WAGENINGEN UR
For quality of life

A demonstration greenhouse for Malaysian Horticulture

Trip report April 2010

Anne Elings

Wageningen UR Greenhouse Horticulture, Wageningen
April 2010

Picture front cover: Greenhouse construction at Serdang.

Wageningen UR Greenhouse Horticulture

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1 Summary

The journey to Malaysia was in the context of the project "Tropical Horticulture in Malaysia", funded by The Netherlands Minsitry of Agriculture, Nature and Food Quality with project number BO-10-010-106.

Modernization of the greenhouse horticulture sector in Malaysiar is required in order to realize better quality of the product, higher yields and less production costs.

Construction of a demonstration greenhouse on the basis of this design has been started early April 2010 at Serdang by the Malaysian Department of Agriculture (DoA).

The Terms of Reference of the March mission follow directly from the planned activities:

1. Discuss with DoA staff the activities to be conducted in the greenhouse.
2. Discuss with DoA staff training needs.
3. Visit the greenhouse construction site at Serdang.

The major outcomes of the mission are:

1. Highlighted activities in the demonstration greenhouses:

a. The prime goal will be to attempt to grow a good crop and achieve a good production with a nice quality. This is most convincing towards growers. This will be supported by a number of measurements on the crop, climate, and fertigation.
b. The production in the new greenhouses will be compared with production in an old greenhouse, and with production in the open field. This will give a clear insight in the production and quality increase that this innovation can realize.
c. Rock melon will be the first crop to be evaluated. This crop is relatively easy to manage, and has a 3 months growth period, which will provide swift results. Other possible crops for the future are: bell pepper, chilli, japanse cucumber, various tomatoes, strawberry.
d. Different fertigation regimes will be evaluated.
e. Sensor information will be available on-line for both DoA and WUr, which will enable close monitoring.

2. Funding

It was indicated by DoA that the project would be handed over to growers after one year. However, one year is most likely not sufficient to optimize the greenhouse production system, and that a longer period of production testing would be very useful. It should be reminded that greenhouse cultivation is very knowledge-intensive and that it takes time to acquire experience and become fully acquainted with the greenhouse, its possibilities and limitation. Certainly if various crops are to be evaluated, just as various approaches to crop management and fertigation, then more time would be required.

<u>It was therefore suggested to allocate a number of years for production testing in the new greenhouses, for example 3-5 years.</u>

3. Training priorities:

f. Crop Management and Physiology, and Fertigation
g. Pest and Disease Management
h. Climate Management
i. Marketing
j. Human Resources
k. Greenhouse Construction

The focus during in 2010 should be on Crop Management and Physiology, Fertigation, Pest and Disease Management, and Climate Management. Marketing, Human Resources and Greenhouse Construction, even though they are important, have been given second priority and will therefore be addressed later.

Anne Elings and Jouke Campen can deal with the principles of Crop Management and Physiology, Fertigation, and Climate Management, and will give attention to this in their up-coming visits. A different solution has to be found for Pest and Disease Management.

Mr. Luuk Runia has been contracted to provide on-location, hands-on knowledge where required, and will serve as prime contact person for the greenhouse activities. The Priva company, who supplies the installations, will provide training on the operation of their equipment.

Frequent contact between WUR and DoA would be very useful in monitoring the developments in the greenhouse. This can be by telephone and email.

Kuala Lumpur, Wageningen, May 2010

Anne Elings (anne.elings@wur.nl)

2 Introduction

This report results from the project "Tropical Horticulture in Malaysia", funded by The Netherlands Minsitry of Agriculture, Nature and Food Quality with project number BO-10-010-106.

2.1 Problem statement

Protected greenhouse horticulture in Malaysia has traditionally been concentrated in the highland regions of the Cameron Highlands, where land is scarce and production competes with tropical rainforest. Protected greenhouse horticulture is a growing activity that has been prioritized by the Malaysian government as an area of cooperation with The Netherlands. Also, the private sector sees business opportunities and initiates modernization. Several alternative developments have been initiated recently. For example, in Terengganu in the lowlands, greenhouses that are modern to Malaysian standards have been successfully realized in 2007. The Sime Darby company is seriously interested in constructing greenhouses for their aeroponic vegetable cultivation and for their Northern Corridor rice activities. The Malaysian Agrifood Corporation (MAFC) is developing new areas for horticulture, in which greenhouses may find their place. Most relevant crops are currently rock melon, tomato, cucumber, chillies and sweet pepper; however, consumer's demand or export opportunities may lead to the introduction of other crops. It is desired that these first developments are taken further, also for the highland regions in the Cameron Highlands where the majority of horticultural production is located. Protected greenhouse horticulture is therefore a promising area where public and private partners meet, that can contribute to employment.

Modernization of the sector is required in terms of:

- location-specific greenhouse designs, taking into account climatic conditions and required cooling system, and crop requirements;
- improvement of planting material;
- optimization of cultivation techniques;
- introduction of integrated pest management to substantially reduce use of pesticides and contribute to a lower environmental impact;
- design of above-mentioned components such that they form a well-balanced technology package;
- better quality of the product, higher yields and less production costs;
- an enabling environment (government, research) that is conducive to the further development of the Malaysian horticultural sector;
- a Malaysian training and research capacity that can support the local horticultural industry.

WUR met with a wide variety of stakeholders in 2008 and identified the major obstacles and options for the further development of greenhouse horticulture in Malaysia. Subsequently, WUR designed in 2009 a greenhouse for the tropical lowlands in Malaysia. Construction of a demonstration greenhouse on the basis of this design has been started early April 2010 at Serdang by the Malaysian Department of Agriculture (DoA). Dutch supply industry will be involved.

Operating a modern greenhouse requires a high level of knowledge with regards to general management, climate control, water and nutrient application, pest and disease management, crop management, etcetera. A serious training effort is required here. Only then, sustainable modernization of the Malaysian greenhouse horticulture sector can further develop.

2.2 Terms of Reference Mission

The Terms of Reference of the March mission follow directly from the planned activities:

1. Discuss with DoA staff the activities to be conducted in the greenhouse.
2. Discuss with DoA staff training needs.
3. Visit the greenhouse construction site at Serdang.

3 Department of Agriculture

3.1 Preliminary meeting

A preliminary meeting was held on Wednesday morning April 14th, with Mr. Nordin bin Mamat, Deputy Director, Horticulture Division, Department of Agriculture Malaysia, and staff.

It was agreed that a workshop on greenhouse activities would be held on Thursday, and a workshop on training needs on Friday.

The construction site of the Serdang demonstration greenhouse was jointly visited.

Figure 1. Constuction of one of the greenhouses at Serdang.

3.2 Greenhouse activities

The greenhouse construction has started on Friday April 9th. The footings and first poles are being erected these days. The entire construction can be finished by mid – end May, and first planting should be possible in the first week of June.

The prime goal will be to attempt to grow a good crop and achieve a good production with a nice quality. This is most convincing towards growers. This will be supported by a number of measurements on the crop, climate, and fertigation.
The production in the new greenhouses will be compared with production in an old greenhouse, and with production in the open field. This will give a clear insight in the production and quality increase that this innovation can realize. Rock melon will be the first crop to be evaluated. This crop is relatively easy to manage, and has a 3 months growth period, which will provide swift results. Other possible crops for the future are: bell pepper, chilli, japanse cucumber, various tomatoes, strawberry. Other options for the future are: bell pepper, chilli, japanse cucumber, various tomatoes, strawberry.
Sensor information will be available on-line for both DoA and WUr, which will enable close monitoring.

Three new greenhouses are available, in which different fertigation techniques can be evaluated:

- Greenhouse 1 has a recirculation system, and can for example focus on saving of nutrients. Drain water will be in a underground tank a pumped back to pump house to be used and mixed in the next irrigation.
- Greenhouse 2 is a more simply type than greenhouse 1 and can focus on the minimization of the amount of irrigation water drained.
- Greenhouse 3 pumps water through the system (to flush previous warm irrigation water) and can evaluate the effect of a lower temperature of irrigation water.

It was indicated by DoA that the project would be handed over to growers after one year. KC Chong and Anne Elings brought forward that one year is most likely not sufficient to optimize the greenhouse production system, and that a longer period of production testing would be very useful. It should be reminded that greenhouse cultivation is very knowledge-intensive and that it takes time to acquire experience and become fully acquainted with the greenhouse,

its possibilities and limitation. Certainly if various crops are to be evaluated, just as various approaches to crop management and fertigation, then more time would be required. It was suggested to allocate a number of years for production testing in the new greenhouses, for example 3-5 years.
Cooperation with growers is absolutely welcome, and can be organized fairly soon to ensure that both sides profit from each others' knowledge. Some sort of long-term interaction can then be developed.
The high investment costs of DoA in the greenhouse will not return; a longer involvement in by DoA in the greenhouse would imply maintenance labour costs.

3.3 Training needs

Training priorities:

a. Crop Management and Physiology, and Fertigation
b. Pest and Disease Management
c. Climate Management
d. Marketing
e. Human Resources
f. Greenhouse Construction

The focus during in 2010 should be on Crop Management and Physiology, Fertigation, Pest and Disease Management, and Climate Management. Marketing, Human Resources and Greenhouse Construction, even though they are important, have been given second priority and will therefore be addressed later.

Anne Elings and Jouke Campen can deal with the principles of Crop Management and Physiology, Fertigation, and Climate Management, and will give attention to this in their up-coming visits. A different solution has to be found for Pest and Disease Management.

Mr. Luuk Runia has been contracted to provide on-location, hands-on knowledge where required, and will serve as prime contact person for the greenhouse activities.

The Priva company, who supplies the installations, will provide training on the operation of their equipment.
Frequent contact between WUR and DoA would be very useful in monitoring the developments in the greenhouse. This can be by telephone and email.

4 Other meetings

4.1 Netherlands Embassy

Various discussions were held with Mr. K.C. Chong, Assistant Agricultural Council, on the project progress and future planning.

On Wedesday afternoon, a visit was paid, together with Mr. Luuk Runia, to the Netherlands Ambassador to Malaysia, Mr. Paul Bekkers. Mr. Jan Soer, Deputy Head of Mission, also attended the meeting. The Embassodor was briefed with regards to various aspects of the project.

Annex I.

Greenhouse activities (detailed)

The greenhouse construction has started on Friday April 9th. The footings and first poles are being erected these days. The entire construction can be finished by mid – end May, and first planting should be possible in the first week of June.

The prime goal will be to attempt to grow a good crop and achieve a good production with a nice quality. This is most convincing towards growers. This will be supported by a number of measurements on the crop, climate, and fertigation.
The production in the new greenhouses will be compared with production in an old greenhouse, and with production in the open field. This will give a clear insight in the production and quality increase that this innovation can realize.

Three greenhouses are constructed. The greenhouses differ with respect to their fertigation system:

- Greenhouse 1:
  - Recirculation
  - Drain meter, tensio meter and at light meter at pump house.
  - Drain water will be in a underground tank a pumped back to pump house to be used and mixed in the next irrigation.

  Greenhouse 1 therefore enables the evaluation of a recirculation system, and can for example focus on saving of nutrients.
- Greenhouse 2:
  - Tensio meter and light meter only.
  - Minimum drain.

  Greenhouse 2 is a more simply type than greenhouse 1 (but also cheaper), and can focus on the minimization of the amount of irrigation water drained.
- Greenhouse 3:
  - As greenhouse 2
  - But, before every irrigation the water will be pumped through the system (to flush previous warm irrigation water).

  Greenhouse 3 can evaluate the effect of a lower temperature of irrigation water (the warm water in the system is removed each irrigation moment).

The discussions on the greenhouse activities are summarized. In the near future, DoA staff will gather to further discuss details.

To plan activities, a number of subjects was dealt with in a systematic manner:

1. **Reasons for greenhouse activities:**
   Business / money / new technology / productivity & quality

2. **Goals**
   a. Stakeholders:
      i. Farmer (big / small)
      ii. DoA
      iii. Governement
      iv. Private sector
      v. consumers
   b. Commercial and institutional setting:
      i. Help small farms move forward, solve cost / benefit
   c. Broad lines, priorities:
      i. Finetune and transfer established technology
      ii. Production / quality increase
      iii. Small farms, also big farms
3. **Objectives (more detailed) for the first year:**
   d. Double production, quality, food safety
   e. Right environment (temperature, fertigation, etc.)
   f. Cost reduction, profit increase

g. Suitability of construction

4. Possibilities:

h. Greenhouses/ land:
   i. 3 greenhouses
   ii. 1 open field
   iii. Already existing, standard greenhouses
i. Equipment:
   i. All: drip irrigation, runn-off water to pond, motorized power spraying
   ii. Land: drip irrigation
   iii. New greenhouse: cocopeat, screens (haze 32/24), roll-up plastic
   iv. Existing greenhouse: autopot, polybag, cocopeat, paddy husk
j. Sensors, computers:
   i. Land: irrigation timer, weather station
   ii. New greenhouse: fully equipped (*check: are all sensors everywhere?)*
   iii. Existing greenhouse: manual: temperature, EC, pH, light, Dissolvent Oxygen (DO)
k. Staff – expertise:
   i. DoA for new greenhouses
   ii. Existing greenhouses: commercial growers
   iii. Management: administration, marketing, growth advisors
   iv. Technical: Officer in charge, assistant to OiC, 5 labourers
   v. Engineering: Engineering officer, 1 technician
l. Water:
   i. Quantity: OK
   ii. Quality: TDS, pH, EC, DO; periodic sampling
m. Nutrients:
   i. Availability OK
n. Chemicals
   i. Availability OK
   ii. Detergent for cleaning plastic (*which one?*)
o. Finances:
   i. OK for operating in 2010 (*it would be useful to make a budget*)
   ii. Budgets to check:
      1. Maintenance
      2. Development, modification
      3. budget 2011
p. Time
   i. Project is now for one year. Should be longer?

5. Preferred working habits

q. task division:
   i. Site Coordinator
   ii. Site Engineer
   iii. Site Officers (2)
   iv. Leader at HQ (2)
   v. Secretary
   vi. Labourers (5)
r. back-up facility
s. 24h, seasonal, timing
t. External
   i. electrician

6. Experimental details?

u. Treatments
   i. Facility (old/new greenhouse, land)
   ii. Fertigation system
   iii. Pest management system (*it still has to be decided whether in different greenhouses, different pest management systems will be applied*)?
v. Planting date
   i. Sowing 4th week May
   ii. Transplanting 2nd week June
w. Crops, cultivars

i. Rock melon (relatively easy to manage, 3 months growth period, therefore swift results)
(other options: bell pepper, chilli, japanse cucumber, various tomatoes, strawberry)
ii. 2 cultivars (Golden Langkawi, Glamour)

x. Crop management
i. 2 stems
ii. Own expertise

y. Fertigation regime
i. The fertigation regimes follow from the differences between the three greenhouses.
ii. Fine-tuning will take place as the crop grows.

z. Climate
i. Use of for example Reduheat
ii. Variation in opening of plastic; active cooling is not possible.

aa. Observations
i. Production
ii. More: fruit size, fruit growth duration, fruit abortion, leaf area, etc.
iii. Sugar (Brix), fruit appearance
iv. Pesticide usage, residues on fruit
v. Pest and disease pressure
vi. chemicals
vii. Climate
viii. Fertilizers
ix. water

bb. Pest & disease management
i. IPM (trapping, spraying based on scouting, nets, etc.)
ii. Viruses, bacteria, fungi

7. Data to be acquired, and how?

cc. Climate
dd. Fertigation
ee. Crop
ff. Experiences

8. Expected method of analysis?

gg. Continuous data analysis
i. Regular fruit set

hh. Do the expected data answer your questions?

9. Practical organization?

ii. Electrical supply
jj. Pond
kk. training

Annex II.

Training needs (detailed)

1. **Crop Management and Physiology, and Fertigation**

   Crop Management

   Basic physiology must be supplemented.
   Vegetative and generative growth.
   Plant development, flowering, pollination, fruit set.
   Varietal choice.
   Nutrient levels over time.
   Water requirements.
   Radiation levels.

   Fertigation

   Crop requirements
   Technical application (Priva will do this)
   pH of cocopeat

2. **Pest and Disease Management**

   Surveillance.
   Pesticide use: pesticides are expensive and must be applied in an appropriate manner.
   Insect cycles.
   Types of control.
   Equipment.
   Weeds, host plants.
   Currently, pest management is based on manuals.
   Environmentally-friendly production is an important issue that is to a large extent related to pest and disease management. This requires residu measurement, for which a laboratory is required. The MoD laboratory, which is used for such purposes, is rather slow. Private laboratories are too expensive. Therefore, a fast and simple method for the measurement of insecticeds and heavy metals is needed. An issue of environmental cultivation, that is not relelated to pest and disease management, is the re-use of cocopeat, which will be used in the demonstration greenhouses.

3. **Climate management**

   What is the optimum climate for the crop?
   How can this optimum climate be realized?
   The Priva company will give training in computer operation: technical application, setpoints.

4. **Marketing**

   What added value can be generated, as bringing to the market only fresh products is not sufficiently beneficial.
   Post-harvest handling
   Customer preferences.
   Markets/buyers.

5. **Human Resources**

   Standard operational procedures (SPO's) help pesonell to follow instructions. SOP's can be produced for a number of operations, in particular the standard ones, however, many operations are not-standard. Flexibility and understanding of the greenhouse system is required (therefore, training is important).
   Skilled personell needed.
   Training abroad in new technologies and applications.

6. **Greenhouse Construction**

   A central question is whether the construction works in terms of temperature management and crop production.
   Sensors have to be able, and checked.
   Maintenance.
   A deeper understanding of the greenhouse system is aimed for.

Implementation of knowledge transfer

Given these priorities, the focus during in 2010 should be on Crop Management and Physiology, Fertigation, Pest and Disease Management, and Climate Management. Whereas all knowledge should be available from planting onwards, the question with regards to the suitability of the climate can be fully anwered only at the end of the season.
Marketing, Human Resources and Greenhouse Construction, even though they are important, have been given second priority and will therefore be addressed later.
Anne Elings and Jouke Campen can deal with the principles of Crop Management and Physiology, Fertigation, and Climate Management, and will give attention to this in their up-coming visits.
While Anne has some knowledge on Pest and Disease Management, he is not sufficiently experienced to provide adequate knowledge on this. A different solution has to be found.
Mr. Luuk Runia has been contracted to provide on-location, hands-on knowledge where required, and will serve as prime contact person for the greenhouse activities.
The Priva company, who supplies the installations, will provide training on the operation of their equipment.

Frequent contact between WÜR and DoA would be very useful in monitoring the developments in the greenhouse. This can be by telephone and email. Also, sensor information will be available on-line for both DoA and WUr, which will enable close monitoring.

Annex III.
Itenary

Tue 13 April	afternoon	Departure from The Netherlands
Wed 14 April	Morning & afternoon	Arrival to Kuala Lumpur; pick-up by Luuk Runia, drive to Serdang. Visit construction site at Serdang. Preliminary discussions with Mr. Nordin bin Mamat (Deputy Director Horticulture Division, DoA) and DoA staff.
	afternoon	Check-in at Lanson Place, Kuala Lumpur Rest
	evening	Dinner with Mr. KC Chong, assistant agricultural council, based in Singapore
Thu 15 April	Morning + afternoon	Workshop on training acticities in greenhouse with DoA staff. Visit construction site at Serdang.
	evening	Dinner with Mr. KC Chong, assistant agricultural council, based in Singapore
Fri 16 April	morning	Workshop on training needs with DoA staff.
	afternoon	Visit construction site at Serdang. Lunch with Mr. Luuk Runia, consultant
	evening	Dinner with Mr. Kong Yik Wah (Director Green Farming Agriculture) and Mr. Chan Loy Onn (Executive Secretary), KC Hong and L. Runia.
Sat 17 April		Tourist visit to Melaka
Sun 18 April	morning	Tourist visit to musea in KL
	afternoon	Report writing
Mon 19 April		No flights due to volcano eruption at Island. Other work-related activities.
Tue 20 april		Other work-related activities.
Wed 21 April	Morning	Other work-related activities.
	afternoon	Meeting with Ambassador
Thu 22 April	morning	Visit to DoA, Serdang
	afternoon	Other work-related activities.
	evening	Departure to The Netherlands
Fri 23 April	morning	Arrival to Amsterdam and Wageningen

Annex IV.

Persons met with

Name	Position	Address	Email / web	Telephone/fax
Luuk Runia	Consultant to the project	Asian Perlite Industries Sdn. Bhd. 7B Persiaran Camellia 4 39000 Tanah Rata Cameron Highlands, Pahang	growsys@tm.net.my	T: +60135305566
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Jan A. Soer	Deputy Heade of Mssion	Embassy of The Netherlands 218 Jalan Ampang 50450 Kuala Lumpur	Jan.soer@minbuza.nl	T: +60-3–21686211
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	Partner	Green Farming Agricultural		
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Annex V. Photographs

Figure 2. Some more images of the construction of the demonstration greenhouse at Serdang. Below right: Mr. Luuk Runia.

Annex VI. Introduction to greenhouse activities

20 January

7 February

9 February

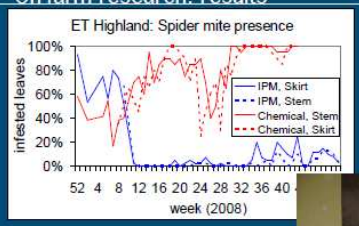
16 February

First harvest

Expectation: IPM in Ethiopia

- Rose: various varieties
- Red spider mite *(Tetranychus urticae)*
- *Phytoseiulus persimilis* & *Amblyseius californicus*

On-farm research: results



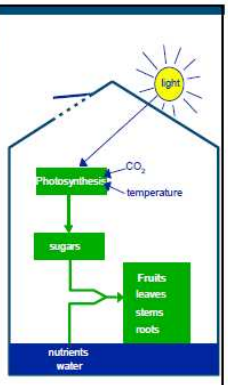
- 10-15% more stems m²
- Greater stem length

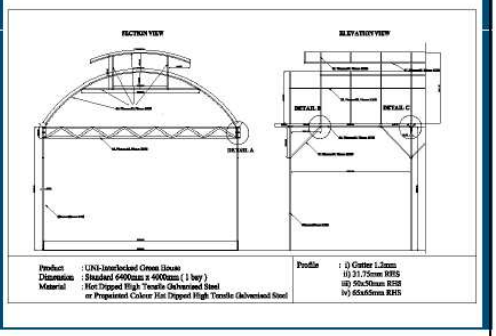
On-farm research: lessons learned

- Commitment
- Identification & monitoring
- Intensive communication
- During transition phase:
  - Low pest levels
  - No chemical residues
- Knowledge exchange

Greenhouse horticulture: more than just a crop

- Optimize
  - Crop
  - Climate
  - Greenhouse
  - Grower
  - Value chain
  - Enabling environment





Three greenhouses

- Greenhouse 1:
  - Recirculation
  - Drain meter, tensio meter and at light meter at pump house.
  - Drain water will be in a underground tank a pumped back to pump house to be used and mixed in the next irrigation.
- Greenhouse 2:
  - Tensio meter and light meter only.
  - Minimum drain.
- Greenhouse 3:
  - As greenhouse 2
  - But, before every irrigation the water will be pumped through the system (to flush previous warm irrigation water).

Sensors

- Weather station
  - Temperature (in & out)
  - Relative humidity
  - Wind direction & speed
  - rain
- CO2 (?)
- Tensio
- Light
- Medium temperature
- drain

Setting up the research

- reason for the research
- research goals
- research objectives: more detailed
- possibilities
- restrictions
- preferred working habits
- experimental details
- data to be acquired, how
- practical organization
- expected method of analysis

Annex VII: Introduction to training

Serdang demonstration greenhouse – knowledge component

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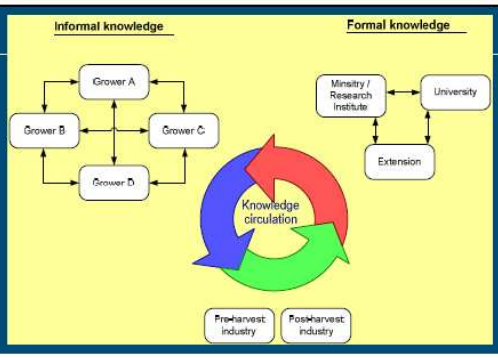
Greenhouse horticulture & knowledge

- Growing a greenhouse crop is knowledge-intensive
- Knowledge needs to be in line with latest insights with regards to
  - crop management
  - Pest and disease management
  - Fertigation
  - climate control.
- Only then MoD staff can make the most out of the demonstration greenhouse.

Two knowledge systems

- Formal knowledge system
  - researchers and extension workers
- informal knowledge system
  - growers
- Both systems generate and possess different types of knowledge.
- A strong interaction is needed to
  - ensure fast learning
  - stay on top of latest developments in practice and research



Knowledge

- Short term
- Medium term
- Long term