Present situation on protected horticulture in China

JIANG W.J.   Professor
Institute of Vegetables & Flowers (IVF)
Chinese Academy of Agri. Sciences (CAAS)
Beijing, China
Who am I?

- 1985  B.S.  NAU
- 1990  M.S. Graduate School of CAAS
- 1995  Research Group head, IVF/CAAS
- 2001  Project Consultant for AfDB,
  1 month in Zambia
- 2002  Professor, IVF/CAAS
- 2002 & 2003  Project Consultant for FAO
  2 month in Egypt
- 2005  Vice Chairman,  Chinese Association for Protected Cultivation
- 2009  Greenhouse survey, invited by CDB,
Protected horticulture

Total area 3450 (thousand Ha)

Main crops:

- Vegetables (3347) - 95.62%
  (Watermelon)
- Fruits trees (89) - 2.55%
- Flowers (64) - 1.83%
Type of Protected Cultivation

- Low tunnel, High tunnel (Plastic)
- Multi-span greenhouse (Plastic, Glass)
- Solar lean-to greenhouse, Energy saving solar-heated lean-to greenhouse (Plastic)
Rainproof cultivation
Tunnel Frames made by different materials
South China: year round
North China: Spring, Fall
High plastic tunnel
- bamboo stem or steel pipe (\(21-22 \times 1.2-1.5\) mm).
- usually single span, 8-12m wide and 2.5-3.0m ridge heights.

- Most of them length of about 50-60m.
- covered with plastic film
Straw mat
Poverty reduction

Rain collection
Rain water collection

Water inlet

Water tank
Greenhouse in desert
Mushroom plus horticultural crops
Mushroom

<table>
<thead>
<tr>
<th>Year</th>
<th>Output (million T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>0.40</td>
</tr>
<tr>
<td>2000</td>
<td>5.23</td>
</tr>
<tr>
<td>2005</td>
<td>13.35</td>
</tr>
<tr>
<td>2007</td>
<td>18.60</td>
</tr>
</tbody>
</table>

(65% of world total yield)

Main provinces: fujian, zhejiang, henan.

Mushroom in greenhouse
Fruit Trees
Multi-span greenhouse

High production cost
Water heating system
- developed around big city since 1970s.
- cost of greenhouse is high, too much energy cost (40-50% N.L40)
- not popular in China
Protected horticulture

Main crops:

• Vegetables (Watermelon)

• Fruits trees

• Flowers
Development of cut flower in protected cultivation (ha)
Development of pot flower in protected cultivation (ha)
As Compared to protected vegetable, the area of protected flower is very small.
Development of protected vegetables (10,000 ha)
Development of different type of protected vegetables (10,000 ha)
Development of different type of Greenhouse (10,000 ha)

- Heated
- Soar lean-to
- Energy saving solar lean-to


Heated: 0.38, 1.84, 7.82, 14.13
Soar lean-to: 0.68, 0.68, 12.5, 2.9
Energy saving solar lean-to: 9.2, 9.2, 34.2, 50.6
Amount of Protected Vegetable Per Capita (kg/year)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount (kg/year)</td>
<td>0.2</td>
<td>59</td>
<td>82.2</td>
<td>106.2</td>
</tr>
</tbody>
</table>
Modern Multi-span Greenhouses

In 1995 the total area of multi-span greenhouse was only about 45 ha, by 1999 it was 588.4 ha, Of which 185.4 ha of multi-span greenhouse was imported from overseas, and 403 ha was made locally. By 2007 the total area of multi-span greenhouse reached over 2100 ha, of which glasshouse was less than 60 ha, and most of the glasshouse was imported from Holland.

The outputs of modern greenhouse are unsatisfactory, especially in most of the imported greenhouses. This is due to: (1) lack of essential knowledge by growers, and (2) lack of adaptation of foreign greenhouses to local conditions.
Agricultural High-tech Demonstrating Farms Established All over the China

For speeding up the extension of new agricultural technique in countryside, central and local government established about 5000 high-tech agricultural demonstrating farms to popularize the new agricultural techniques. The main part of these demonstration farms is protected horticulture. These demonstration farms are bridges between scientists and growers, and promote growers to learn new technology.
Sulphur evaporator
THE DEVELOPMENT OF SOILLESS CULTURE

- NFT, DFT, Rockwool Culture, and Bag culture were all learned from the western. Recent 15 years China had developed some systems, such as Eco-organic type soilless culture system, Floating capillary Hydroponics system etc. which were low cost, more suitable for local conditions.
Soilless culture has developed very rapidly during the last two decades in mainland China. The area of soilless culture in China was around 0.1 ha in 1985, In 1993 China had 43ha soilless culture, in 1996 it progressed to 83ha soilless culture, in 1999 it was 315 ha, it reached 5500ha by 2010. This is mainly due to the development of eco-organic type soilless culture system. Eco-organic soilless technique covers over 80% of total area of soilless culture in China.
Different type of soilless culture

<table>
<thead>
<tr>
<th>Year</th>
<th>Total area (ha)</th>
<th>Eco-organic type (ha)</th>
<th>Nutrient solution type (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>1000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1990</td>
<td>2000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1995</td>
<td>3000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1998</td>
<td>4000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2004</td>
<td>5000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>6000</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Sources of Disease in the growing area

1. Infection during propagation
   - 2. Water (reservoirs, open air tank)
   - 3. Debris in the growing area (so sterilize)
   - 4. Infected material blown in by wind
   - 5. Insects (Virus)
   - 6. Works !! (Soil-borne on feet, Virus on hands & Clothes)
网纹甜瓜

MUSKMELON
WATERMELON
南瓜
In recent years, a so-called gravitational drip irrigation system has been invented and being extended more and more.

A Schematic diagram of a gravitational drip system
Irrigation Tape
Coal cinder
Pea
Radish
Chinese mahogany
育苗盘长 54cm 宽 28cm, 50~800孔/盘
Strawberry
Peach
Cherry
Appricote
基质栽培
根结线虫发病状
MAP OF CHINESE PROVINCES
THANK YOU FOR YOUR ATTENTION!
Suggestion for Caribbean Greenhouse Development

Dr. JIANG Weijie, Professor
With development of tourism industry, greenhouse crop produce has huge market potential in the Caribbean countries due to high quality and year round supply of greenhouse crops; growers are active to shift their conventional cultivation method in open field into protected production in greenhouse due to high crop yield and profit.
Greenhouse technologies are feasible, even in case of heat and hurricane; I have seen very successful vegetable crops production in some greenhouses in all three counties visited, and two greenhouses made of wood have existed 4 years in Jamaica though hurricane occurred in recent years.
Chinese greenhouse technologies are well-recognized by the farmers in the Caribbean Countries; China has more than 2 million ha of greenhouse from low input to high tech, and in Hainan island where climate is similar to the Caribbean region there are more than 20,000 ha of greenhouse. In recent 3 decades, China has developed a series of technologies related to greenhouse industry from greenhouse structure design and manufacture to crops cultivation.
OBSERVATIONS FROM FIELD WORKS

*Government actions*: The governments in all three countries have paid much attention to greenhouse industry. Barbados has built two units of demonstration greenhouse in the yard at Ministry of Agriculture and Rural Development. Jamaica has launched national program on cash-crop industry development, farmers in Trinidad can get financial support for greenhouse construction from government.
**GH technologies:** I visited 13 farmers, the greenhouses were mainly introduced from Spain, USA, Canada and Israel. Of which four farmers built their greenhouses in 2008 or 2009, One farmer imported the greenhouse of 960m² from Spain, it cost 63US$/m²; one farmer imported the greenhouses of 768m² from USA, it cost 65US$/m²; one farmer imported the greenhouse from Israel, it cost 40US$/m²; One farmer imported the greenhouse frame materials from China, and design and construction works were done locally in Jamaica, it cost 27US$/m²; I also visited the two greenhouse of 1400 m² made of wood completely in Jamaica, one wood greenhouse of 50 m² in Barbados, and existed 4-6 years though hurricane occurred in recent years, which cost 10-14 US$/m²;
GH facilities: Greenhouse accessories such as fertilizer, irrigation equipment, growing media mainly imported from Spain, USA, Israel. Importation of greenhouse and its accessories build up the cost of greenhouse construction and crop production, therefore there is very high expectation on introducing of greenhouse construction and crop cultivation materials from China in three countries I visited.
Heat: The main issue for crop cultivation in greenhouse is high temperature inside greenhouse. It is possible to get solved through following approaches, (a) new design of greenhouse. (b) Screening of vegetable varieties, It is simple and cheap way to solve the heat problem by collection of vegetable cultivars from tropical area, then test them in Caribbean, the vegetable varieties with tolerance to high temperature could be selected. (c) Use insect net with low number of meshes (large hole), high mesh insect net is effective to prevent insects from entering and attacking crops in greenhouse, but will block the air cross movement and build-up the heat inside greenhouse. Therefore insect net with less than 20 meshes is strongly recommended to cover the walls of greenhouses.
Hurricane: A another major issue is hurricane for development of greenhouse industry in Caribbean region. For resistance to hurricane attacking, local people usually enforce the frame of greenhouse structure which greatly build up the construction cost. I do not think it is wise to invest more expensive greenhouse for resistance to hurricane which occurs once every 5 or 10 years.
The suggestions for coping with hurricane issue are as follows: (a) Design of greenhouse structure. A further in-depth survey need to be conducted for making a proper and cost-effective design of greenhouse structure. (b) Remove the covers of existed greenhouse. For greenhouse already existed in Caribbean region, the simple and effective approach is to remove the cover of greenhouse when hurricane (which is strong enough to break down greenhouse) occurs, then the frame of greenhouse will be saved, after the hurricane, recover the greenhouse, replant crops if need.
MISSION FINDINGS FROM FIELD VISIT

- There is very high expectation on introducing of greenhouse construction and crop cultivation materials, crop production technology from China whether in Caribbean countries or Caribbean Development Bank, due to cost-effective of greenhouse construction and crop production. In all three countries I visited, greenhouse technology has not been well developed, including fertilization and irrigation management, pest control etc.
Production of vegetable crops in greenhouse, even in low-input greenhouse, is possible, though issue of heat and hurricane exists, if proper approaches are adopted in greenhouse crop cultivation in Caribbean countries.
The technology of greenhouse crop production and rich experiences on development of greenhouse industry have great potential of utilization. China has more than 20 years experience on development of greenhouse industry, there are a series of vegetable crop cultivation technology from low input to high-tech greenhouse. Total area of greenhouse in China accounts for over 80% of greenhouse area in the world at present.
Greenhouse in Trinidad, Growing media inside white bag is coir imported from Spain with a cost of US$7.00 per bag. Growing media in black bags was cheap and local made mixture of sand and sawdust made, but sawdust was not well-composted, and caused nitrogen deficiency in tomato plants.
Wood greenhouse in Barbados. The greenhouse was built under the guidance of local greenhouse manufacturing company 6 years ago, costing US$500.
Greenhouse in Jamaica, the greenhouses were made of wood completely, is 10m by 70m and cost US$10,000. and existed 4 years though hurricane occurred in recent years.
Greenhouse in Jamaica, the greenhouses were designed and manufactured locally, the ventilation is at the roof top covered with insect net horizontally, 50 cm above the insect net installed plastic film cover for preventing rain from entering into the greenhouse. The greenhouse frame materials were imported from China,
Greenhouse in Jamaica, there is roof ventilation at the ridge of the greenhouse. But air vent in ridge and walls are all covered by high mesh insect net which blocks cross air movement.
Greenhouse in Trinidad, fan ventilation is used. The wall is covered by high mesh number insect net which blocks cross air movement.
Greenhouse in Barbados. The greenhouse sidewalls were covered with low number mesh net for cross air ventilation. There is no roof ventilation. Sweet pepper plants are growing very well with no insects and diseases even if low mesh number insect net was installed at side wall.
Greenhouse in Jamaica, greenhouse sidewall installed low mesh number insect net. Lettuce is grown very well in pure perlite substrate with nutrient solution recycling system.
THANK YOU FOR YOUR ATTENTION!