Greenhouses.

NETAFIM™
GROW MORE WITH LESS

Why to use greenhouse technology ?

Economic Advantages of Greenhouses:

- Ability to grow in various climatic conditions
- Crop can be marketed throughout the year
- High quality crop
- Plant Protection - minimal use of pesticides

Preparation For a Project

Plot size

Distance between structures

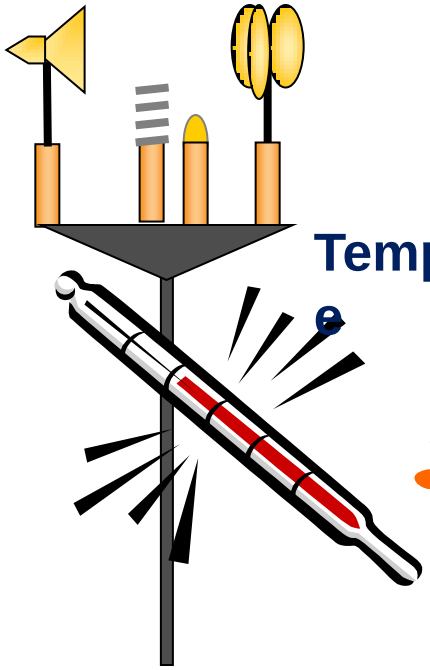
Topography

Directional position

Slopes.

Drainage

Analyze Crop Adjustment to Climate Data



Temperatur
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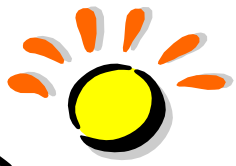
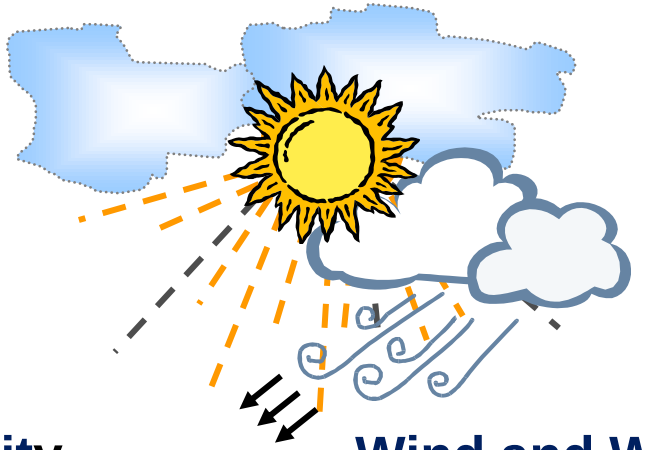


Humidity



Wind and Wind
Direction

Principle Requirements of the Greenhouse Structure

Suitability to climatic conditions

Suitability to a variety of crops

Adapted to add components to the structure

Labor efficiency

Light transmission

Resistance to winds and crop loads

Easy assembly

Greenhouse Options & Components

Structure: Height, Width, Length & Number of Spans, Veranda

Type of Ventilation

Type of Covering

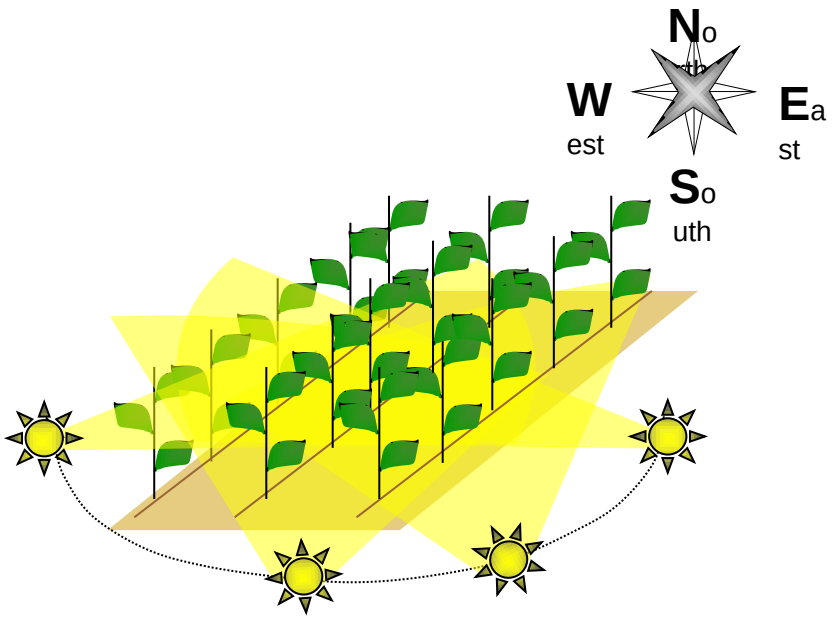
Irrigation Systems

Heating Systems

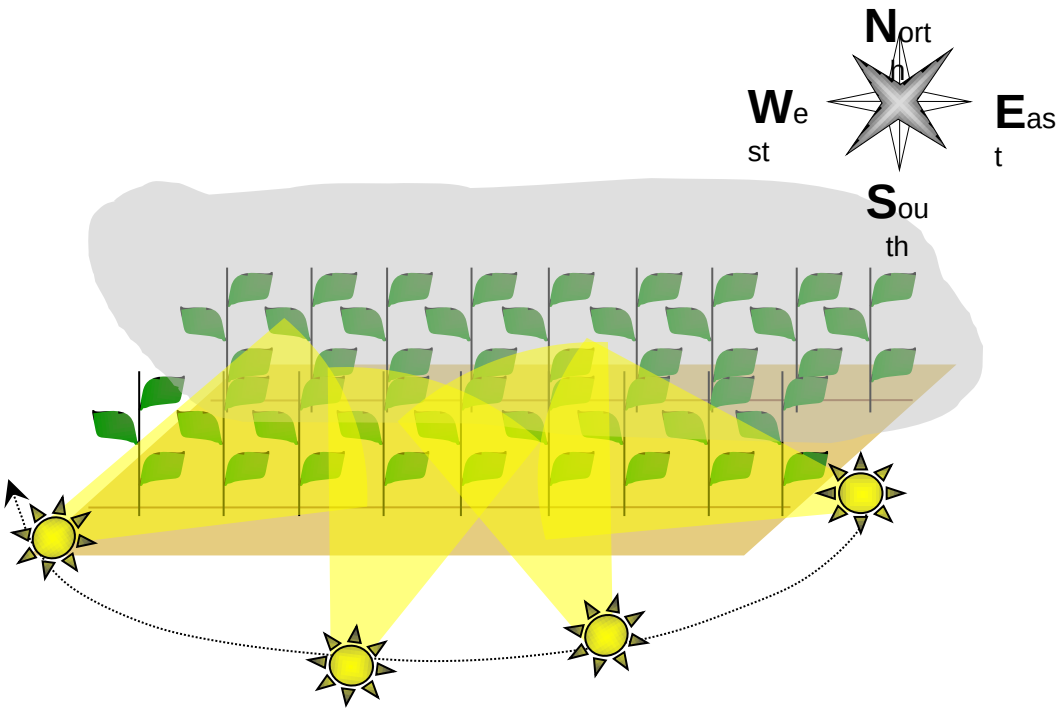
Expelling Excess Heat

Climate & Fertigation Control System

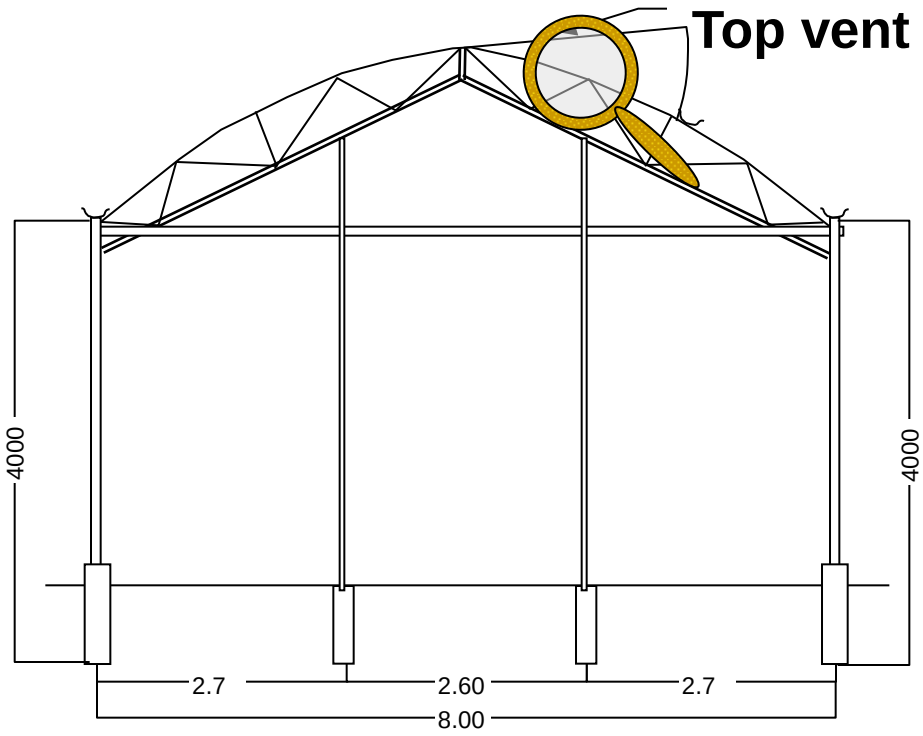
Orientation North to South



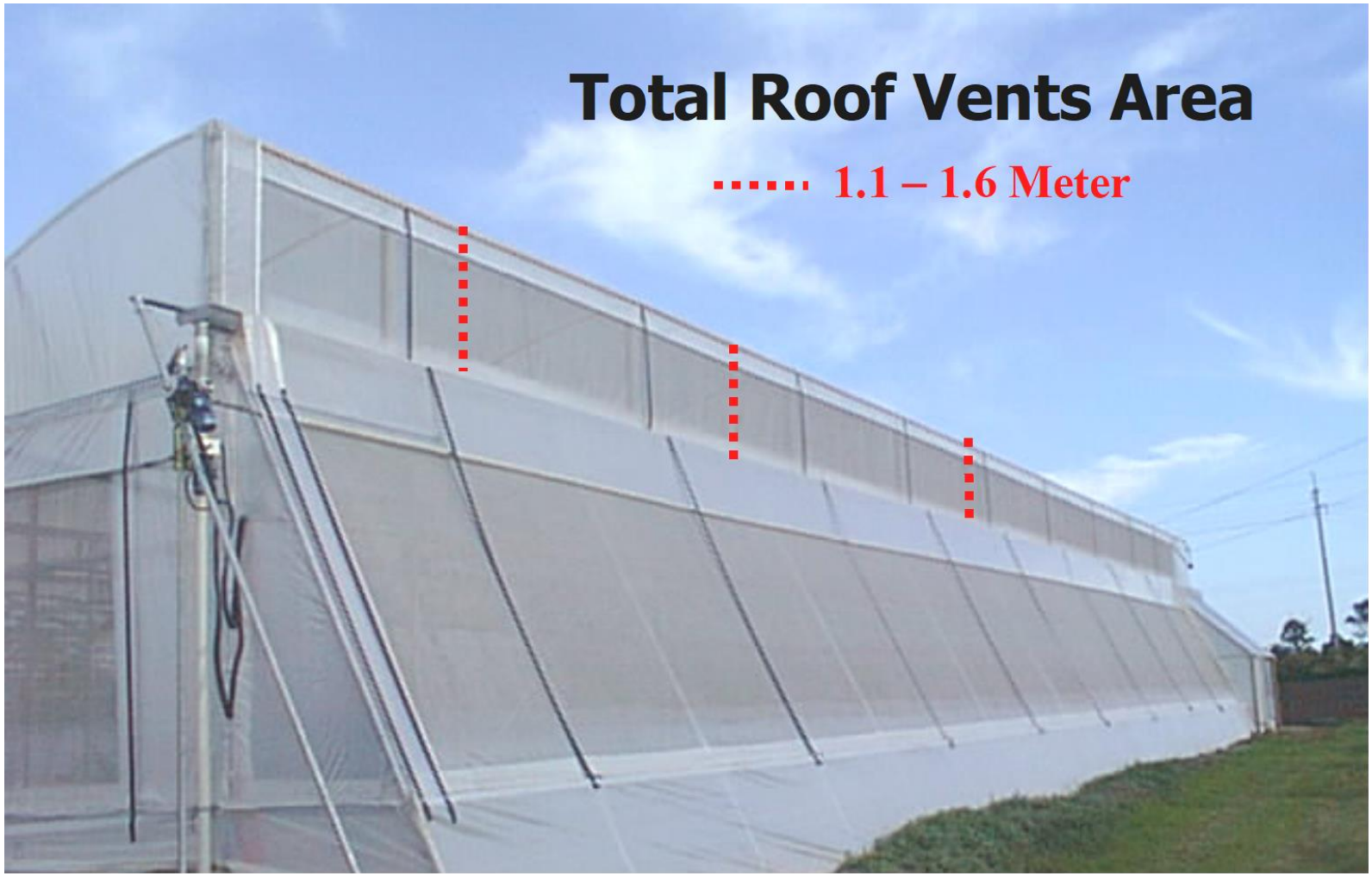
Orientation East to West



Structure with side wall & one roof ventilation system



Side-walls & Roof ventilation



Greenhouse Structure in Tropics - Requirements

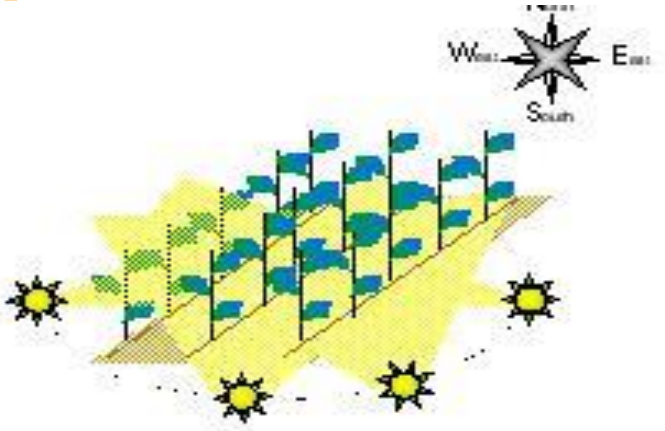
High gutter

High level of radiation penetration

Optimal drainage system

To solve plant protection problems

Can we influence light penetration into the greenhouse?



- Location of greenhouse
- Orientation of greenhouse
- Structure
- Amount of steel on roof
- Type and size of gutters

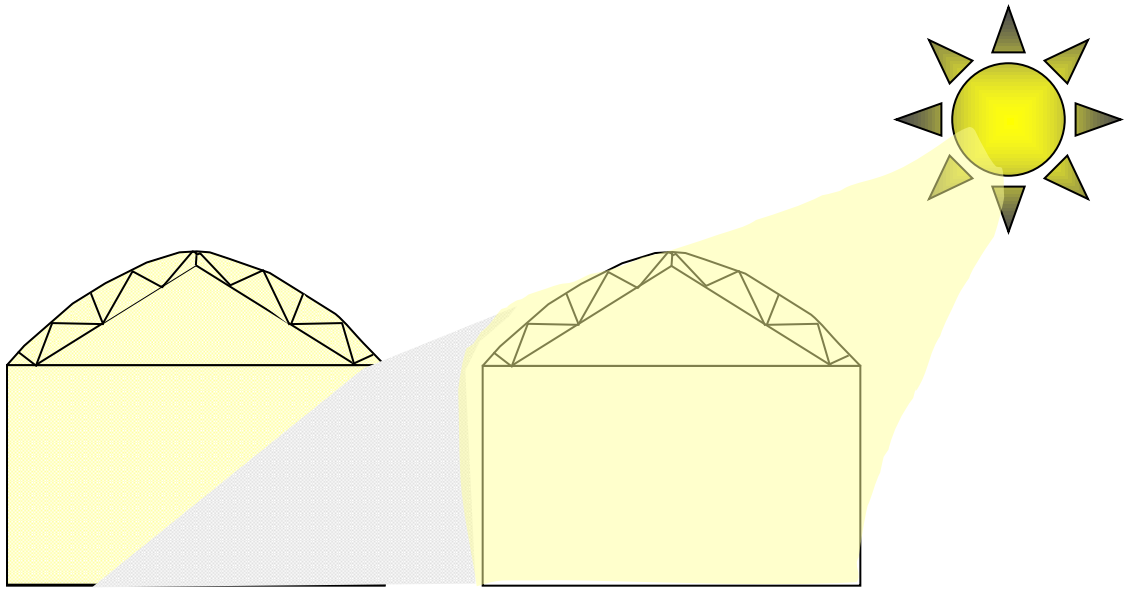
Can we influence light penetration into the greenhouse?

Covers

Total / Diffuse light transparent
Dust, Algae, Others
Condensation

Can we influence light penetration into the greenhouse?

Distance Between Greenhouses



Light penetration - summery

Location of greenhouse

Orientation of greenhouse

Structure

Amount of steel on roof

Type and size of gutters

Hanging devices - pipe & fans

Covers

Total / Diffuse light transparent

Dust, Algae, Others

Condensation

Glasshouse versus Greenhouse

Light Transition(~94%)

Energy Saving

Low Maintenance Demands

Relatively Strong Construction

High Cost

Complicated Installation

Limited Natural Ventilation

Large Variety of Models

Large Variety of Covers

Low Cost

Efficient Natural Ventilation

Relatively Easy Installation

Polyethylene Replacement

Lower Light Transition (~87%)

Heat loss

Soilless Media

Advantages

Ability to control water and fertilizer quantities

Optimal moisture in the substrate

Optimal nutrient supply

Significant advantage in disinfecting between growing periods

Limitations

Low root volume

Low nutrient storage

Trace elements-important to control

Low buffering capacity

Fast changes in pH

Salinity -control

Root Volume

Cultivation	Root vol. (l/m^2)	Water content (%)	Available water (l/m^2)
Soil	500	30	150
Peat	25	50	12
Rockwool	15	60	10

Nutrient Storage

Cultivation	Available water (l/m^2)	n gr / m2	
Soil	150	52	
Peat	12	3.4	
Rockwool	10	2.1	

Irrigation in soilless media

Plants requirements-

Water availability according to plant uptake (Evapo-transpiration)

Nutrients availability at the right level (EC& pH control)

Washing to prevent accumulation of salts

Irrigation in soilless media

limitations-

Limited volume of growing media – limited buffer of available water in the media

Preventing salinity in the soilless media

Extreme situations and changes during the day and throughout the seasons (changes in plant requirements)

Irrigation in soilless media

To meet the plant requirements and overcome the limitations the irrigation system must follow basic rolls-

Uniform distribution of water & nutrients to all plants.

Perfect control of nutrient availability in the soilless media (save water & nutrients => save cost)

Irrigation in soilless media

Very accurate and quick response system (irrigation by pulses)
Being able to supply the right quantity of water in a limited time (1 hour)- “Hourly return rate”.
Water availability according to plant needs (evapo-transpiration)
Efficient media leaching in order to prevent accumulation of salts.

Irrigation in soilless media

To achieve quick response and max. uniformity

Optimization between operation shift size and plant requirements (optimal hydraulic system)

Small operation unit

Quick response valves

Short distribution lines

Main line should be under continuous pressure (without filling time)

Irrigation in soilless media

General Requirements:

Irrigation timing according to plant requirements

Optimal availability of macro and micro elements, according to plant needs

Short and frequent irrigation cycles to overcome the limited buffer of water in soilless media

Filtration- secondary filter close to the drippers is required for a long life of the drippers (120 mesh)

Irrigation in soilless media

Back up design

Fresh water storage for at least 1 day of irrigation (6mm + 4mm leaching(drainage)=10mm a day= 100 m3/Ha/day)

More then one head control (including dosing unit (Netajet) for area that is bigger then 5-6 Ha, with bypass between the systems.

In case of one Netajet in the project, backup dosing system is required (Fertikit, etc.)

Hydraulic by-pass in case of controller failure.

Design principles

In soilless media all Evapo-Transpiration calculations are per hour (and not per day):

"Hourly return rate of mm/h or l/m^2/hour"

According to research, the evapo-transpiration rate for common greenhouse crops under normal conditions* is 0.8 l/m2/h

Requirement of 50% drainage (mainly for leaching root area)

Ev.-Tra. / (1 - % of drainage) = Return rate

0.8 / 0.5 = 1.6 l/m^2/h

Design principles

Calculation of the expected capacity per operation (shift)irrigation

Required hourly return rate = 1.6 l/m2/h

Greenhouse area: 10,000m2 (1 Ha)

1.6 l/m²/h X 10,000m² = 16,000 l/m² (16 m³/h)

The capacity per operation shift must be greater than the return rate

Calculation of Hourly return rate (Irrigation in Slabs)

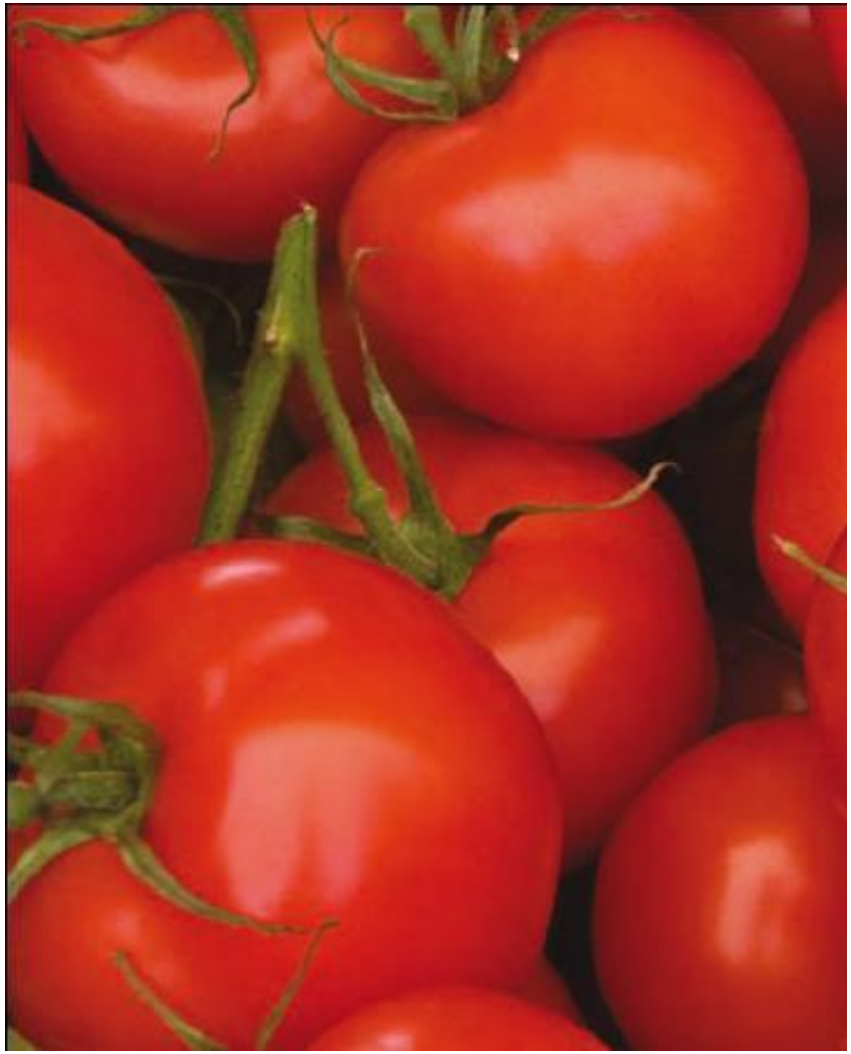
Plants/m² (Drippers/m²) X Dripper flow rate = Application rate (l/m²/h)

Application rate / number of shifts = Hourly return rate (l/m²/h)

Ventilation serves 5 purposes:

- Reduces the temperature in the structure
- Reduces humidity and prevents condensation
- Increases or maintains CO_2 level
- Reduces concentration of gases and toxins in the greenhouse
- Creates air movement near the leaves

Irrigation Control- Integrated Approach



Irrigation control is based on:

Grower's knowledge of plant requirements:

Will low plant water potential be the strategy?

(water supply equal (or nearly equal) to transpiration)

OR

Is stress required?

(Water supply lower than transpiration)

The concept of control

THE MODEL WILL:

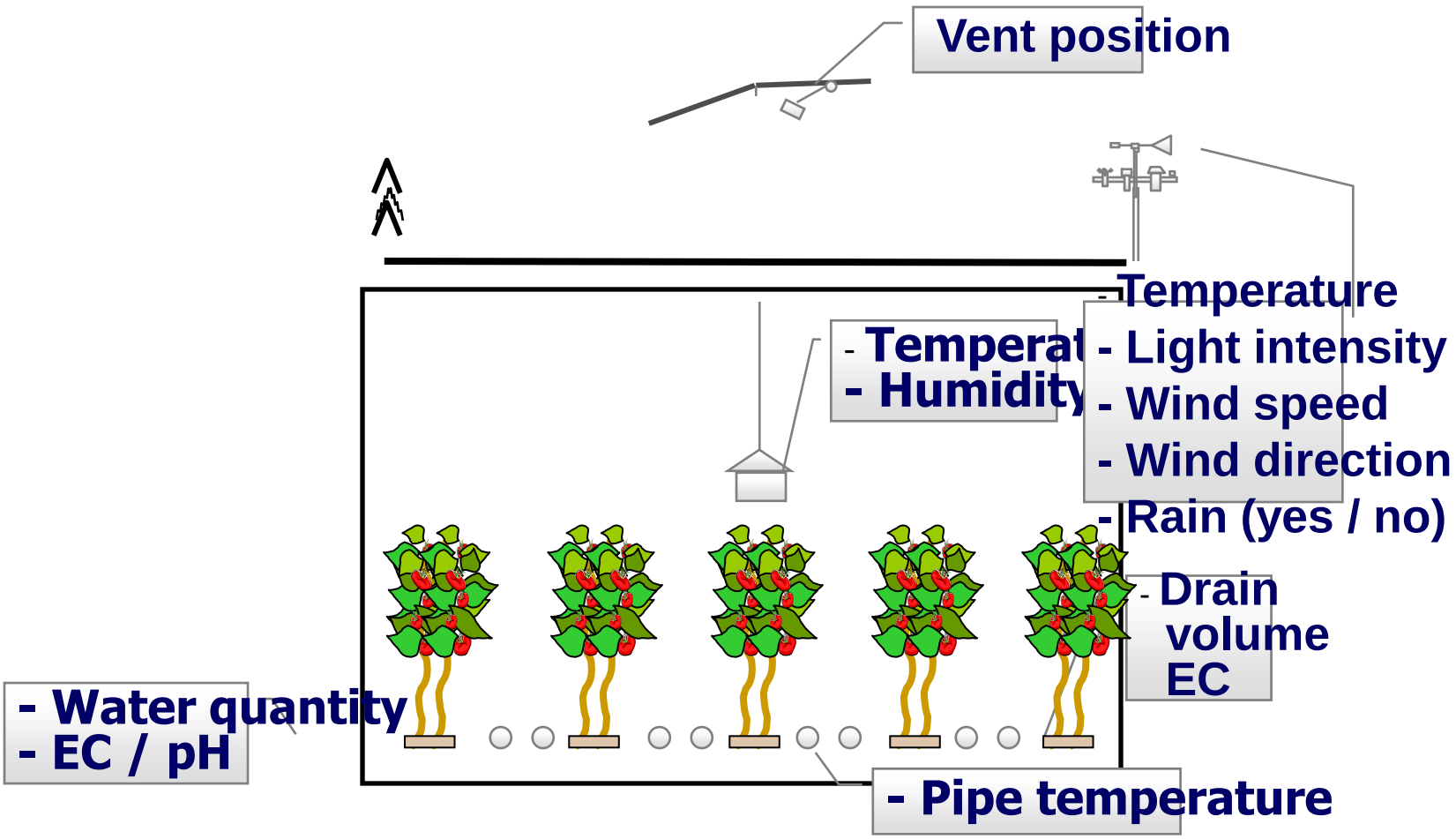
EVALUATE TRANSPIRATION RATES

CORRECTION WILL BE –

SOIL WATER STATUS

PLANT WATER STATUS

Netafim-control system



The Main Targets in Irrigation Control are:

To determine the optimal time to start irrigation

To supply The optimal quantity of water

Water Supply to the Substrate will be Determined

by Water Uptake = Transpiration

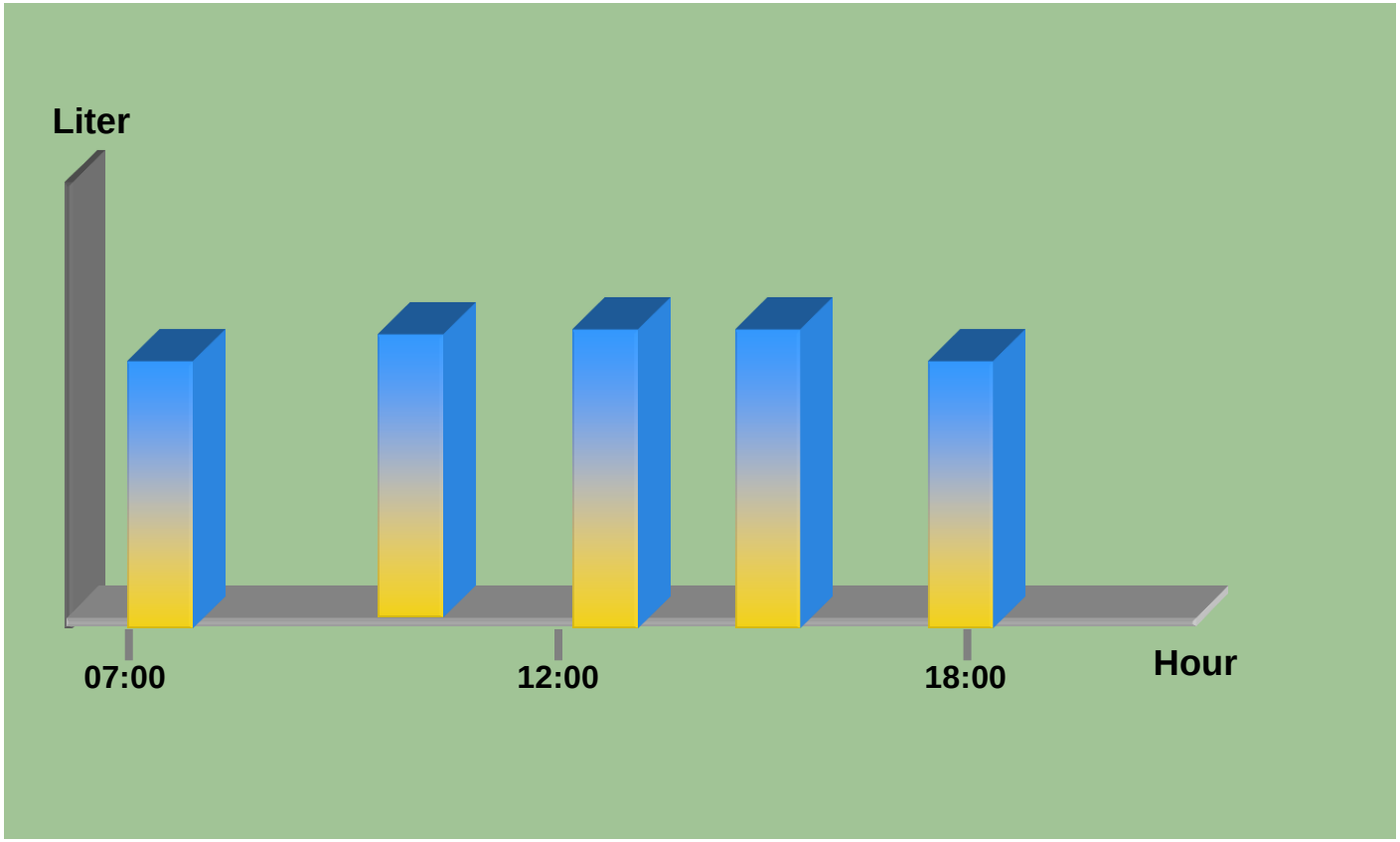
Water supply will be

Equal (or nearly equal) to transpiration
OR
Lower than transpiration

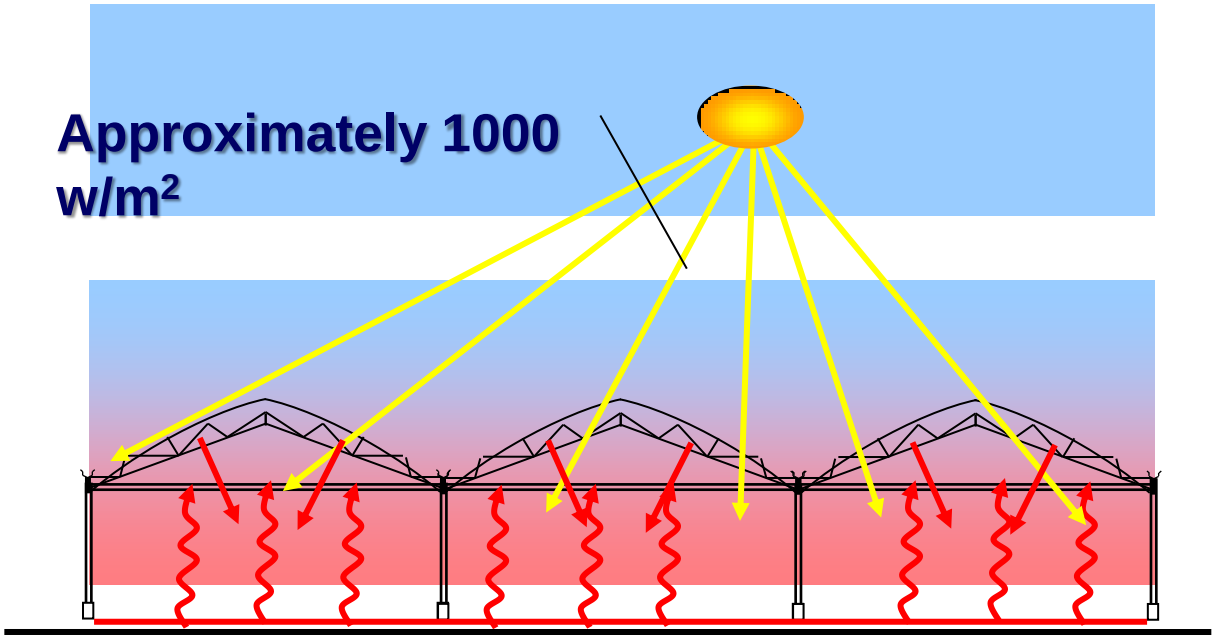
With additional quantity for drainage

Irrigation Timing

By hours



What is The problem ???



Greenhouse effect

WHAT IS THE PROBLEM ?

what parameters are influencing on
cooling ?
temperature
humidity
how humidity influence cooling ?
high humidity less cooling (2-3 centigrades)
low humidity high cooling (5-8 centigrades)
cooling is not irrigation, germination etc.
in cooling there is no irrigation uniformity

Ventilation serves 5 purposes:

- Reduces the temperature in the structure
- Reduces humidity and prevents condensation
- Increases or maintains CO_2 level
- Reduces concentration of gases and toxins in the greenhouse
- Creates air movement near the leaves

COOLING PRINCIPALE

Cooling effect is being achieved through water evaporation into the air.

a controlled number of very small drops are sprayed into the air and absorbed into the atmosphere.

The physical change of water from its liquid state to a gas state absorbs energy from the environment - 560 calories for every gram of water. thereby cooling the micro-climate.

COOLING PRINCIPALE

CoolNet units are spread throughout the greenhouse for best distribution.

Sensors with predetermined activation temperature and/or humidity level are activating relevant valves.

Length of pulse and interval are subject to local conditions such as:

external temperature

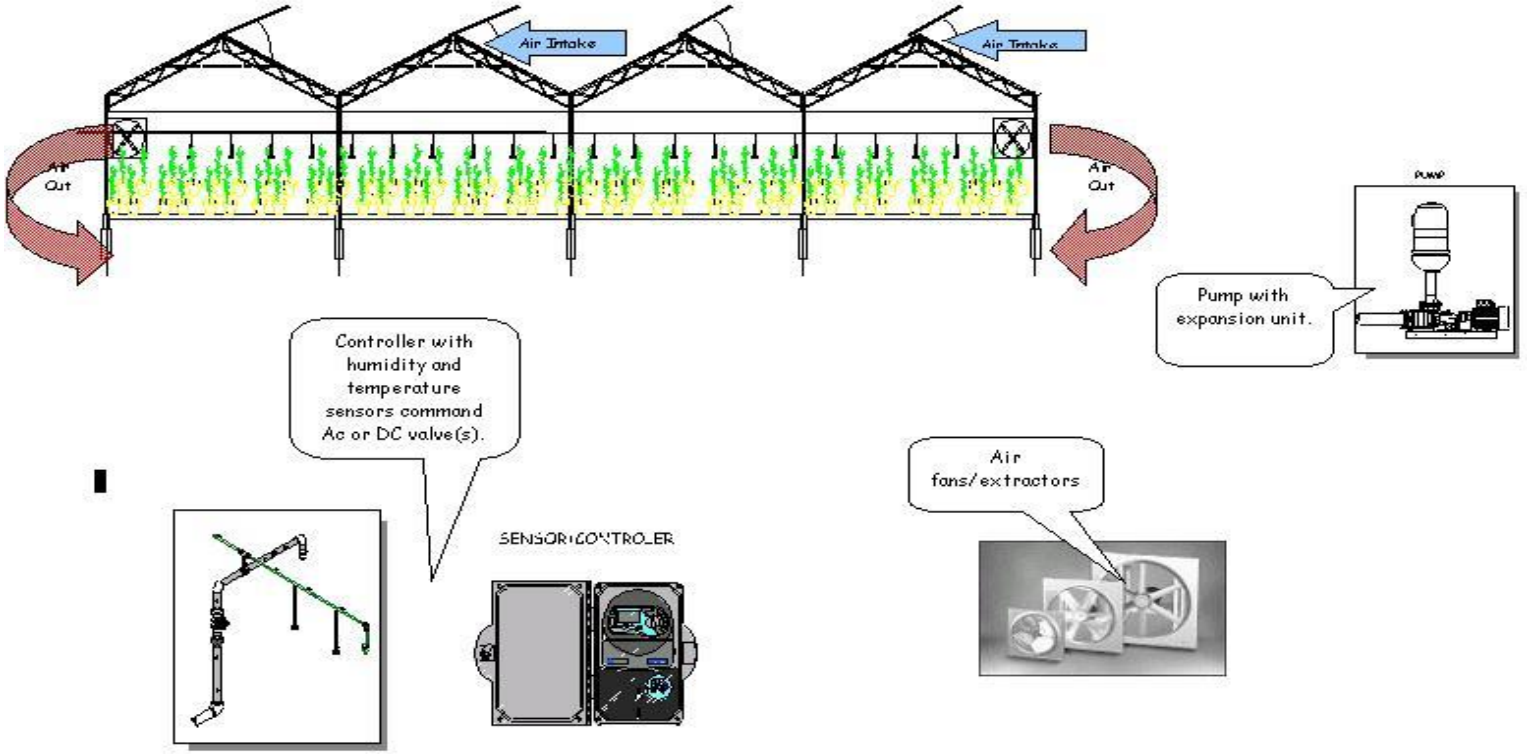
Humidity

size and type of construction and crop.

COOLING GREENHOUSE PRINCIPLE

Greenhouses with roof ventilation

Air is being pulled by fans located on walls, intake from roof windows and outtake through side fans.



Removing Excess Heat

3 Principals

Air exchange

Adiabatic cooling

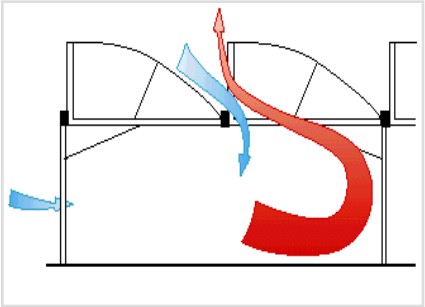
Shading

Natural Ventilation

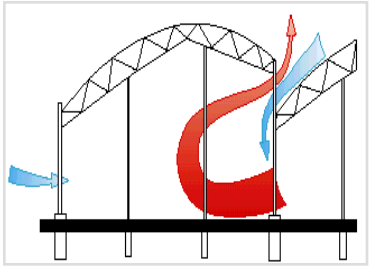
- **Air exchange through roof & side opening**
- **Total window area**
- **Greenhouse geometry**
- **Location**

Heat & Humidity Expulsion

Air flow through side wall & roof opening

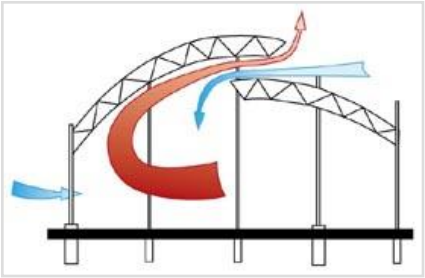


Hot air inside replaced with cooler air from outside



Hot air exits via roof vents, whilst cold air enters

Air flow serves to expel excess humidity



Forced Ventilation

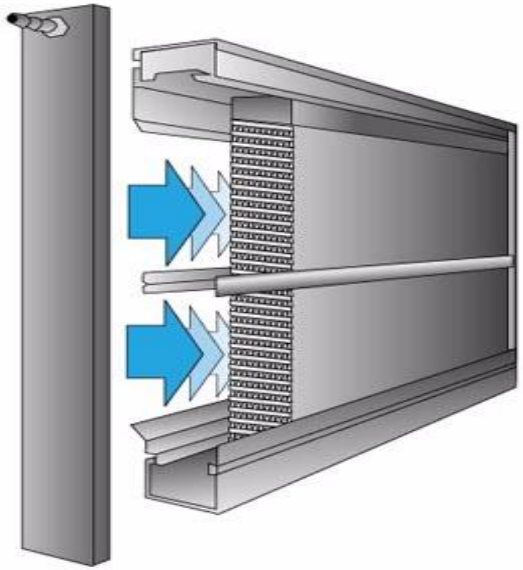
- Used when fresh airflow is insufficient for plant needs or when using pad & fan system
- Based on negative lengthwise ventilation

Removing Excess Heat

Evaporative Cooling

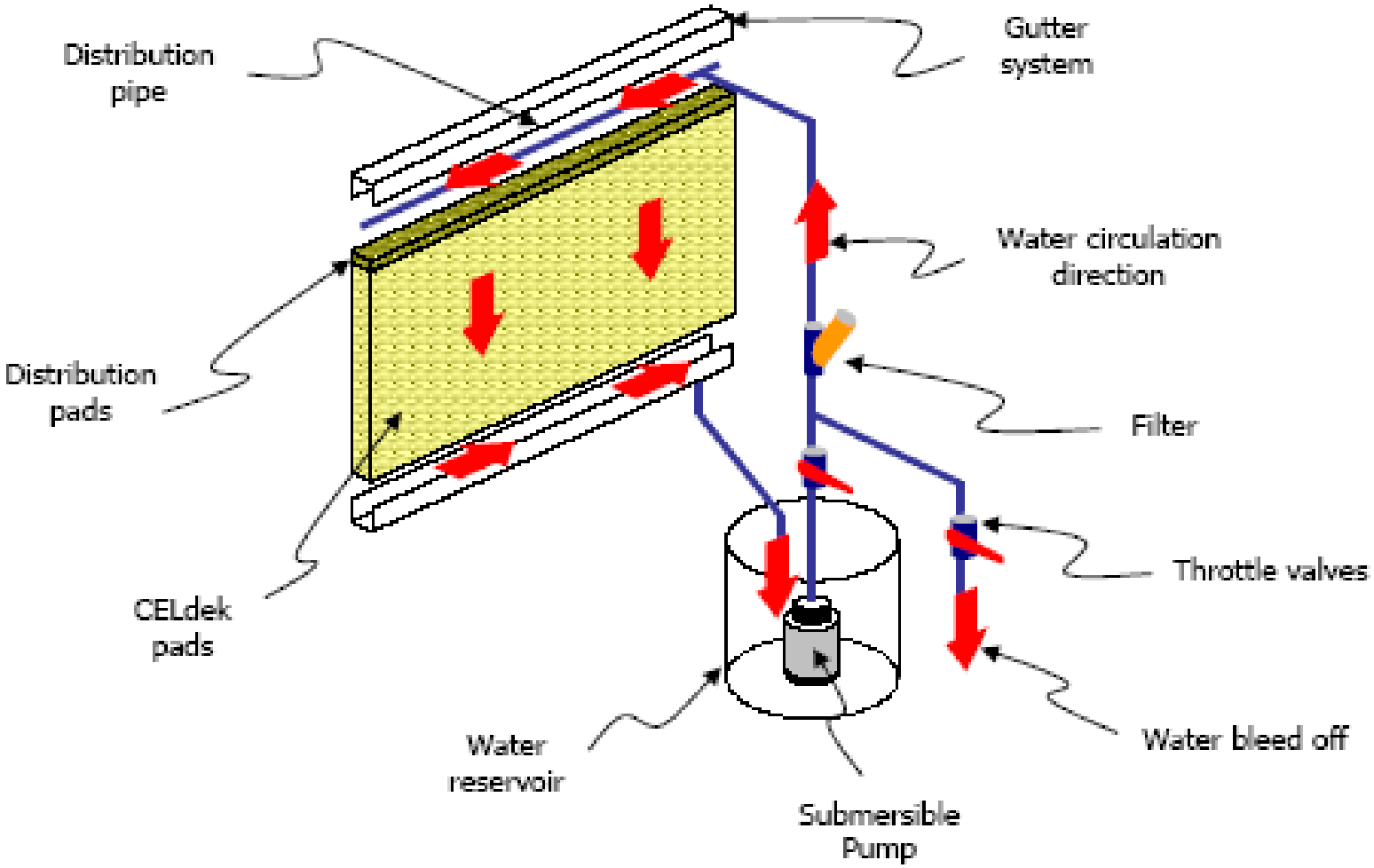
The adiabatic cooling process is the process of evaporating water in the air, during which the air humidity increases and the temperature decreases. This cooling process takes place without any need for an external energy supply.

Pad &\ Fan

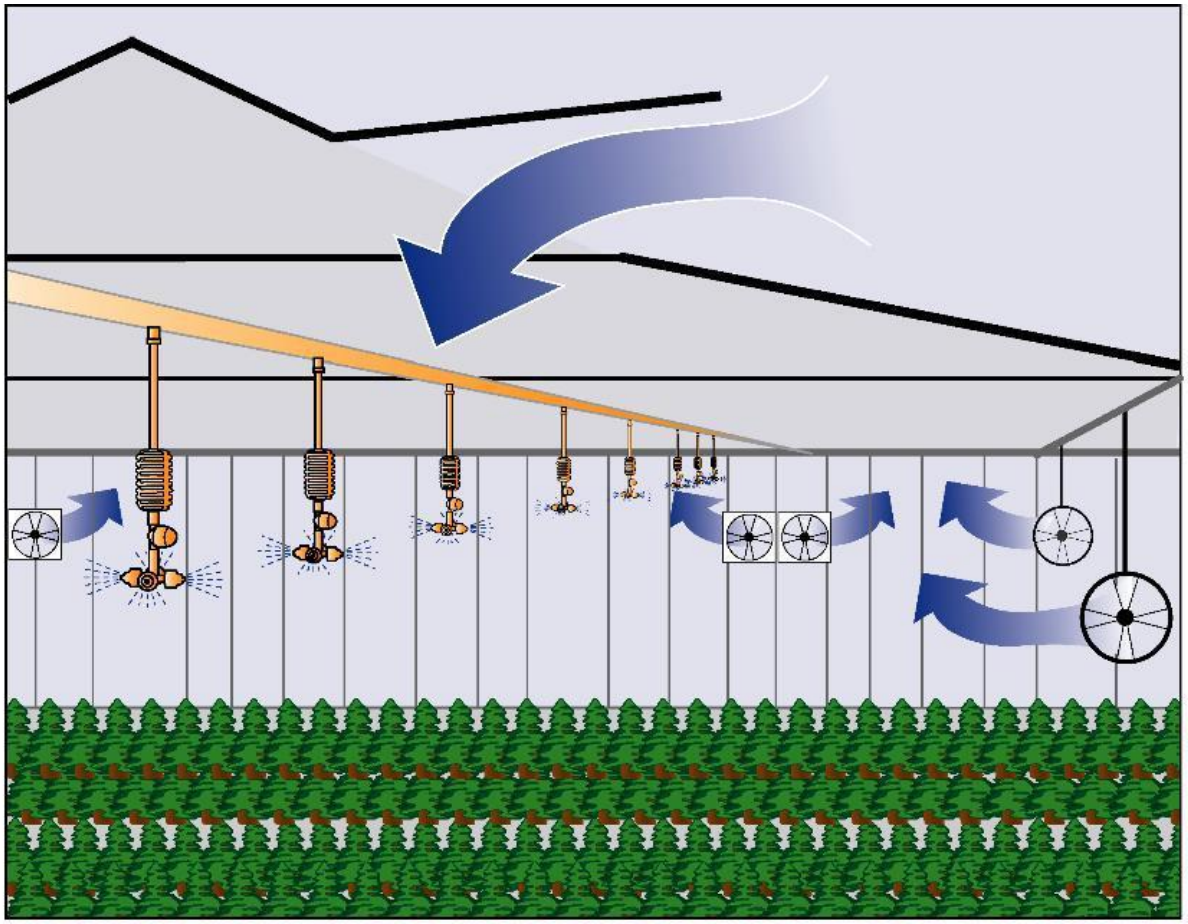


Foggers (Coolnet)

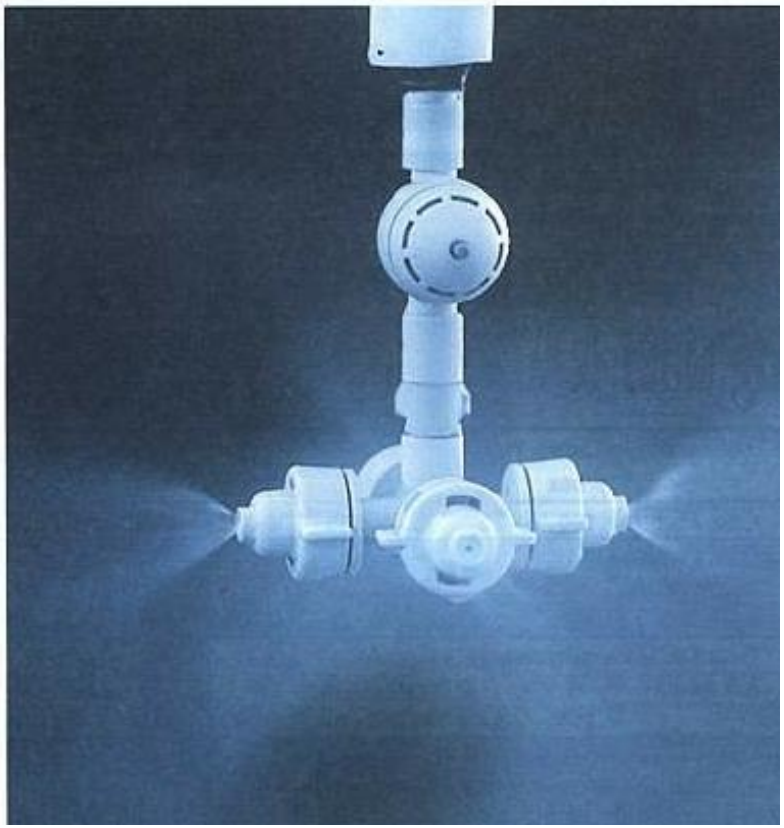
Pad &\ Fan


Distribution pipe
Gutter system
Water circulation direction
Distribution pads
Filter
Throttle valves
CELdek pads
Water bleed off
Water reservoir
Submersible Pump

Cooling and Humidifying with Coolnet



Coolnet System



Fogging.

Sprinkling - Leaf & Air cooling

Drop size - wide range of drop sizes

Uniformity - not critical (compared to nursery)

Water quality - critical

Control - controller or manually

Drop Size - Specifications

Wide range of drop sizes - 30-100 mic.

The very small drops will be used for evaporative and air cooling purposes

The large drops will wet the leaves and reduce leaf temperatures

Operation

Normally - starts after 10 a.m

do not use sprinklers after 3 pm

Operate every 20 -30 min. for 20 sec.

IF AUTOMATIC CONTROL IS AVAILABLE:

Air Circulating System Combined With Cooling System

- Circulation of air in greenhouse
- Avoiding temperature and humidity differences

Coolnet (foggers)

Principle: a “low pressure fogger” that works on standard pressure (4-5 bar). Via short pulses, temperatures can be substantially reduced and humidity elevated.

Heat exchange between water & air inside the greenhouse space.
Exhaust fans could be install in the side wall higher efficient.
Could be use for reduce temperature or increase of humidity.

Comparison between:

Coolnet	Pad & Fan System
Cooling the inside air.	Cooling the outside air.
Excellent temp. uniformity.	Temp. gradient inside g.h.
Excellent humidity uniformity.	Humidity gradient inside g.h.
Forced air exchange (extra).	Forced air exchange (Must).
Affectivity will be determined by inside conditions.	Affectivity will be determined by outside conditions.
Danger of leaf wetting.	No leaf wetting.
Required good water quality.	Could use a salty water.

Comparison between:

Coolnet

- Low operation costs.
- Very low maintenance.
- No influence on structure cost.
- Adiabatic principles.
- Low investment.
- Cost per m2 ~ $1

Pad & Fan System

- High operation costs.
- Required high maintenance.
- Expansive structure (per m^2)
- Adiabatic principles.
- High investment.
- Cost per m^2 > $12

BOOSTER PUMP AND AIR SUSTAINABILITY

Heating

Requirements determined by:

Crop's heat needs

Minimum mean temperature in the area

Expected heat loss from greenhouse

Properties of covering

Shape of greenhouse

Temperature differences between exterior and interior

Wind velocity

Hot water method

Based partly on direct radiation

Temperature controlled by 3-way valves

Continuous temperature regime Uniform heat dispersal

Control through central computer system

Hot water method

Steel pipes serve as convenient transport lines

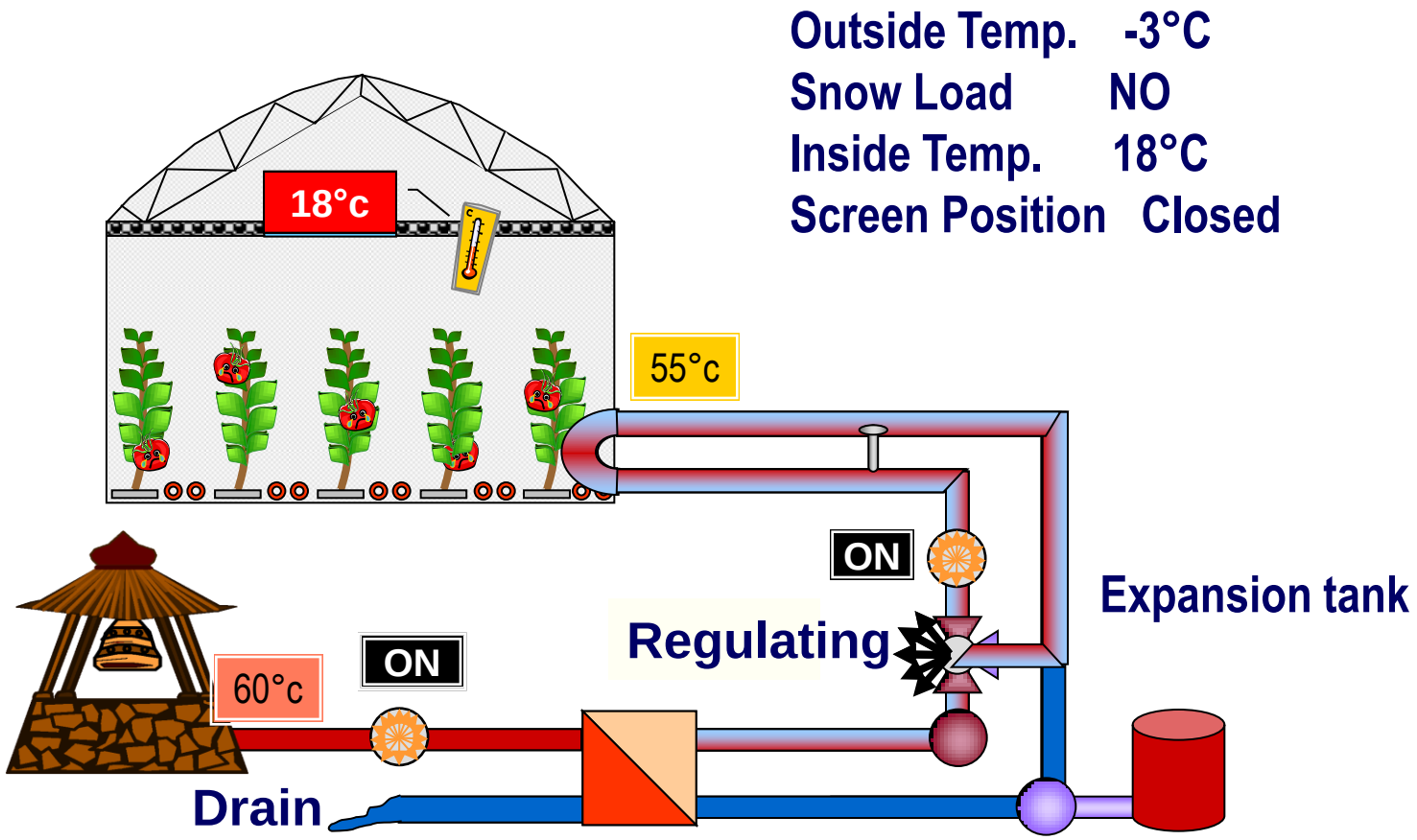
Hot air method

Burning cell. Heat expelled & passes over external walls of cell by radiation & convection.

Cold air passing over burning cell is expelled through perforated sleeves in the greenhouse.

Air circulation done by electrically operated centrifugal blower.

Typical project



Summary

- The greenhouse can creates conditions where the temperature and humidity deviate from the desired optimum for the plants.
- High heat loads could damage certain plants processes.
- Low humidity have a negative effect on certain crops.
- High humidity could foster outbreaks of disease.

THANK YOU

NETAFIM™
GROW MORE WITH LESS