. fan ventilation
- 1.2. natural ventilation
- 1.3. evaporative cooling
- 1.4. shading

#### 1.1. Fan ventilation

Fan ventilation can provide high rates of air movement in a large greenhouse or one that has inadequate natural ventilation. The advantages include accurate control of airspeed and direction, increased CO<sub>2</sub> uptake and leaf surface humidity control due to the forced air circulation through the leaves. It allows for less complex and more airtight greenhouse construction than ridge vents. The exhaust fans and inlets must be designed to give good uniform airflow through the plants.

Typical ventilation rates for commercial greenhouses are given in the following table:

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### COMPLETE INSTRUCTIONS

The Canada Plan Service, a Canadian federal/provincial organization, promotes the transfer of technology through factsheets, design aids and construction drawings that show how to plan and build modern farm structures and equipment for Canadian agriculture.

For more information, contact your local provincial agricultural engineer or extension advisor.

This leaflet provides ventilation information applicable to commercial greenhouses in Canada. Much of the information is extracted from the Agriculture Canada contract report Energy Efficient Greenhouse Design and Operation (Towning and Turkewitsch, 1980). Ventilation of a greenhouse has several functions such as: temperature control (cooling), humidity control and carbon dioxide control. To obtain a copy, please contact:

**CANADA PLAN SERVICE**  
Website: <http://www.cps.gov.on.ca>