Greenhouse Construction and Equipment

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Contents

1. Introduce my institute
2. Greenhouse development in China
3. Greenhouse structures for tropical region like Caribbean areas
4. Environmental control system for tropical region like Caribbean areas
1 Introduce myself and our Institute
Introduce myself

- Dr. Qichang Yang, Professor, Director of Center of Protected Agriculture & Environmental Engineering, IEDA, CAAS

- Research field: Protected agriculture and environmental engineering

- Recent Projects:
  1. The simulation model of environment and the structure optimization for Chinese solar greenhouse
  2. New saving-energy engineering in greenhouse
  3. Plant factory and hydroponics system
  4. LED light system in plant factory
Our institute: Institute of Environment and Sustainable Development in Agriculture (IEDA), one of the 39 institutes in CAAS
7 Departments (Centers) in our Institute:

1) Protected Agriculture & Environmental Engineering
2) Climate Change
3) Water Environment
4) Agricultural Ecology
5) Soil Environment
6) Agricultural Meteorology
7) bio-safety

156 staffs: 25 professors, 45 associate professors
105 students: graduate students (Master & Ph.D), 10 foreign students.

http://www.ieda.org.cn
Center for Protected Agriculture & Environmental Engineering

Group 1: Greenhouse Engineering
Group 2: Greenhouse Climate Control
Group 3: Hydroponics
Group 4: Animal Environmental Engineering
Group 5: Bio-physical Engineering

23 staffs : 5 professors, 7 associate professors
28 graduate students (Master & Ph.D)
1 Greenhouse Engineering
(Modeling, Design, Saving-energy)
2 Greenhouse Climate Control based on Internet
Environmental control system

**Inputs:**
Temperature
Humidity
Wind speed
wind direction
Sun radiation
CO2
pH
EC
Rain
Water quantity
Fertilizer qty.

**Outputs:**
Valves
Fert. Pumps
Water pumps
Filters
Windows
Fans
Screens
Motors
Foggers
Heaters
CO2
Sprayers
Humidifiers

DATA Processing
3 Saving-energy (LED) and new energy (ground source heat pump, Solar power) in greenhouse
Application of LED Tube in Tissue Culture

T5 or T8 LED Light Tubes
Test of cucumber seedlings with LED

sprouting

sowing

harvest

first true leaves
R & D of LED Light Source and Plant Seedling Factory
Application of LED in Leaf Vegetable cultivation

Field planting

10 days

30 days

20 days
Application of LED Light in Vegetable cultivation
Heat pump system in greenhouses
4 Research on Plant factory
Plant factory with artificial light
5 Research on Hydroponics
Wall cultivation
Wall cultivation
Column cultivation
Column cultivation
Over-ground tuber production of sweet potato

Tuberous roots
Tuberous roots

Nutrient feeding roots
2 Development of greenhouse technologies in China
Main types of greenhouse structures in China

- Plastic tunnel & awning
- Chinese Solar greenhouse
- Multi-span greenhouse
The types and areas of greenhouse in China

<table>
<thead>
<tr>
<th>Total Areas (ha)</th>
<th>Chinese Solar greenhouse (ha)</th>
<th>Plastic Tunnel (include small tunnel &amp; Awning) (ha)</th>
<th>Multi-span greenhouse (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,460,000</td>
<td>1,250,000</td>
<td>2,200,000</td>
<td>10,000</td>
</tr>
<tr>
<td>100%</td>
<td>20.23%</td>
<td>78.46%</td>
<td>0.29%</td>
</tr>
</tbody>
</table>
Large plastic tunnel

Height: 2.2~3.5m  Width:  6~12m  Length: 30~60m
plastic tunnel
(Small one 700,000
Large one 1,500,000)
Lettuce in plastic tunnel
Multi-span plastic tunnel
Small plastic tunnel

Height: 1~1.5m

Width: 1~3m

Length: 10~30m
Small plastic tunnel cultivation
Chinese solar greenhouse (1,250,000ha)

Structure and dimension of the Chinese solar greenhouse:

Span (width): 6.0-9.0 m
Length: 40-120 m
Height: 2.8-3.5 m
North wall thickness: 0.6-1.5m
Principles of the heat reservation in the CSG

- Sun light
- Straw mat
- Back wall
- South roof (cover)
- Soil
Main areas suitable for the CSG

North latitude of 32-41 degrees, no heating system needed

North latitude of 42-48 degrees, partly supplemental heating needed only in the extreme weather

North latitude of 32-41 degrees, no heating system needed
Chinese Solar greenhouse
Crops in the CSG (Vegetable, flower, fruit,...)

- Cucumber
- Muskmelon
- Mushroom