Development of Greenhouse Crop Production in Thailand
Regional Workshop on Protected Cultivation of High-Value Crops under Changing Climate Condition, Lahore, Sept 12-14, 2017.
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Outline topics
• Introduction.....
• Greenhouse crop production
  – Chronology of development
  – Types of greenhouse technology
  – Application of greenhouses
  – Cooling methods
• Government support & policy
• Problems and constraints
• Prospect...........

Presentation outline...........

Background....
Location: 13°37′ and 20°27′ latitude and between 77°22′ and 105°37′ longitude
Climate: Tropical climate with three seasons; summer, rainy and winter seasons.
(Max, Min and Avg temp = 35, 24, and 28°C, the RH% ranges 70-80%).
Economy: Population: 68 M, GDP per capita : USD 5,788, and Total GDP : Billion USD 400

Declining of GDP from Agriculture Sector

Role of Thailand’s Agriculture
agriculture contributes
THB500 billion (USD16.6 billion),
8-10% of Thai GDP
agricultural industries use
41% of land and employ
49% of workforce
fresh fruits and vegetables
US$ 820 million export value
processed fruits and vegetables
US$ 1,725 million export value
one of the world biggest
agricultural exporters
(world Ranking 12th in 2012)

Dilemma Affecting Agriculture
Crop failure had occurred more frequently

Heavy application of insecticides was done to control insect infestation.

In 2010, EU banned the imported vegetables from Thailand due to excessive insect and chemical residuals.

Public Food Safety Awareness is increasing "Safe, Clean and Green food!"

AGRI.-LABOR CIRCUMSTANCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Labor in agricultural sector</th>
<th>unit: Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>15.43</td>
<td>39.67%</td>
</tr>
<tr>
<td>2013</td>
<td>13.04</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>12.73</td>
<td>32.20%</td>
</tr>
<tr>
<td>2015</td>
<td>12.27</td>
<td></td>
</tr>
</tbody>
</table>
Protected Cultivation is the solution

• Climate independent.
• Protecting plant from pest.
• Increasing supply-use efficiency.
• Be harmless to the environment.

History of Greenhouse Crop Production in Thailand

Pressure from health concern consumers since the last decade.
Emerging of soilless culture industry in mid 1990s.
Introduction to Greenhouse crop production by “Doi-kham” foundation in early 1990s.

PAST & PRESENT
NFT hydroponic system was firstly introduced to Thailand in 1997.

Consumer’s demand has been increasing.

Greenhouses have been used to support all-year round the exotic lettuce production.

Greenhouse melon growing is in a rising trend.

Substrate grown melon in modern greenhouses.

Soil-grown melon in simple polyhouses.

10,000 plants/3600 m²
150 MT/crops
3 crops/year
Melon grown in a DIY greenhouse in urban BKK

400 fruits/gh x 3 crops/year
600 kg/crop x US$ 6/kg
(US$10,800 /year/gh)

Consumer’s behavior has pushed forward the use of greenhouse for crop production

Mr. Sravut, Former civil engineer

Growers had adopted greenhouse technology to meet consumer’s satisfaction.

Greenhouse crop production becomes widely-spread across all regions nowadays.

Types of greenhouse technology

Low-technology greenhouse / US$ 15-25 m²
Medium-technology greenhouse / US$ 35-60 m²
High-technology greenhouse / US$ 80->120 m²

Low-technology greenhouses
(US$ 15-25/m²)
Medium-technology greenhouse
(US$ 35-60/m²)

High-technology greenhouse
(US$ > 80 m²)

Fan-pad greenhouses

Commercial application of greenhouse in Thailand
• For producing fresh produces
• For producing seeds
• For producing transplants
• For agro-tourism

High-valued and chemical-free crops are grown in greenhouses nowadays.

Greenhouse tomato production by farmer's community enterprise

Greenhouses are used to ensure the success of seed production in term of quantity and quality.
Transplant production is a rising agro-business

Locally developed a semi-automatic seeding machine

Farm visit during holidays is newly popular agro-tourism.

Use of greenhouse for agro-tourism in the resorts.

Greenhouse cooling technology

- Natural ventilation:
  - Side-wall opening and roof ventilator

- Light-shading:
  - Light-shading net is the common and essential accessory in greenhouse in Thailand

- Evaporative cooling:
  - Fogging/Misting is more common than fan-pad cooling method
  - Fan-pad cooling

- Forced air

The natural ventilating through roof ventilator is the most common greenhouse cooling method

- Double-roof style
- Saw-tooth style
- Tropical style
Light-shading net is the essential accessory in greenhouse

Plastic net

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Local technology

Shading-net color

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Evaporative cooling method

Fogging/Misting

Fan-Pad Cooling

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The potential efficiency of fan-pad greenhouse

<table>
<thead>
<tr>
<th>Outside EVAP-Greenhouse</th>
<th>Inside EVAP-Greenhouse</th>
<th>In-outside Temperature Difference (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry bulb temp. (°C)</td>
<td>Wet bulb temp. (°C)</td>
<td>RH (%)</td>
</tr>
<tr>
<td>35</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>35</td>
<td>26</td>
<td>50</td>
</tr>
<tr>
<td>35</td>
<td>29</td>
<td>65</td>
</tr>
<tr>
<td>35</td>
<td>32</td>
<td>80</td>
</tr>
</tbody>
</table>

Effects of greenhouse cooling method on growth, fruit yield and quality of tomato (Solanum lycopersicum L.) in a tropical climate

Effects of greenhouse cooling methods on growth, fruit yield and quality of tomato (Solanum lycopersicum L.) in a tropical climate
Efficiency of EVAP varied with ambient RH%

From Max et al., 2009: Scientia Horticulturae 122 (2009):179-186

Growing techniques used in greenhouses

- **Soil growing**
  - Domestic leafy vegetables e.g. Brassicas, basil, Alliums, etc.
  - Fruit vegetables e.g. melon, cherry tomato, etc.

- **Soilless growing**
  - Hydroponics: lettuces, herbs, etc.
  - Substrate culture: sweet pepper, strawberry, tomato, melon, orchids, etc.

Soil-grown cropping

Substrate grown cropping

Effect of accumulative growing time of coco-coir dust on growth of lettuce (Hossain, 2016)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fresh weight (g plant⁻¹)</th>
<th>Dry weight (g plant⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shoot</td>
<td>Root</td>
</tr>
<tr>
<td>Time used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>76.92a</td>
<td>9.45a</td>
</tr>
<tr>
<td>2</td>
<td>76.03a</td>
<td>9.24a</td>
</tr>
<tr>
<td>3</td>
<td>75.28ab</td>
<td>9.05ab</td>
</tr>
<tr>
<td>4</td>
<td>72.30b</td>
<td>8.50b</td>
</tr>
<tr>
<td>5</td>
<td>68.25c</td>
<td>7.82c</td>
</tr>
</tbody>
</table>

Nutrient (N)

<table>
<thead>
<tr>
<th></th>
<th>Fresh</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shoot</td>
<td>Root</td>
<td>Total</td>
<td>Shoot</td>
<td>Root</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>4.50</td>
<td>8.96</td>
<td>83.46</td>
<td>4.18</td>
<td>0.82</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>3.01</td>
<td>8.65</td>
<td>81.69</td>
<td>4.18</td>
<td>0.82</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Effect: Significant

CV(%): 3.59, 5.77, 3.55, 5.07, 4.58, 4.74
Government support & policy

Technology transfer (KU, DOAE and DOA)
Research (KU, DOA, AIT, NTEC, MTEC)
Extension (DOAE)

The Establishment of Agricultural Technology Complex at Kasetsart University in 2009

Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom, Thailand

ATC Demo: Greenhouse

Visit of visitors to ATC, KU
Seminar & workshop in 2013-15

Seminar & workshop Activity

Participant feelings

From training to commercial

From training to agro-tourism business

Roles of Department of Agriculture

Research & Technology transfer

Capacity Building
THAILAND 4.0

Smart farming

In 2017, DOAE and Provincial governments subsidized
the farmers with greenhouses to promote quality
vegetable production

Center of leafy vegetable production area

6 x 24 m²

The research output from
the Ministry of Science & Technology

National Electronic and Computer Technology Center
National Science and Technology Development Agency

The photo-selective film for greenhouse covering has
already been successfully developed in Thailand.

3 °C Lower
1) Heat accumulation
2) Lack of greenhouse technology transfer system
3) Lack of academic and experienced personnel

Problems and Constrains

Heat build-up inside greenhouse

Growth reduction as the adverse effect of excessive temperature

Winter season

Summer season

A Natural Ventilation Augmented Cooling Greenhouse

1. Light shading net
2. Movable PE film
3. Insect exclusive net
## Lack of appropriate fertigation technology

<table>
<thead>
<tr>
<th>Analysis result</th>
<th>OM (t/t)</th>
<th>Total N (t/t)</th>
<th>Available P (mg/kg)</th>
<th>Available K (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient level</td>
<td>&gt; 5</td>
<td>-</td>
<td>&gt; 60</td>
<td>&gt; 200</td>
</tr>
<tr>
<td>Found</td>
<td>0.25</td>
<td>0.18</td>
<td>357.34</td>
<td>534.35</td>
</tr>
</tbody>
</table>

### Analysis result

- **OM (t/t)**
- **Total N (t/t)**
- **Available P (mg/kg)**
- **Available K (mg/kg)**

### Tailor-made fertigation research reduced fertilizers used 10 times

<table>
<thead>
<tr>
<th>N (mg L⁻¹)</th>
<th>Stem Fresh Wt (g)</th>
<th>Stem Dry Wt (g)</th>
<th>Fruit Wt (g)</th>
<th>Veg. Growth</th>
<th>Repro. Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>200</td>
<td>778.2 ab</td>
<td>94.2</td>
<td>1,612 ab</td>
<td>1,898 ab</td>
</tr>
<tr>
<td>300</td>
<td>300</td>
<td>933</td>
<td>85 ab</td>
<td>1,722 a</td>
<td>1,598 ab</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
<td>842 b</td>
<td>87 b</td>
<td>1,506 b</td>
<td>1,662 ab</td>
</tr>
<tr>
<td>200</td>
<td>300</td>
<td>876 ab</td>
<td>87 bc</td>
<td>1,623 ab</td>
<td>1,722 ab</td>
</tr>
</tbody>
</table>

F-test: * * *

- Tailor-made fertigation reduced fertilizers used 10 times
- Farmer’s conventional fertigation method

## The Prospect of Greenhouse Crop Production Industry

The greenhouse crop production industry can be divided into several parts:

1. **Planting**
2. **Cultivation**
3. **Harvesting**

### Greenhouse crop production industry

**The Prospects of Greenhouse Crop Production Industry**

500 units

THANK YOU FOR YOUR KIND ATTENTION