Wageningen UR
For quality of life

Egyptian greenhouse cultivation at a higher level with Dutch technology

Annual Report 2013

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Summary
The project 'Egyptian greenhouse cultivation at a higher level with Dutch technology' is co-funded under the Top Sector Programme Horticulture and Starting Materials. The project wants to realizes through the use of Dutch technology a higher level of sustainability of Egyptian protected cultivation, especially in the areas of water and crop protection. Collaborating private partners are Koppert and HortiMaX in The Netherlands, and BioEgypt and AllGreen in Egypt. Wageningen UR Greenhouse Horticulture is the collaborating resaerch partner. In the first year 2013, the project proposal was agreed upon, and after summer, water technology was demonstrated at the AllGreen farm. As this is only effective if crop cultivation in a general sense is improved as well, weekly skype meetings were organized between Wageningen UR and AllGreen. The political unrest caused delay in the process to suggest revision of current rules with regards to the import of biological control agents. It is envisaged that in 2014, when the political situation has become more quiet, the project will accelerate.

Samenvatting
Het project 'Egyptische kasteelt op een hoger niveau met Nederlandse technologie' wordt gecofinancierd door het Topsector programma 'Tuinbouw en Uitgangsmaterialen'. Het project wil door middel van toepassing van Nederlandse technologie een hoger niveau van duurzaamheid in de Egyptische bedekte teelt realizeren, met name op de gebieden van water en gewasbescherming. Samenwerkende private partners zijn Koppert en HortiMaX in Nederland en BioEgypt and AllGreen in Egypte. Wageningen UR Glastuinbouw is de samenwerkende onderzoekspartner. In het eerste jaar, 2013, werd overeenstemming bereikt over het projectvoorstel, en na de zomer werd watertechnologie bij AllGreen gedemonstreerd. Aangezien dit alleen effectief is als de gewasteelt in algemene zit wordt verbeterd, werden wekelijks skype vergaderingen georganiseerd tussen Wageningen UR en AllGreen. De politlieke onrust zorgde voor vertraging in het proces dat was gericht op het aanbieden van veranderingsvoorstellen met betrekking tot de import van biologische gewasbeschermingsmiddelen. Het wordt voorzien dat in 2014, als de politieke situatie meer tot rust is gekomen, het project versneld kan worden uitgevoerd.

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Content

1 Introduction

1.1 Project summary

The project 'Egyptian greenhouse cultivation at a higher level with Dutch technology' realizes through the use of Dutch technology a higher sustainability of Egyptian protected cultivation, especially in the areas of water, which has absolute priority in Egypt, and crop protection. The Egyptian horticultural sector is in dire need of an innovative approach that increases its sustainability. Dutch technology is offered as an integrated and optimized package for Egyptian conditions. In particular, this concerns the import and application of water technology and of biological control agents, which are currently not permitted on the Egyptian market. With regards to water technology, the project want to demonstrate the effects of high-quality water technology on the water use efficiency and crop production. With regards to biological control agents, the project wants to open a dialogue with the Egyptian Government to realize a new legislation. The ambition is to import biological agents from The Netherlands, either under a new legislation, or on the basis of a waiver. In a demonstration trial, the effects of better water management and more biological control of pests and diseases on sustainability in Egyptian greenhouse horticulture will be shown. Knowledge on local conditions is gathered to optimize the greenhouse management strategies. The project realizes under practical conditions a platform where knowledge can be shared and that forms the nucleus for scaling up to other horticultural companies. This leads to follow-up business. The project wants to seize commercial opportunities in Egypt.

1.2 Project details

The project 'Egyptian greenhouse cultivation at a higher level with Dutch technology' is co-funded under the Top Sector Programme Horticulture and Starting Materials ('Topsector Tuinbouw en Uitgangsmaterialen) of the Netherlands Ministry of Economic Affairs under number 399, and under number BO-27.05-001-002 (contact person Mr. Jan van Vliet). It falls under the Innovation Theme 'More with Less', sub-theme Sustainable Production.

The intended project duration is from January 1st, 2013 to December 31st, 2016.

The formal contact person is Mr. Yassin Lahiani, Koppert B.V., Veilingweg 14, 2651 BE Berkel en Rodenrijs; P.O. Box 155, 2650 AD Berkel en Rodenrijs T: 010-5140444; M: 06-51956893;ylahiani@koppert.nl.

The project co-ordinator is Dr. Anne Elings, Wageningen UR Greenhouse Horticulture (see report cover for contact details).

1.3 The consortium

The full consortium is given in Table 1.

Table 1. Consortium details.

Name	Company	Further information
Yassin Lahiani Johanette Klapwijk	Koppert Biological Systems	Berkel en Rodenrijs
Arjen Janmaat	HortiMax	Pijnacker
Mahmoud Zaki	BioEgypt	Cairo, Egypt
Hussein Hassan	AllGreen	Cairo, Egypt
Anne Elings Frank van der Helm Chris Blok Rob Meijer	Wageningen UR Greenhouse Horticulture	Wageningen

The private project partner Koppert supplies packages of biological control agents, biological soil enhancers and knowledge, and participates in workshops in which the results of the demonstration trials are evaluated, and in which up-scaling to other growers is discussed. In addition, periodic consultancy visits to Egypt are paid to guide the demonstration trial and consult with other interested growers. The company provides advisory backing support in the process of designing a new decree on the import, export, production and use of biological control agents.

The private company HortiMaX is supplier of advanced greenhouse management systems and will participate in workshops and training sessions to educate growers on the benefits of advanced water management.

The private partner BioEgypt is present at workshops on biological control and is active, through consultancies, in the spread of knowledge and crop protection technology over Egypt. BioEgypt, being a local company, will have an important role in the dialogue with the Egyptian Government, and may be involved in the evaluation of biological products.

The private partner AllGreen is a grower of high quality fresh fruits and vegetables for export. The company will provide greenhouse facilities with greenhouse management, and be run the first responsible for executing the demonstrations. AllGreen will participate in communication and knowledge transfer.

Figure 1. Mr. Mahmoud Zaki (left) of BioEgypt and Mr. Hussein Hassan (right) of AllGreen.

Wageningen UR Greenhouse Horticulture is involved because of its experience with innovative horticultural projects and international experience. Wageningen UR has an important role in the dialogue with the Egyptian government regarding the (legislation to) import biological control agents. Additionally, Wageningen UR will assist in designing and improving the systems of water management, crop protection, and crop management in general. Also, Wageningen UR Greenhouse Horticulture will participate with scientists in the fields of water technology, crop management, crop protection, and international projects.

Leading in the project are the commercial interests of the private project partners, although there is also a strong public agenda in terms of legislation, sustainability and food supply. The group of project partners is small, are well-known to each other, and share a similar agenda and cooperate intensively by default in the project activities. For this reason, a project committee and an explicit structure to facilitate the cooperation are not considered appropriate. However, if the need arises, senior managers will be involved.

Internal quality control, process management and strategic decision is managed through an annual revision by the project team of project achievements, project plans.

Other project partners:

- Early up-scaling is anticipated. Other Egyptian farms will then join the project, however, not necessarily become a project member;
- A local University may be requested to participate, e.g., through the involvement of a student to assist in data acquisition and analysis;
- The Netherlands Embassy will be requested to facilitate contacts with Egyptian governmental representatives.

1.4 Project description

1.4.1 Goal

The goal of the project is to raise protected cultivation in Egypt to a higher level through the use of Dutch technology, in particular in the field of water, which has absolute priority in Egypt, and in that of crop protection where the use of chemicals still prevails. The project results in a transition to a more advanced and sustainable production system in protected horticulture, limiting the use of water, increasing the water use efficiency ('More Crop Per Drop'), making maximum use of natural enemies and soil enhancers, and minimal use of chemicals. This, in turn, leads to a greater market share of the Dutch horticultural supply sector.

1.4.2 Background

The Egyptian horticultural sector can be divided in two broad areas, viz. small to medium-scale producers that serve the national supply chains, and medium to large-scale producers that serve the export market. The first group uses basic fertigation equipment and operates in a market with little food safety regulation, resulting in high levels of chemical use and risks for both farm workers and consumers. The second group is variable in terms of water technology and complies with international certification standards - as they would otherwise not be in a position to export -, but can nevertheless substantially improve their cultivation system.

Water availability and quality are major issues in Egypt in general, and in agriculture and horticulture in particular. Water resources are declining, quality is problematic, and the use of fossil water resources is not sustainable. Critical for Egypt is also the fact that import of biological control agents (bca's; of which predators are the best-known example, but which also includes soil enhancers) is not permitted. These issues seriously hamper a sustainable development of the industry. Egypt is not in the position to continue the business-as-usual approach, and has to act in a variety of ways to deal with a number of sustainability and food supply/safety issues. As the resource-use efficiency in protected cultivation is higher than in open-field cultivation, a move towards more protected cultivation fits in this strategy.

1.4.3 Scope

The project concentrates on the demonstration of water management and the use of biological control in greenhouse horticulture in Egypt. The actual demonstrations are located at two locations, and should result in up-scaling to other farms in Egypt. The project engages in awareness raising and knowledge transfer.
The project has no activities beyond Egypt, and is not engaged in demonstration activities beyond those at the farm (for example, the supply chain is excluded).

1.4.4 Relevance

1.4.4.1 Relevance for project partners

A successful project will provide Dutch business with a relevant new and growing market. Egypt is an important producer of horticultural products, certainly in the Arab region. New market prospects will therefore also develop in other countries in the region.

The project provides the knowledge institutions with greater expertise regarding protected cultivation under North African conditions, which fits in the internationalization agenda of Wageningen UR as a whole, and of its Business Unit Greenhouse Horticulture. The Middle East has been selected as one of its focal areas.

The project is successful if the import of water technology and biological control agents has been made possible, and if the use of water technology and bca's is spreading over Egypt.

The project builds on a number of earlier initiatives by the project partners, namely:

- Long-standing Netherlands involvement with the Egyptian water sector;
- HortiMaX is a global market leader in greenhouse technology and developer of advanced water management and fertigation equipment. Together with our local partner AllGreen, we promote the use of advanced irrigation automation in Egypt to improve efficiency and save water and nutrients. In 2011, HortiMaX realized the first demonstration greenhouse project together with AllGreen;
- Koppert been trying for a decade access to the Egyptian market to obtain for its products, the project will through mediation and demonstration accomplish this;
- Workshop greenhouses, Ghiza, 2011;
- IPM workshop in December 2010 in Sharm El Sheikh, Egypt;
- Triple-P project (People, Planet, Profit) conducted by WUR, where a chain approach was defined to realize innovations in horticulture.

1.4.4.2 Relevance for the sector

The project is important for the sector due to the fact that Egypt is a major horticultural producer for The Netherlands, Europe and of course the growing domestic market for quality horticultural products. The Egyptian horticultural sector will not only develop for the water technology and crop protection supply industry but in its slipstream also a variety of other suppliers. One technical innovation stimulates further technical innovations. Also for other technologies, Egypt plays a regional example role.

The project reflects the ambition of the top sector T & U to stimulate sustainability internationally. This is very relevant for Egypt with major problems in the field of water pollution, land use and urban development (especially Cairo).

1.4.4.3 Added value

The economic value lies in the increased turnover of the Dutch supply sector in Egypt, and the regional example. In the future, Dutch logistics can play a role in the increased exports from Egypt to Europe. There are also links with the Dutch water sector, which is very active in Egypt.

The social added value lies in better working conditions for farm workers, the better quality of the drain water and therefore that of the surface water in the Nile delta, and delivering products with less chemical residues, which adds to the food safety.

The scientific value lies in increasing the expertise of integrating Dutch technology in the Egyptian technology level, which strengthens the knowledge base relative to other exporting countries for horticulture.

The project contributes to the international position of the Dutch supply sector, especially in the Arab world. The Human Capital Agenda is served by exporting Dutch knowledge and on-site training of horticultural staff, and by for example organizing open days.

1.4.4.4 Knowledge and innovation

The project makes available and improves knowledge and systems that are available in Dutch horticulture, but not yet in Egyptian horticulture. For Egypt, this is an innovation, bringing protected horticulture to a new technological level and introducing new approaches and forms of collaboration.

The project knows three major elements, viz.

1. Introduce advanced water management systems and knowledge in Egyptian horticulture;
2. Enable the import of biological control agents into Egypt, and stimulate the use of biological soil enhancers;
3. Integrate advanced water management and biological control in the management systems of Egyptian horticulture.

The Netherlands possesses high-quality water management technology that can be adapted to local conditions. It concerns for example appropriate decision rules operated by a software system, high-quality fertigation equipment, disinfection of the incoming water, recirculation with disinfection of the re-circulated water, minimization of drain to the outside environment.

Enabling the import of biological control agents is a mixture of a dialogue with all relevant stakeholders, in particular the Egyptian Government represented by the Ministry of Agriculture, the exchange of knowledge regarding the safety and risks to import and use biological control agents in a certain country, and experimentation under controlled conditions. Such a process, resulting in legislation that regulates the import of bca's has been held in different countries. Understanding the political context, identifying key decision points, supply of relevant arguments, and discussing rules and legislation, are some of the process steps.

Stimulating the use of soil enhancers in particular involves the demonstration of their efficacy under local circumstances.

Good water management and integration of biological control agents and biological soil enhancers in the management systems of Egyptian horticulture requires the acquisition of knowledge under Egyptian conditions. Whereas the strategy of good water management and the efficacy of different bca's is known in a general sense, the optimization of the local cultivation system as a whole is not known. Knowledge <u>for local conditions</u> has to be gathered with regards to the interaction between water management, crop protection, climate management, and other crop management strategies. For water, it implies the close monitoring of various water flows and nutrient concentrations, and for crop protection it implies monitoring the survival rates of the predators, the use of other pest and disease management options, and the ultimate efficacy of the bca's. As indicated, much knowledge is available from similar crop protection systems in other places, but nevertheless, this knowledge can not be directly transplanted to Egypt. For biological soil enhancers, it implies the careful evaluation of their capacity under local, often sub-optimal conditions.

More specifically, with regards to knowledge:

- Optimum water application strategy to reduce water needs and increase water use efficiency;
- Optimum nutrient application strategy;
- Effects of Egyptian climate (which can be very hot and dry) and climate management on bca's;
- Effects of crop and water management, and other crop protection measures on bca's;
- Effects of improved water management and integrated pest management on production, product quality, and farm profitability (including possible lengthening of the cultivation season);
- Effects of biological soil enhancers on crop productivity;
- A business case that specifies the benefits, costs and payback time of the new management system.

More specifically, with regards to innovation:

- Transition to a more advanced and sustainable greenhouse system that meets the following Egyptian priorities: less water use, higher water use efficiency, less chemicals, healthier products for consumers, more international trade, a better working environment;
- A national system of knowledge transfer;
- Better market integration.

2 Project plan

Table 2. gives an overview of the planned activities for the entire project period. Revisions are annually decided upon.

Table 2. Time sheet of planned activities.

	Year	**1**				**2**				**3**				**4**			
	Quarter	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	Inception	■															
2	Technical design		■														
3	Realization of demonstration		■														
4a	1st crop, cultivation & monitoring			■	■	■	■										
4b	2nd crop, cultivation & monitoring							■	■	■	■						
4c	3rd crop, cultivation & monitoring											■	■	■	■		
5	Evaluation and system adjustment						■				■				■		
6	Evaluation of biological soil enhancers			■	■	■		■	■	■							
7	Admission of bca's				■	■											
8	first introduction of bca's						■										
9	Knowledge transfer, awareness raising, communication			■	■	■	■	■	■	■	■	■	■	■	■	■	■
10	Up-scaling							■	■	■	■	■	■	■	■	■	■
11	Reporting		■		■		■		■		■		■		■		■
12	Co-ordination	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

2.1 Inception

The project has been started with an inception mission to Egypt, with the aims to meet with the Egyptian project partners and the Netherlands Embassy. Upon return in The Netherlands, results of the discussions held were used to develop this final project plan.
The results of this phase are:
- A concrete project plan;
- Project organization and partner responsibilities;
- Communication protocols.

2.2 General inspection and design of the demonstration facilities

The farms of AllGreen (high-tech) and BioEgypt (mid-tech) are available for demonstration purposes. AllGreen will focus on water and crop management, and BioEgypt will focus on biological soil enhancers. However, biological control agents and water technology may be demonstrated at both farms.
Remote guidance (see phase 3) can only be provided if the demonstration facilities are well known to WUR experts and if possible major shortcomings are removed before commencing the demonstrations. A short mission by a WUR expert on water and substrate issues, and by a WUR expert on crop cultivation will take place shortly early in the project.

The WUR experts will acquire intimate knowledge on the production systems, and will be able to recommend first improvements in the production systems.
The system of data recording, processing and storage will be agreed upon. An automated system is preferred, and standardization is necessary.
The results of this phase are:

- A general description of the demonstration centres (the greenhouse, its installation, crop protection strategies, other management strategies);
- A general description of management strategies and tactics that can be improved upon;
- Agreement on the design of the demonstrations.

2.3 Realization of the demonstration centre

The design that was agreed upon in Phase 2 is realized at AllGreen: installation components (hardware and software), data management, etc. The sanitation is brought to highest possible standards. The system is tested and improved where necessary (fertigation, recirculation, crop protection schemes, data flows, working protocols).
At BioEgypt, an evaluation system of biological soil enhancers is put in place, including enhancer-crop combinations to be tested, growing medium, fertigation schemes, etc.
If possible, water technology is also demonstrated at BioEgypt, just as biological soil enhancers and predators may be demonstrated at AllGreen.
The results of this phase are:

- A working fertigation system and operational crop protection in the demonstration greenhouse;
- En evaluation system of biological soil enhancers;
- Working protocols.

2.4 Crop cycles, growth advice and monitoring

A crop cycle in Egypt last approximately 10 months. No crop is cultivated during the very hot summer months.
Electronic contact will be established weekly between WUR experts in The Netherlands and Egypt, and any relevant aspect of the cultivation cycle will be discussed. The main goal of these discussions is to optimize strategic and operational crop management, in order to maximize production and profit. Without maintaining the broad picture, optimization of water and nutrient application is not fully effective. Access to the local computer system is granted, and visuals (photos, webcam) are made available. Each time, a brief report is written.
This intensive guidance will in any case be provided for the first year, after which the frequency may be reduced as the focus should shift to support the up-scaling (such as open field days and seminars).
To actually be able to demonstrate that more sustainable water use and crop protection is possible, careful observations are necessary. All available data are used to develop a business case in which the profitability of the system is demonstrated. Where possible the data collection happens automatically. It concerns the following:

- Crop growth;
- Production and product quality;
- Water flows (irrigation, drain, recirculation);
- Nutrient use;
- Use of biological and chemical control agent;s
- Fixed and variable costs, and product prices.

The results of this phase are:

- Well growing healthy crops that translate the positive effects of a good fertigation and crop protection in a high yield and good product quality;
- Detailed knowledge on the above;
- A business case, with pay-back time.

2.5 Evaluation and system adjustment

After each cropping season, the results are evaluated and used, if necessary, to adjust the system. This could include an improved method of crop management, fertigation, another biological control, etc. Naturally, improvements will also be implemented during the cultivation period if there is reason to.
The results of this phase are:

- A continuously, motivated improvement of the system.

2.6 Evaluation of biological soil enhancers

Phase 6 starts parallel to phase 4.
Biological soil enhancers are evaluated at BioEgypt for their impact on crop growth and production. Wageningen UR provides, in close consultation with BioEgypt, a detailed experimental design and a working protocol, and is responsible for data analysis. It is likely that first experiments will be conducted in pots, as this for example enables easier randomization. Later validation experiments can be in the ground.
The biological soil enhancers are supplied by both Koppert and BioEgypt, and are admitted to the Egyptian market.
The results of this phase are:

- Quantified effects of biological soil enhancers on crop growth and productivity.

2.7 Import of biological control agents

A workshop on the (legislation regarding) import of biological control agents will be organized. This can be organized as a follow-up to the IPM meeting that was held in December 2010 in Sharm El Sheikh. The current Egyptian legislations currently does not allow for the import of predators (although it does for humble bees), which hampers the sustainability of Egyptian horticulture. Attendees: Egyptian government, Egyptian researchers, Egyptian growers, WUR, EPO, Koppert, BioEgypt, AllGreen, the Netherlands Embassy, others.
This high-level workshop can be organized only after the political situation in Egypt has stabilized. It is not useful to open discussion with lower-rank officials without decisive authority. Give the current situation (April 2013) this is foreseen for the 2nd half of 2013.
After half a year, a follow-up workshop will be organized for further discussions and to bring forward the implementation of legislation.
As an alternative to the political process, it will be attempted to import bca's for experimental purposes, and in this manner enable phase 8 of the project.
The results of this phase are:

- Clear arguments for the import of import of biological control agents;
- Revised legislation on the import of biological control agents. A guarantee for achieving this result can unfortunately not be given;
- As an alternative, import of bca's for experimental purposes.

In case the revised legislation can not be achieved, none of the project partners will be considered defaulting.

2.8 First introduction of biological control agents

The aim is to start integrated pest management (IPM) with the first crop. In any case, pollination with bumblebees is possible because their import has been allowed recently. The greenhouse must be properly monitored for residues of hazardous chemicals. While starting the first demonstrations, the Egyptian government must be involved as closely as possible. Therefore, the project partners are most willing to have parallel demonstrations at farms designated and made available by the Egyptian government. To that end, the dialogue started in phase 6 will be continued.

The results of this phase are:
- Integrated pest management, the use of predators as a first option;
- A lower use of chemicals.

2.9 Knowledge transfer, awareness and communication

Greenhouse horticulture is knowledge-intensive by nature, and even more so when the technology level is increased. The introduction of advanced water management and integrated pest management requires advanced knowledge levels. The grower will, therefore, be guided in the use of the new system. The guidance will be provided primarily by the supervisors of Koppert, HortiMaX, BioEgypt and AllGreen. It will consist of the transfer of background and operational knowledge. The frequency will be relatively high. Where possible, WUR will add knowledge. The goal is not only to transfer facts and cooking book recipes, but rather the transfer of understanding of the entire cultivation system, increasing the awareness of the complexity and operation of the cultivation system. Once this is achieved, independent decision making becoming easier.

Before the technology can be scaled up to the outside world, other growers have to be convinced of its usefulness. This implies an intensive communication of the results to the sector in Egypt, by inviting other growers to the demo. Growers must 'see to believe'. Not only growers will be invited, but also other key stakeholders, such as government officials, researchers, bank representatives, traders, caterers, etc. The entire national and international value chain is the target. The detailed business case is an important part of the communication. Concrete communication means are: open days, journal articles, 1-to-1 conversations, website, etc.
The results of this phase are:
- Informed growers;
- Trained greenhouse staff, from management to workers;
- Informed other stakeholders, such as researchers, decision makers, etc.

Communication of the project results is at the core of the project. To stimulate up-scaling of water technology and biological control, its advantages must be widely known among the Egyptian growers, wholesalers, researchers, governmental representatives, etc. Without this, the project does not meet its commercial potential. A number of means are employed:
- The demonstration sites established at AllGreen and BioEgypt are open to the Egyptian horticultural stakeholders, e.g., through open days or private visits;
- Workshops will be organized on a regular basis, which stimulate an on-going dialogue with stakeholders;
- A quarterly newsletter can be sent a broad audience;
- Project partners bring specific visits to interested growers that are interested in adopting biological control agents and water technology, providing them tailor-made advice;
- Interested growers are invited to training sessions by the project members.

The communication should support the successful spread of the biological control to other growers, and an improvement of the sustainability of Egyptian protected horticulture.

Relevant documents (summary of work plan, progress reports with results) are made available through 'Kennisonline'.

2.10 Up-scaling

There are three types of up-scaling in the project:
a. Up-scaling to other crops;
b. Up-scaling up to other pests;
c. Up-scaling up to other greenhouses, and realizing a larger acreage in Egypt with improved water management and biological control. The ambition is national implementation.

Up-scaling up to other crops and pests may occur within the demo and other growers who are convinced of the possibilities offered by the system. Up-scaling up to other farms is a tailor-made activity in which the Dutch suppliers are closely involved, and in which the results of the demo form an important guideline.
The results of this phase are:
- Application of the system to several crops;
- Application of the system to multiple pests;
- Application of the system by multiple farms.

2.11 Reporting

A progress report will be produced every six months and will account for project progress, and achievement of objectives and finances.
The results of this phase are:
- Periodic reports.

2.12 Co-ordination

Project coordination comprises all activities that are related to project progress, such as monitoring project activities, facilitating communication and exchange of demonstration results, organization of workshops, maintaining contacts with the Egyptian government and Netherlands Embassy, etc.
The results of this phase are:
- A well-coordinated projects in which planning and promises are kept, and adjustments are well motivated, and well communicated.

2.13 Overview of activities in year 1

2.13.1 Planned activities

The first year has a focus on a new legislation with regards to the import of biological control agents, their first introductions, and knowledge transfer, awareness raising and communication. The following activities will be employed in the first year:

Quarter 1
- Inception mission to Egypt, to identify and meet with all relevant stakeholders;
- Development of the final plan.

Quarter 2
- Design of water technology demonstration at AllGreen;
- Design of crop protection trials at BioEgypt;
- Agreed work protocols, including system of data flows;
- Start of water technology demonstration, including providing growth advice by WUR.

Quarter 3
- Continuation of water technology demonstration;
- Evaluation of biological soil enhancers;
- If possible, experimental evaluation of predators.

Quarter 4

- Workshop on (legislation regarding) the import of biological control agents. Attendees: Egyptian government, Egyptian researchers, Egyptian growers, WUR, EPO, Koppert, HortiMaX, BioEgypt, AllGreen, the Netherlands Embassy, others;
- Communication of workshop results;
- Open days at the demonstration site: awareness raising & knowledge transfer;
- Continuation of water technology demonstration;
- Continuation of evaluation of biological soil enhancers;
- Communication of first demonstration results.

2.13.2 Realized programme results 2013

Table 3. Overview of realized deliverables in 2013.

Project Phase	**Deliverables 2013**	**Status end 2013**	**Remark**
1. Inception.	A concrete project plan	Done	
	Project organization and partner responsibilities	Done	
	Communication protocols	Done	
2. General inspection and design of the demonstration facilities	A general description of the demonstration centres (the greenhouse, its installation, crop protection strategies, other management strategies).	Done	
	A general description of management strategies and tactics that can be improved upon	Done	
	Agreement on the design of the demonstrations	Done	
3. Realization of the demonstration centre	A working fertigation system in the demonstration greenhouse	Done at AllGreen	Demo waits for resumption of activities after political unrests
	Operational crop protection in the demonstration greenhouse	-	Postponed to 2014, after revision of legislation
	An evaluation system of biological soil enhancers	-	
	Working protocols	Done for fertigation system at AllGreen	Demo at BioEgypt waits for resumption of activities after political unrests
4. Crop cycles, growth advice and monitoring	Well growing healthy crops that translate the positive effects of a good fertigation and crop protection in a high yield and good product quality	In progress	First season has started at the end of August 2013
	Detailed knowledge on the above		Foreseen for 2014, after first season
	A business case, with pay-back time		Foreseen for later years, after sufficient data have been gathered
6. Evaluation of biological soil enhancers	Quantified effects of biological soil enhancers on crop growth and productivity	-	Evaluation jointly with above-ground biological agents, postponed to 2014

7. Import of biological control agents	Clear arguments for the import of import of biological control agents	Within-project discussions. Development of strategic lines	The work package depends very much on the political situation in Egypt, which in September 2013 did not allow for a high-level meeting. We hope that the situation changes for the better later in 2013. If not, activities are postponed to 2014
	Revised legislation on the import of biological control agents. A guarantee for achieving this result can unfortunately not be given	Not feasible in 2013, postponed to 2014	
	As an alternative, import of bca's for experimental purposes	Not feasible in 2013, postponed to 2014	
9. Knowledge transfer, awareness and communication	Informed growers	In progress	Knowledge transfer is in the first phase restricted to the project partners
	Trained greenhouse staff, from management to workers	In progress	
	Informed other stakeholders, such as researchers, decision makers, etc.		Up-scaling is envisaged from 2014 onwards.
11. Reporting	Periodic reports	Weekly internal reports Annual report	
12. Coordination	A well-coordinated projects in which planning and promises are kept, and adjustments are well motivated, and well communicated	done	

3 Inception missions

3.1 January mission

Anne Elings of Wageningen UR Greenhouse Horticulture visited Egyptian project partners from January 26-29th, 2013. The purpose of the travel was to meet with Egyptian stakeholders (whom had only been contacted my mail and phone, up to that moment), to obtain their expectations, and to agree upon strategic and 2013 project lines. In addition, Mr. Joost Geijer, the Agricultural Counsellor of The Netherlands in Egypt, was met with. Farms were visited, farm staff was introduced, and expectations were formulated.

Brief company descriptions of BioEgypt:
1. Farm since 20 years. 14 ha of which 4 relatively advanced;
2. Very diverse, with flowers for EG market, also vegetables;
3. Agent for Koppert;
4. Low technology level. Initially, the farm was at a higher technological level, however, in finding the best economic balance, the technology level was lowered. Fits with small growers target group;
5. Some houses have pad&fan;
6. Substrate (if used) 50% perlite, 50% cocopeat;
7. Plastic cover lasts only two years. UV, not diffuse. Local production;
8. Provides 300 shops with 8 own truck;.
9. Own production of *Phytoseiulus persimilis.* Own laboratory facilities.

Figure 2. Chrysanthemum grown at BioEgypt.

Brief company descriptions of AllGreen:
1. New farm with self-built greenhouse. Expansion plans after income has been generated;
2. Agent for Hortimax;
3. 1.5 ha capsicum, first crop;
4. Heating through combustion of diesel, hot air led into greenhouse. Heating in winter to realize minimum temperature of 18 ^{o}C at night. Is very expensive;
5. Slabs of cocopeat;
6. Hortimax computer and weather system. Radiation-based irrigation (early morning, every 200 J);
7. Plastic cover, with screens above that are opened/closed dependent on radiation. Plastic is removed in hot summer months; a net house remains;
8. No crop from end-June to mid-August because of high temperatures;
9. Needs 15 kg m^{-1} sweet pepper. Sees this season as start-up, but has to achieve serious production next season;
10. Plants are very compact, with too many fruits. Vegetative / generative balance has to be stabilized.

Figure 3. Yellow-coloured sweet pepper grown at AllGreen.

Company expectations of BioEgypt:
1. Evaluation of predators and soil enhancers; and their promotion and sale (of Koppert products);
2. Optimization of low-tech system.

Company expectations of AllGreen:
1. Increased production;
2. Optimization of high-tech system;
3. Promotion and sale of Hortimax products.

The strategic project outlines were defined as follows:
Water
1. Evaluate relatively high-tech system at AllGreen, meant for large farmers, and organize up-scaling up;
2. Evaluate more medium-tech system at BioEgypt meant for smaller farmers, and organize up-scaling.

Crop protection
1. Enable the import of predators, on the basis of new legislation;
2. Evaluate predators at for example BioEgypt or AllGreen;
3. Evaluate soil enhancing products that contribute to general crop condition.

The programme proposal with work plan for 2013 was agreed upon by all project stakeholders, signed and submitted on April 29th, 2013, to the funding agency TKI.

3.2 April mission

Mr. Frank van der Helm and Mr. Chris Blok of Wageningen UR Greenhouse Horticulture visited Egypt from April 20 to 23, 2013. The purpose of the visit was to prepare for the demonstration projects at BioEgypt and AllGreen. They visited both farms and held long discussions with managers and staff.

With regards to the design of the water technology demonstration trial AllGreen the following improvements in cultivation strategy were identified:

1. Crop maintenance and plant balance (to increase yield: sufficient pinching and pruning in time;
2. Heating (costs): put down a table with night T depending on day T;
3. Screen: calculate the right dates to put in and remove the plastic screen;
4. Substrate (costs): advice on disinfection, re use and re planting (in cubes);
5. Substrate (yield): registration of drain% and drain EC per day and analysing drain.

It was agreed that Skype discussions would be organized each Monday between Mr. Frank van der Helm and Mr. Chris Blok in The Netherlands, and greenhouse staff at BioEgypt in Egypt. Frequent visits to provide cultivation advice are not possible, but Skype discussions were considered a good alternative. Concrete advices on water and nutrient application, climate management and crop management would be provided. Photographs for a visual check are sent, and access to the HortiMaX computer is enabled. Each week, a brief summary of the discussion is distributed.

These discussions were started on August 12th, 2013, preparing for planting of the sweet pepper crop at the end of August.

With regards to the design of the crop protection trials at BioEgypt, it was considered more useful to design the crop protection trails when import of predators would be possible. As a change in legislation is pending, and as because of the political unrest a workshop is not likely to be organized in 2013, this activity is postponed to 2014.

4 Improved water technology

The water technology demo has been planted August 31st.

4.1 Weekly support

Weekly support was provided through Skype and exchange of photos, starting August 12th, 2013. Mr. Frank van der Helm and Mr. Chris Blok of Wageningen UR Greenhouse Horticulture provided support. At the receiving end in Egypt were Mr. Hussein Hassan (farm owner AllGreen), Mr. Nariman Felfel (translator), Dr. Hosni (local consultant), and Mr. Ashraf (crop manager). It took a while before the data on the HortiMaX computer at AllGreen could be accessed by TeamViewer.

Much effort was spent on obtaining complete overviews of plant registrations, production, climate, water and nutrient application. Electricity cuts and non-functional communication channels were frequently frustrating.

4.2 Climate

4.2.1 Outdoor and indoor climate

Climate data are not complete due to power cuts, causing interruption of registration by the sensors.

Daily minimum temperature is approximately 15 - 20 °C. Daily minimum and maximum temperatures are approximately 10-15 °C and 20-30 °C, respectively. However, lowest temperatures occur in the months of January and February, and highest temperatures occur in the months of June, July and August. These months do not fall within the observed period of 2013.
Relative air humidity varies between 40-50% and 90-100%. Most humid (lowest minimum values) was early December. Total daily radiation varied between 5 and 15 MJ m^{-2} d^{-1}, with a relatively large fraction of dully days in the period from mid September to mid November.

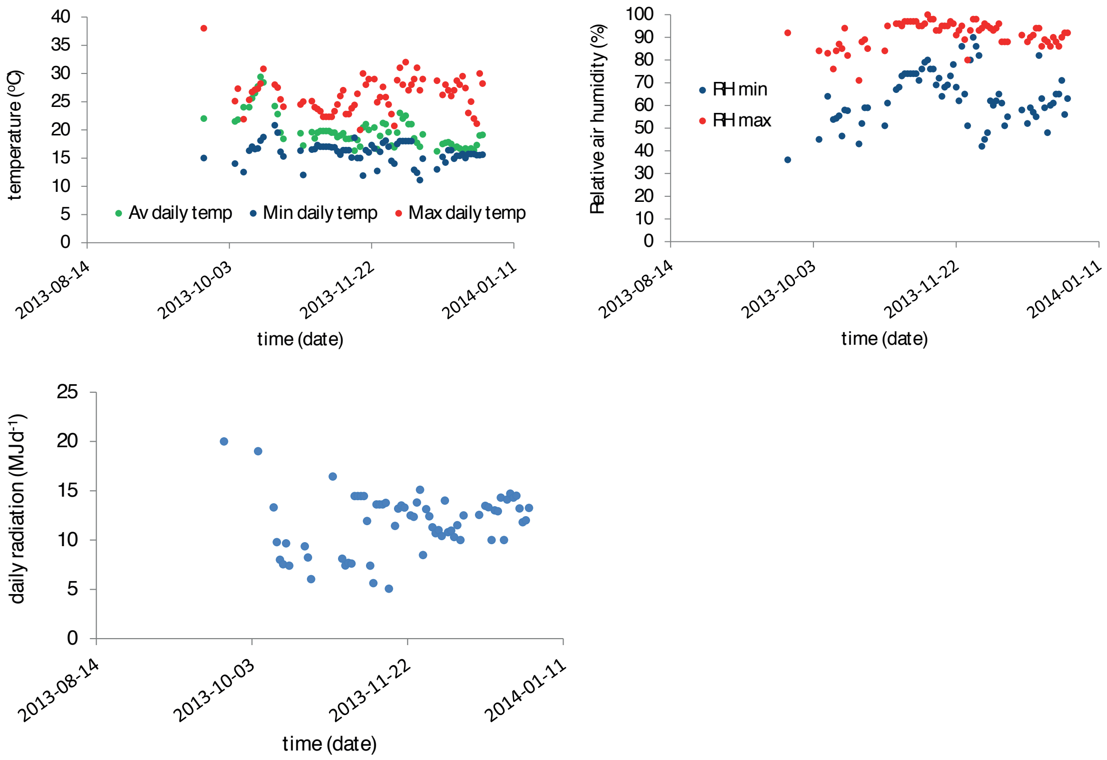

Figure 4. Daily values of temperature, relative air humidity and radiation.

4.2.2 Climate management

The climate in northern Egypt is characterized by high levels of radiation and temperatures in summer, and low night temperatures in winter. Greenhouses therefore require cooling in summer and heating in winter. Cooling is summer at AllGreen is realized through high ventilation rates as the plastic cover is removed and only the net covering is retained (Figure 5). Screens are available to reduce the radiation level. Still, temperatures in the months of June and July are too high to enable production. Low night temperatures in winter are avoided through heating. AllGreen has installed a diesel-operated heating system (Figure 6). Warm air is brought into the crop through plastic tubes, while exhaust fumes are pumped outside.

Figure 5. The AllGreen greenhouse, with an exterior screen/net system.


Figure 6. The diesel operated heating system at AllGreen (left) with exhaust pipes to the outside (right).

The heating strategy for AllGreen is as follows (Figure 7):

- Heating required from November 15th onwards;
- Gradual changes in temperature, to safe energy and avoid condensation;
- Start heating at the end of the light period, to avoid a deep drop at the end of the day/early evening;
- Continue heating early morning, until solar energy takes over;
- Use screens (open shading net; 70% shade) at night to preserve energy;
- Close plastic sides in time.

Major bottlenecks are:

- Problems with data flows, which hamper provision of advice;
- Breakdown of heater or not utilizing heater because of fuel costs. The immediate effects are: low night time temperatures, deformed fruit and parthenocarpic setting, and low fruit quality. Relative air humidity will be higher, pollen will be humid, and pollination with be poor;
- Low night time temperatures will lead to reduced production, and make various improvements in cultivation less effective.

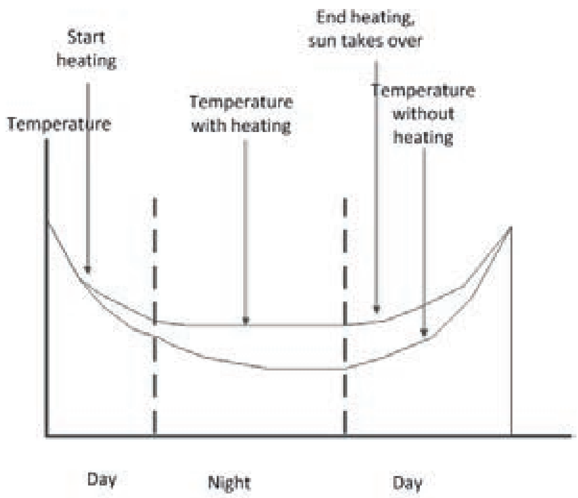

Figure 7. Schematized heating strategy for AllGreen in winter time.

4.3 Fertigation

Irrigation frequency and amounts were based on radiation. The automated HortiMaX system was at times not functional due to power cuts. The goal was to maintain a drain of 20%, and a supply EC of 2.2 and a pH of 5.5 (approximate values;). This proved not always easy. Electricity cuts, not having available nutrient analyses and at times not automated irrigation caused relative instability of the system. Realized slab EC values during 2013 rose from 2.5 to 4.0, after which they declined to 3, and pH values varied at a too high level between 6.5 and 7.5

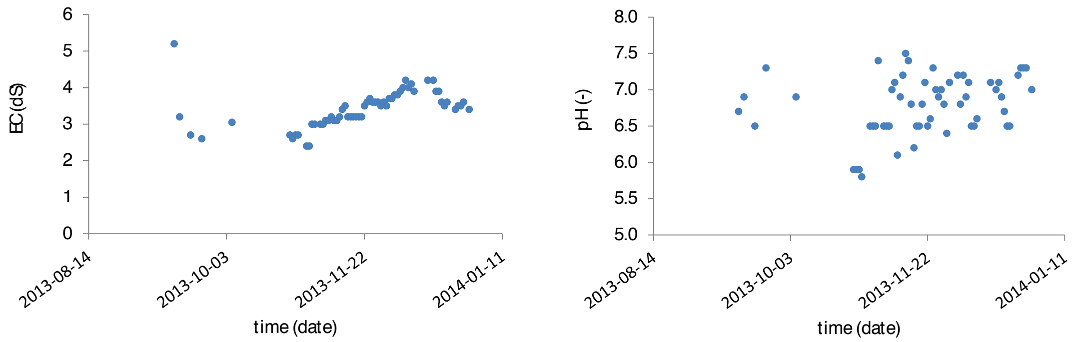

Figure 8. Daily values of slab EC and pH.

4.4 Crop management

The demonstration crop was sweet pepper, colours yellow and red. Plant denstiy was 3.2 plants m^{-2}, two stems per plant, so 6.4 stems m^{-2}. First flowering was recorded on 25/9/2013, and first harvest was on 30/11/2013.

Discussions focused on pruning strategy, setting, fruit load, associated production stability, decent hanging of the plants on the wire, leaf colour, damage control after temperature fall in case of heating break-down, fruit abortion (so, source-sink balances), and various other items.

Essentially, the message that was conveyed was to maintain a stable number of fruits of good quality over time, therewith stabilizing production. This process was very much hampered by low temperature due to breakdown of the heating system.

Production data will be presented in the 2014 annual report.

Figure 9. Sweet pepper plant at November 19th, 2013, and fruit colouring at December 12th, 2013.

4.5 Crop protection

The major crop protection issues were:

- Minimum residue levels permitted in the EU, and by supermarkets in the EU (supermarkets may have their own lists). Recommended websites are:
    - o http://ec.europa.eu/sanco_pesticides/public/index.cfm?event=homepage&CFID=3934;
    - o http://ec.europa.eu/sanco_pesticides/public/?event=activesubstance.selection.
- White fly. recommended website for roller trap management is: http://www.koppert.com/products/monitoring/products-monitoring/detail/rollertrap/;
- Chemicals compatible with humble bees. To be checked with supplier of humble bees;
- Chances of Phytophtera;
- Chances of stem borer;
- Unidentified small worms;
- Mildew.

5 Improved crop protection

Improvement of crop protection systems through the introduction of biological control agents needs to be enabled through changes in current rules and legislation. The current legislation essentially prohibits all activities regarding biological control agents. The strategy was to organize a high-level round-table conference with a number of selected authorities that would result in recommendations towards the Minister of Agriculture and Land Reclamation.

Because of the political unrest1) it was not safe to travel to Egypt and 2) the politically responsible persons changed regularly. The situation was regularly assessed by BioEgypt, Koppert and WUR, and eventually, it was decided to postpone most of the process to 2014, anticipating a situation in which true progress could be made.

Mr. Mahmoud Zaki visited Wageningen UR on December 4th, 2013, during which the strategy was fine-tuned:

- A meeting with the Committee to Review the Laws of Importation of Bioproducts will be organized early 2014, in which amendments will be recommended to the current Ministerial Decree no. 368 of 2010 concerning Production, Export and Import of Biological Control Agents for Agricultural Pests;
- Coordination with the EU Twinning Project on Phytosanitary Services will be realized;
- Macrobials are first priority;
- Soil enhancers are second priority.

6 Other activities

Mr. Hussein Hassan, owner of AllGreen, visited Wageningen UR Greenhouse Horticulture on November 7th, 2013.

Mr. Mahmoud Zaki, owner of BioEgypt, visited Wageningen UR Greenhouse Horticulture on December 4th, 2013.

7 Outlook for 2014 and beyond

Table 4. Planned deliverables 2014.

Project Phase	Deliverables 2014	Remark
1. Inception	-	Finished in 2013
2. General inspection and design of the demonstration facilities	-	Finished in 2013
3. Realization of the demonstration centre	An evaluation system of biological soil enhancers	Postponed from 2013
4. Crop cycles, growth advice and monitoring	Well growing healthy crops that translate the positive effects of a good fertigation and crop protection in a high yield and good product quality	
	Detailed knowledge on the above	
	A business case, with pay-back time	Foreseen for later years, after sufficient data have been gathered
5. Evaluation and system adjustment	A continuously, motivated improvement of the system	
6. Evaluation of biological soil enhancers	Quantified effects of biological soil enhancers on crop growth and productivity	
7. Import of biological control agents	Clear arguments for the import of import of biological control agents	It is anticipated to reach these results in 2013, in spite of hindrance due to political situation. However, it is possible that activities have to be postponed to 2014.
	Revised legislation on the import of biological control agents. A guarantee for achieving this result can unfortunately not be given	
	As an alternative, import of bca's for experimental purposes	
8. First introduction of biological control agents	Integrated pest management, the use of predators as a first option	
	A lower use of chemicals	
9. Knowledge transfer, awareness and communication	Informed growers	
	Trained greenhouse staff, from management to workers	
	Informed other stakeholders, such as researchers, decision makers, etc.	
10. Up-scaling	Application of the system to several crops	
	Application of the system to multiple pests	
	Application of the system by multiple farms	Envisaged for later years, but it might take place sooner
11. Reporting	Periodic reports	
12. Coordination	A well-coordinated projects in which planning and promises are kept, and adjustments are well motivated, and well communicated	

On November 7th, discussed were held with Mr. Hussein Hassan, owner of AllGreen. He expressed interest in expanding to strawberries (planting May/June, first harvest October) and melon in Upper Egypt (planting October, first harvest December/January). This can be considered up-scaling within the project, if two conditions are met: advanced fertigation (HortiMaX line) and utilization of biological pest management (Koppert line).

Annex I Overview of recommendations by WUR

Table 5. Overview of climate management recommendations given by WUR to AllGreen.

Date	Recommendation
2/9/2013	• Radiation peaks at 800 W m^{-2} and is 2300 J d^{-1}. With 70% shade peak is 690 J.
16/9/2013	• Screen is closed automatically at 400 W m^{-2} and will be fully open from Sept. 27th after first setting of fruits. • Sunrise is at 5.45 and 400 W m^{-2} is reached at 8.00 hour. 500 W m^{-2} is reached at 9.20 hour. • Increase light supply over the coming days by closing screens at 500 W m^{-2} for 3 days, than at 600 W m^{-2} for 4 days, than at 700 W m^{-2}
23/9/2013	• Screen is now closed at 600 W m^{-2}, in two days the limit will be 700 W m^{-2} and will be fully open from sept 27th after first setting of fruits.
10/10/2013	• Prepare for heating. Abortion will not be a problem at low temperature, but deformed fruit and parthenocarpic setting could be. Also fruit quality can be negatively influenced. A temperature of 16 °C will be enough at this stage, day temperatures are high
28/10/2013	• Night temperature falls to 12 °C and 24 hour temp is 17.2 °C. This is too low. Heating will be used from next week. • Proposed strategy for heating, before 5.00 am T_off=18 °C => at 5.00 am. T_off=19 °C and T_on = 18 °C, at 7 am. T_off=20 °C and T_on= 19 °C. • Steps for heating setpoinst are 1 °C only, no 0,5 °C steps possible. • Screens are no longer used during the day, but are used during the night to save energy.
4/11/2013	• Last 2 days the screen has been opened manuall during the night because RH was high. Closed screen reduce heat emission and increase greenhouse and plant temp, so it seems better to close the screen. We make a test for 1 night with closed screen. • Heating is expected to start at nov 15th. Currently temperatures have increased and 24 hour temperature is 18,5 to 19,5 which is acceptable in relation to light levels. • It is expected that opening sides would make a difference at the only sides of the greenhouse, however, it would create an unequal climate. Not recommended. • It is not possible to increase light in the greenhouse, there is only plastic, which is already washed.
26/11/2013	• Start heating to prevent deformed fruits by bad setting or reconsider offer on bumble bees.
27/11/2013	• Heating is on since nov 20 • Ventilation by daily opening of sides. • RH is lower during night and also during day, which will improve pollen quality and distribution
28-11-2013	• Ventilation is increased by opening the sides between 10.00 and 15.00 hour • Keep temperature higher than 16 °C, it was again lower on several days.

9/12/2013	• One of the heaters caught fire, and plastic was burned. About 50 slabs of plants are damaged. Flower and young fruit abortion is expected because of smoke. Ventilation immediately after the fire could have prevented some perhaps.
	• The gap in the greenhouse caused lower RH and low temperatures. The gap is closed and heating is restarted.
	• Temperature is constant 18 °C to increase setting, but WUR expects that a drop to 16 °C between 18.00 hour and 0.00 hour would save fuel cost and improve setting
	• Proposed temperature strategy :
	  • 5 pm. heating T_off=17 °C and T_on = 16 °C
	  • 12 pm. T_off=18 °C and T_on = 17 °C,
	  • 4 am. T_off=19 °C and T_on= 18 °C until day temperature is good.

16/12/2013	• Light conditions in greenhouse have improved, because rain washed dust away and fruits are harvested so plants have new energy for young fruits. • Heating is now according to advised strategy.
23-12-2013	• Heating is from 5 to 12 pm at 16 °C and then slowly increased to 20 °C until daytime
28/11/2013	• Keep temperature above 16 °C. • Proposed heating strategy, from 1 hour before sunset to 4 a.m. heating T_off=17 °C => at 4.00 am. T_off=18 °C and T_on = 17 °C, at 6 am. T_off=19 °C and T_on= 18 °C until day temperature is good. • Keep RH as low as possible.

30/12/2013	• There is a strong increase in temperature in the morning: consider to open the sides a little earlier on a sunny day (10 am), so temperature will be more equal. • 15.30 would be a good time to close the sides to keep the warmth in the greenhouse. Close the outside dark screen to in the night when the sky is bright, it will also save energy. • Minimum temperature is reached at 5 am, but should then be 19 °C. • The temperature rise in the morning is done, there are 2 °C drops and peaks, because of the setpoints. Hussein will ask supplier if it can be 1 °C, it is expected it is not good for the heater.

Table 6. Overview of fertigation recommendations given by WUR to AllGreen.

Date	**Recommendation**
28/8/2013	• Irrigation strategy: from 6 am to 10 am every 100 to 150 Joules 2cc/j/m2. It means on average 5 irrigation cycles of 200 to 300 cc. This strategy is in line with our recommendation of about 1.0 litre per square meter per day. This should result in a drain percentage of 0% to maximum of 10%, i.e. rather dry to stimulate rooting in. Preferably slabs should become a little bit drier than at the start of the cultivation. • Because it can be frustrating to have nothing I put down in the table below the fertilisers you mentioned on the phone with formulation and % as I understood (to be checked). In the column 2012 you will find the recipe by Dr. Hosni. I compared that with data for Holland and Spain (they start in august in Spain) and chose and adapted the schedule for this moment (column 2013). The reasons for some changes were: 1. The schedule 2012 gave an EC of 1.9 which I raised to 2.3. Perhaps this was unnecessary as I did not add the nutrients in the basic water you use (I don't have that analysis) or used the wrong dilution. 2. The supply of ammonium was very high. This is OK in soil but dangerous in coir slabs as it will result in a too low pH over time (reason why the grower will do a hand measurement of EC and pH of water from within the slabs every week). So I lowered the amount. 3. The supply of zinc is halved as the levels might become too high and such levels are not necessary in coir. 4. The amount of Borium is increased quite a lot as Dutch advice is a lot higher but not as high as the Dutch for your yield level is lower.
2/9/2013	• A new fertiliser programme using 85% for phosphoric acid and A and B indication • This programme is for EC 2.5, pH 5.5
15/9/2013	Observations: • normal water Ec: 0.9 PH: 7.2 • irrigation water Ec: 1.7 PH: 5.8 • drain water Ec: 3.1 PH: 6.1 • quantity 220 cm3 / day
16/9/2013	• EC in drain this morning was 5.5, irrigation quantity is increased to 400 CC/plant/day • The supply water EC and pH are as we expected and require no action other than to send us a total water analysis. • EC of irrigation water is considered too low • Drain is low, 12 ml/plant/day • The EC of the irrigation water is too low for fast growth as the amount of nutrients is only 1.7-0.9 = 0.8 EC (water EC does not count as nutrient). Raise EC starting with another 0.5 in nutrients, irrigating with 1.7 + 0.5 = 2.2 EC. • Increase irrigation to 400 cc/plant/day
23/9/2013	• EC in drain dropped from 5.5 to 2.6 this morning, irrigation quantity is increased to 400 cc/plant/day, drain increased to 23% this morning. This is good. • The supply water EC and pH are as we expected and require no action other than to send us a total water analysis. • EC of irrigation water is 2.0, which is close enough to recommended 2.2.
30/9/2013	• Maybe small plants are too wet or too dry. Weigh the slabs by hand to feel if they are dry or wet. • PH of drain is high (7.3) but irrigation pH is good (5.5)
28/10/2013	• EC and pH are good, slab measurements not done. • Drain is 20% on average which is good. • New irrigation strategy proposed: every 200 J an irrigation of 300 cc/m2 aiming at 20% drain. If drain is less than 15% change irrigation to 350 cc and if drain is more than 30% change irrigation to 250 cc. If drain changes strongly contact us. End of irrigation at 1.30 p.m.
4/11/2013	• Now 2 to 3 times per day irrigation, quantity is 300cc as discussed, drain is 20%. Is good, all plants look better now. • EC in slabs with strong plants is 3.5 and EC in slab with weak plants is 4 or even more. Slabs with weak plants are wetter and heavier. Some root problems occur, probably Fusarium. Fungicide is used. Measurement is performed at 10 am.

5/11/2013	• Lack of drain noticed, therefore irrigation raised to 400 cc.
7/11/2013	• Drain is currently 20% • Drain is measured daily, but should be measured more frequently, in order to avoid early-morning drain. • Some roots grow inside the drippers. Solution: move the drippers up, and realize space between the soil surface and the dripper. • Hussein will arrange for an analysis of the irrigation water. There might be a K problem. If a new analysis is required, Chris/Frank will indicate so.
11/11/2013	• pH is high and symptoms of possible manganese deficiency in leaves observed on photo • Lower pH of delivery water to 5.0 by using sulphuric acid • Take a nutrient analysis of delivery water and drain water as soon as possible!. • A new nutrient solution will be calculated based on analysis. • Drain % varies strongly between days, (cause is Power cuts) • Irrigation is 400 cc every 200 J between 7 am and 1.30 pm. Results in 4 cycles per day. • New strategy proposed 300 cc every 150 J between 7 a.m. and 1.30 p.m.
18/11/2013	• Drain goes up with a decrease in radiation level. This is dangerous as slabs may become too wet, which may lead to diseases. • Start and stop time of irrigation should be close togehter on dull days (e.g., 9:30 and 12:00). • It seems that automation on the basis of irrigation is not working
21-11-2013	• The drain is too high on several days because the irrigation setting is too high. After a electricity cut off 300 cc every 150 joules is given, but after three days the slabs are full of water and drain % rises over 50%. Irrigation is then decreased to stabilise at 20% drain by changing irrigation to 75 cc per 150 joule. • Nutrient analysis will arrive next week • pH is dropping fast now. It rised up to 7.4, but on day of meeting it was 6.2. When pH gets lower than 5.8 than increase pH of delivery water from 5.0 to 5.5.
26/11/2013	• Drain is good, but what is now the irrigation strategy • Keep pH of delivery water at 5.0, inform why pH increased to 7.3?
27/11/2013	• EC of fresh water is 0.2, pH is 8.1 • pH in irrigation water setpoint hortimax is 5.0, but at dripper 5.6 is measured. Something is wrong here. • Irrigation strategy is now 220 cc/m2 and 4 to 6 irrgation cycles are given (4 cycles is 300 cc per plant).

28/11/2013	• A complete nutrient analysis is urgently required.
	• The pH is much too high in the slabs and the unit does not correct the pH correctly because of the bicarbonate content. Deviation in pH between unit and dripper is common. The basic reaction is H+ + HCO_3- = H20 + CO_2 BUT this reaction takes time because it takes time for the gaseous CO_2 to leave the solution to the air. The unit adds acid and then sends the solution within a minute. The reaction however takes 30 min-6 hours depending on the concentration bicarbonate. This means between the unit and the dripper the solution will go on liberating CO_2 which then disappears at the dripper and at the same time increases the pH. The reaction will even continue in the slab.
	• Solutions are:
	  • Use a clean water basin and add acid “(to bring the pH to 5.5) days before sending it to the unit (best solution, done in Spain)
	  • Add slightly more acid i.e. up to pH 4.5 because you know it will still be higher at the dripper and even higher in the slab (this you can do now right away).
	• Sent nutrient solutions to dutch laboratory
	• Lower pH of nutrient solution to 4.75
	• pH goes up and down and also irrigation supply. pH in water at dripper is steady about 5.3
	• Power cuts are cause for variation in irrigation. Most likely also pH variation.
	• New irrigation strategy is proposed by TD to 500 cc every 250 joule to create more flowers. It is not supported by Frank and Chris because it will increase differences between plants and give higher risk of drying out. Plants are stressed by water shortage already enough because of power cut.
	• Yellow in leaves might be caused by many causes; aging because of pesticide use, defficiency of magenesium (Mg was not in analysis), defficiency of Manganese (Mn) because of high pH. We need all analysis and fertigation programme to know.
	• Do not increasing P as ti is already very high in last nutrient analysis.
	• Keep old irrigation strategy of Lower irrigation to 75 cc every 150J as long as 20% drain is achieved (TD), if drain is low increase irrigation at same 150J

9/12/2013	• It was observed that the Hortimax installation did not control the heating, but that the control panel in the greenhouse did. The system is now changed such that the control panel is set at 15 °C, so heating is now controlled by Hortimax

16-12-2013	• No drain, so no pH and EC are measured, during meeting pH was measured (EC 3.8 and pH 6.8) • Ammonium nitrate is increased from 15 to 50, plant growth is good at the moment. • Calcium nitrate appeared to be wrong formula (fraud by company) • Ammonium nitrateof 50 kg is too high, danger is that pH will drop very fast. Daily measuring pH is very important • If the tank is empty a new schedule with lower ammonium will be made. Dr Hosni will sent next fertigation programme • Nutrient analysis of Egyptian laboratory is useless. Hussein will sent sample to Netherlands
23-12-2013	• Ammonium nitrate in fertigation is reduced again to 15 kg, because pH is now 5.3 in slab, so it starts to get low. • Evaporation improved by lower RH and more leaves and resulted in higher level of irrigation at equal drain %, watch out to give too much water now, drain % should remain under 30%.
30-12-2013	• pH was high again, so Dr hosni made a new programme and increased Ammoniumnatrate to 30 kg. • Please be aware that there are two risks of using a lot of ammoniumnitrate: the roots may burn by a quick drop of pH and a higher risk of Blossom end rot

28/8/2013

			%			2012	2013
				liter	dilution	kg	kg
Ammonium nitrate	solid	NH_4NO_3			200	35	20
Potassium sulphate	solid	$K2SO_4$			200	80	107
Magnesium sulphate	solid	$MgSO_4$			200		0
Magnesium nitrate	solid	$Mg(NO_3)2$			200	51	68
Calcium nitrate	solid	$Ca(NO_3)2$			200	125	167
Phosphoric acid 58%	liquid	H3PO4	58%	25	200	35.5	47
Mono ammonium phosphate	solid	NH_4H2PO4			200		0
Fe-EDDHA 6%	solid	Fe	6%		200	3.3	4.4
Manganese sulfphate	solid	Mn	32.5%		200	0.35	0.5
Zinc sulphate	solid	Zn	23%		200	0.4	0.3
Copper sulphate	solid	Cu	25.5%		200		0.0
Borax	solid	B	11.3%		200	0.90	2.7
Molybdenium	solid	Mo	39.6%		200		0.0

2/9/2013

			%				2012	2013
				liter	dilution		kg	Kg
Ammonium nitrate	solid	NH_4NO_3			200	B	35	20
Potassium sulphate	solid	$K2SO_4$			200	B	80	107
Magnesium sulphate	solid	$MgSO_4$			200			0
Magnesium nitrate	solid	$Mg(NO_3)2$			200	A	51	68
Calcium nitrate	solid	$Ca(NO_3)2$			200	A	125	167
Phosphoric acid 58%	liquid	H3PO4	85%	25	200	C	42	40
Mono ammonium phosphate	solid	NH_4H2PO4			200	B		0
Fe-EDDHA 6%	solid	Fe	6%		200	A	3.3	4.4
Manganese sulfphate	solid	Mn	31.0%		200	B	0.35	0.47
Zinc sulphate	solid	Zn	21%		200	B	0.40	0.27
Copper sulphate	solid	Cu	25.5%		200	B		0.13
Borax	solid	B	11.3%		200	A	0.90	2.7
Molybdenium	solid	Mo	39.6%		200	B		0.05

			%	gr/kg								NH4	K	Ca	Mg	NO3	SO4	PO4	Fe	Mn	Zn	Cu	B	Mo
					Specific Weight	Molar weigth	gr/kg	liter	kg	dilution														
						g/mole						mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	micromol/l	micromol/l	micromol/l	micromol/l	micromol/l	micromol/l
Ammonium nitrate	solid	NH4NO3				82			50	150		4.1				4.1								
Potassium sulphate	solid	K2SO4				174			75	150			5.7				2.9							
Magnesium sulphate	solid	MgSO4				120				150														
Magnesium nitrate	solid	Mg(NO3)2				150			51	150					2.3	4.5								
Calcium nitrate	solid	Ca(NO3)2				166			100	150				4.0		8.0								
Phosphoric acid 58%	liquid	H3PO4			1.42	98		25		150								0.0						
Mono ammonium phosphate	solid	NH4H2PO4				116			17.5	150		1.0						1.0						
Fe-EDDHA 6%	liquid	Fe	6%	60		1422			4.5	150									21.1					
Manganese sulfphate	solid		32.5%	325		169			0.47	150										18.5				
Zinc sulphate	solid		23%	227		287.5			0.23	150											5.3			
Copper sulphate	solid		25.5%	255		249.7			0.056	150												1.49513		
Borax	solid		11.3%	113		381.2			0.82	150													14.3	
Molybdenium	solid		39.6%	396		241.9			0.025	150														0.68899
											Sum	5.1	5.7	4.0	2.3	16.6	2.9	1.0	21.1	18.5	5.3	1.5	14.3	0.7
											cation sum	23.4												
											anion sum	23.4												
											EC	2.3												

Table 7. Overview of crop management recommendations given by WUR to AllGreen.

Date	Recommendation
29/8/2013	• Strategy: • 3.2 plants m^{-2}, two stems per plant, 6.4 stems m^{-2}. • Fruits only from 3nd node above junction. • Have bumble bees been used?
15/9/2013	• Expected 1st flowering: On 25/9/2013 • expected 2nd flowering (bumble bees in your area are most commonly used from the second flowering): On 2/10/2013
16/9/2013	• Plants are in splitting phase, first flowers open and are removed until sept 25th
17/9/2013	• Some plants are collapsing and already needed to be bound up in the wire to prevent them from lagging behind and producing less. Bind plants in as soon as possible.
23/9/2013	• Lowest three leaves flowers are pruned, first setting expected sept 25th
25/9/2013	• Crop looks good, clearly better than last week, more growth, benefit from extra light shows • Older leaves look worn out. Might be early aging due to low light/high temperature combination, but can also be damage or defeciency. Needs a closer look, what is TD opinion? • Pruning is done a bit late, because broken stems are thick, better leave one leaf on the plant with pruning. We are approaching a period of lower light and a load of developing fruits on the plants. I think the plants can use a leaf more than. • The 2nd plant on the 2nd row has a brown plantfoot. Stem also looks thinner. Do you seen more smaller plants, do they have a brown foot like that plant, please take a good look. • The 2nd plant on the 1st row shows a little shoot at the foot end. Please remove these when you see them. • Some plants are clearly smaller than others. Take away flowers of one or two extra leaves if a plant is small.
30/9/2013	• Some plants growth is retarded, what can be the cause? • Keep one leaf with pruning
28/10/2013	• Current fruit load is 5 fruits per plant (2 stems), setting still continues the coming 2 weeks. • Pruning is discussed. Limitation of fruit set because of coming darker period. Proposal: Allow total of maximum 7 fruits per plant (2stems) at strong plants. Allow no more than 4 to 5 fruits per plant (2 stems) at weak plants. • Smaller plants are still observed, no disease problems seen. Decrease fruit load on these plants. • Proposal for fruit load: Allow total of maximum 7 fruits at strong plants. Allow no more than 4 to 5 fruits at weak plants. • Be on time with crop management (pruning and keeping plants in the wire, any that fall out is a big loss).
4/11/2013	• Fruit load of 6. Growth is decreasing, smaller internodes (5 cm to 3cm), flower abortion is occuring. Plant is loaded maximum at 6 fruits. No more setting over 6 fruits is alowed. Watch plant growth. • Please also remove all medium sized fruits of infected plants or plant that you suspect are infected. It gives the plant more power to make new roots.
11/11/2013	• Difference between small and large plants is getting smaller, small plants seem to catch up a bit. • Fruit load is heavy at plants on photos . Plants on Photo carry 7 to 8 fruits, which is to heavv. However, counting says average is 5-6 fruits per plant (not per stem) on large plants and 4-5 fruits per plant on small plants, which is good. • Removing some green fruit, but only of plants that carry more than 6 fruits is advised to prevent too much growth retarding, preferably flat and misshaped fruits.
21-11-2013	• The variability of plants is still to big, great difference in plant size and it is increasing. Ashraf would like to open screens at the side when temperature is above 25 °C, which is ok. However, difference in plant size can also easily be increased by the irrigation problems. • Currently there is no setting, considering the number of fruits it is not expected. Some fruit setting was there but fruits arre deformed and seedless. It is expected to be caused by low night temperatures. In data no low night temperatures are observed, but data is not reliable. • Photo is sent of deformed seedles fruit and it looks indeed like a problematic setting due to low night temperatures. Heating will be started as of november 20.
26-11-2013	• Photo’s sent last week indicate very bad setting, can be low temperature and high humidity (probably it is both) • Bumble bees are expected to strongly improve setting, production and quality in this situation • Heating is expected another method to improve setting., production and quality in this climate • RH is getting lower, it is also good for setting. Is improved setting observed

27-11-2013	• Fruits are starting to colour • Deformed fruits are removed, new fruits can not be evaluated (to small) • Plant growth is better according to TD, more space between nodes.
28-11-2013	• Deformed fruits because of bad setting is observed in fruits that had setting 9 days ago. Temperature 9 days ago was 11.2. Low temperature and high humidty both can cause bad setting. These conditions were present in the greenhouse until november 20 at least. Situation now improved by heating in the night and ventilation during the day. New fruits should be better, if not, than only bumble bees can help, because ventilation posibilities of the greenhouse are limited. • Deformed fruits are not caused by nutrient solution or pH problems it is a climate problem. We have said this several times see meeting of october 28 and meetings after that. • Deficiency symptoms in leaves are most likely caused by high PH • Low setting at this stage can be because of lower light. • Grop growth is improving, yield starts in two days • Crop data is missing in table
9/12/2013	• The crop looks darker, EC is higher (4). Caue is possibly higher evaporation because of heating but drain is stil 20%, which is good, but slightly lower.
16/12/2013	• Red pepper yield a little faster than yellow pepper • New setting observed in red pepper, not visible on photo's. Yellow are expected to follow • Plants are not good in the wire, more attention for crop maintenance is needed. Binding the plants fast. It is planned for the next days.
23-12-2013	• Growth has been good, leaves are larger, colour is good and setting is observed. • Setting on measurements plants is 1, but other plants have setting up to 3 fruits. • Three reasons for improved growth, improved fertigation (nitrogen supply and improved pH), heating and irrigation not disturbed too much and light improved because of washing away of dust, fruits are harvested, so plant has extra power for growth and setting of fruits. The RH is also clearly lower. • Ashraf asks why there is a gap in production?; With sweet pepper a gap between production peaks can not be avoided, especially not the first setting. However, the gap could have been less if temperature, irrigation, nutrient availability would not have been disturbing growth. It is hard to say what was the biggest disturbing factor, especially not since no data from nutrient analysis is available and not all fertiliser were what should have been, so the exact nutrient situation is not clear. Some setting was lost to bad setting and misshaped fruits (end of november), which We expect was because of low temperature and high humidity. • 15% of plants are weak, Dr Hosni proposed to remove the fruits, keep two equal heads and remove yellow leaves. Do not remove too much leaves, other measures are agreed upon. • Binding is done, now pruning needs to be done • Pruning to two strongest heads per plant. Save leaves and young fruits. • Special prune weaker plants. For pruning save leaves (one leaf with pinching) and setted fruits. Leave the strongest head and two heads per plant, pinch all other shoots.
30/12/2013	• Many plants are not good in the wire, there is a risk of breaking stems or stems falling out of the wire. Both will cause lower yields. • 10 cm of young fruits at the top of the plants are removed to spread production. Frank stresses that it will also cost production and total yield will be lower doing this. • Recorded fruit setting is low, because the measurement plants have a low average setting, but in general setting is good.

Table 8. Overview of crop protection recommendations given by WUR to AllGreen.

Date	Recommendation
23/9/2013	• MRL and pesticide list. In practise each supermarket has its own list of norms. It is recommended to request the list at one or more future customers. See: http://ec.europa.eu/sanco_pesticides/public/index.cfm?event=homepage&CFID=3934 • Please realise that many pesticides on the list are not allowed to be used, even though MRL's exist • Information regarding bumble bees is required from *e.g.* Koppert. • There is a problem with white fly coming from grapes nearby. Closing the greenhouse and ventilation with nets is too expensive. Two pesticides applications have been done (Lambada and Confidor) with 4 day interval. TD asks if we have suggestions regarding traps or pesticide strategy.
24/9/2013	• In organic tomatoes growers have good experience with trapping white fly with yellow roller traps. Koppert sells these, among other suppliers (http://www.koppert.com/products/monitoring/products-monitoring/detail/rollertrap/) • Place the trap above the heads of the plant, the chance to catch white fly is than greatest. Please install it in such a way that it can be replaced or removed easily and that it will not disturb growth of the plants. • Just using roller traps will not be enough. Dutch organic growers combine these traps with biological control (predators like Encarsia or Amblyseius swirsky). Since these are not available in Egypt a combination of traps with chemical control is the only alternative.
30/9/2013	• Some plants show a brown foot. No fungal infection observed. • White fly level is low, problems under control
28/10/2013	• Whitefly is still a bit of a problem, but decreasing, because of wintertime. Perhaps new biological control agents can help.
4/11/2013	• Take out dripper at wilted plants. Leave it to dry for several days. Remove the plants in a plastic bag. Be very carefull moving plants through the greenhouse, because you might infect other plants. Do not dump the plants outside the greenhouse, but remove them from property and burn the plants. If it is really Phytophtora, than there are some more hygenic measures to take.
5/11/2013	• AllGreen: As for the root problem, very small worms were found in the rotten place which may be caused by the egg plant steam digger, leading to the death of plants. • WUR: Small worms may also be fungus gnat and secondary, but please invite an expert on this that can visit the farm.
7/11/2013	• Crop protection and bumble bees: • Sulphur is a preventive measure against mildew. It is expensive, however. • Bumble bees can be helpful in winter time when temperatures are low and when the humidity negatively influences the pollen. • A list from Koppert with safe products in view of the use of bumble bees is needed.
11/11/2013	• White fly is under control • Root problems are getting less. Pesticide is used to control stem borer • Take notice of residue issues, list of MRL is attached, as well as list of aproved and not aproved pesticides. Some retailers have higher demands that EU law, such as no more than residues of 4 different pesticides even if concentration is below MRL. • Website aproval EU http://ec.europa.eu/sanco_pesticides/public/?event=activesubstance.selection
21-11-2013	• Root problems persist in infected plants but no new infections are observed (pesticide is used advised by Dr Hosni).
30-12-2013	• Please know that there are two risks of using a lot of ammoniumnitrate: the roots may burn by a quick drop of pH and a higher risk of Blossom end rot

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