PLANT RESEARCH INTERNATIONAL
WAGENINGEN UR

Trip Report January 2011

Integrated Pest Management in Ethiopian Horticulture

Eefje den Belder & Anne Elings

Report 381

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Plant Research International, part of Wageningen UR
Wageningen UR Greenhouse Horticulture
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Summary

The IPM project has been on-going for a number of years, during which much progress has made. During the first years (2007-2009), the main focus was on the management of red spider mite in rose, while in later years (2009-2010) up-scaling in terms of acreage, pests and crops became the major issue. More suppliers joined, more growers showed interest, and the formal steps (application, on-farm trials, import permits) became standard practice.

The first Workshop on the achievements and the future direction of IPM in horticulture under the auspices of the Ethiopia-Netherlands Horticulture Partnership Programme was hold last year, 6th of August 2010. Dr. Adefris Telkewold, Director of Crop Research Process of EIAR, explicitly asked the workshop for two outcomes:

1. Develop an IPM management approach with good modalities that satisfies all stakeholders (growers, suppliers, researchers, registration bodies, and facilitators). As a part of this, the methodologies for IPM research must be refined, bearing in mind that the research is more business-oriented than academic.
2. Resolve the current registration challenges. See for the details of this workshop e.g. Den Belder & Elings (2010b).

The January 2011 mission by Wageningen UR attempted to bring these issues further.

The terms of reference and summarized outcomes of the January 2011 mission were as follows:

- Investigate concrete options for up-scaling (visit farms, discuss with scientists).
  - We met with a number of growers interested in up-scaling IPM. IPM at Jittu (white fly, and also nematodes, powdery mildew in tomato) and Linssen Roses (red spider mite in roses) will seriously increase the acreage under IPM.
  - EIAR management and scientists remain involved in the on-farm research, as is their responsibility.
- Assess the need for further discussion on the approach (system, component) to IPM research, and identify concrete actions.
  - Plans were made with EIAR management for a more systems approach to the work.
- Investigate whether there is a wish to support the development of mass-rearing.
  - EIAR management requested support in this field, just as commercial growers.
- Investigate whether the economics of IPM need to be determined, as a certain share of the growers claim that IPM is too expensive.
  - This issues received less attention, although local mass rearing can be considered a cost reducing action.
- Can experience sharing be re-vitalized? Although this has always been very high on the agenda, growers seem not to develop the habit to structurally exchange experiences Students and training need to be re-vitalized.
  - Training activities were discussed and planned with EHPEA. Training will require the input of various stakeholders.

Eefje den Belder (eefje.denbelder@wur.nl) & Anne Elings (anne.elings@wur.nl),
Wageningen,
January 2011

1. Introduction

1.1 Introduction

The Ethiopian government is supporting the introduction of a series of measures to promote a long-term shift away from (over-)use of chemical controls where this is practicable, and thus moving towards more sustainable forms of pest management in the various crops. Research programmes are also looking at ways to reduce pesticide use while maintaining agricultural productivity. Experts both in the commercial as well as from the scientific side see good possibilities for the introduction of Integrated Pest Management (IPM) as an alternative to the heavy use of chemicals, given the successful introductions in Zimbabwe and Kenya.

In this context, the Ethiopian Horticulture Producers and Exporters Association have taken the initiative to develop a code of conduct for the floricultural sector. The development of this code of conduct (including a plan for implementation) is supported by the Royal Netherlands Embassy in Addis Ababa.

From a technical perspective the main characteristic of IPM is that it seeks to minimize the occurrence of pests and diseases by manipulating the interactions between these organisms, their crop and natural enemies (beneficials/biological control agents) in the system that help to maintain pest populations below loss levels. IPM brings together various control strategies and can therefore make a big contribution to realizing a more sustainable production.

The IPM project has been on-going for a number of years, during which much progress has made. During the first years (2007-2009), the main focus was on the management of red spider mite in rose, while in later years (2009-2010) up-scaling in terms of acreage, pests and crops became the major issue. More suppliers joined, more growers showed interest, and the formal steps (application, on-farm trials, import permits) became standard practice.

Through inclusive partnerships the various stakeholders in Ethiopia are creating an enabling environment that helps organizations to collaborate more closely and so, by increasing the quality and usefulness of Integrated pest management research, to be more effective in reducing both direct crop production losses and indirect costs to health and the environment that result from inappropriate pest management practices.

The first Workshop on the achievements and the future direction of IPM in horticulture under the auspices of the Ethiopia-Netherlands Horticulture Partnership Programme was hold last year, 6th of August 2010. Dr. Adefris Telkewold, Director of Crop Research Process of EIAR, explicitly asked the workshop for two outcomes:

1. Develop an IPM management approach with good modalities that satisfies all stakeholders (growers, suppliers, researchers, registration bodies, and facilitators). As a part of this, the methodologies for IPM research must be refined, bearing in mind that the research is more business-oriented than academic.
2. Resolve the current registration challenges. See for the details of this workshop e.g. Den Belder & Elings (2010b).

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1.2 Terms of Reference

The terms of reference for the January 2011 mission were as follows:

- Investigate concrete options for up-scaling (visit farms, discuss with scientists).
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- Investigate whether there is a wish to support the development of mass-rearing.
- Investigate whether the economics of IPM need to be determined, as a certain share of the growers claim that IPM is too expensive.
- Can experience sharing be re-vitalized? Although this has always been very high on the agenda, growers seem not to develop the habit to structurally exchange experiences.
- Students and training need to be re-vitalized.

2. Visits to farms and institutions

2.1 Jittu Farm

Monday January 10, 2011
With Mr. Yeraswork Yilma, Ministry of Agriculture

Mr. Jan Prins, General Manager
Mr. Gashu, Specialist Crop Protection

Jittu Farm at Awassa produces tomatoes (10 ha), cucumbers (10 ha), sweet peppers, chilies, egg plants, and other products for both export and the local market. Export is to Europe, the Arabian Peninsula, and to some African countries. In Ethiopia, the farm supplies to many hotels and restaurants. Jittu also has opened a number of own shops in for example Addis Ababa, Debre Zeit and Awassa. Demand is higher than supply, and expansion of operations is seriously considered.

Jittu Farm is, or will be the location of a number of on-farm tests for biological crop protection products:

1. **Nematodes**: Root-knot nematodes (*Meloidogyne spp.*) are one of the most economically damaging groups of plant-parasitic nematodes on horticultural and field crops. Root knot nematodes are distributed worldwide, and are parasites of the roots of thousands of plant species, including monocotyledonous and dicotyledonous herbaceous and woody plants. The use of fungal BCA's is under development. Attention check the fungal strains/isolates used: some strains are dangerous others are useful. There are dangerous and useful Paecilomyces lilacinus isolates like in the Bacillus strains (see Den Belder & Elderson, 2010c).
2. **Powdery mildew**: *Erisyphe* (*Oidium neolycopersici*) is found worldwide and symptoms first appear as small, powdery white colonies on the upper surface of the leaves.
3. **White fly**: Importation of bca's against white fly has been attempted a while ago, but failed due to procedural reasons. Much effort has led to improvements. The farm has appointed a new researcher (Amare) who has taken responsibilities for the logistics of the imported bca's once they arrive to Ethiopia. Dr. Ferdu from Awassa University, who is the assigned scientist, has delegated the authority to collect bca's from the airport to Jittu. Application for a new trial takes 3-4 weeks, which is a little for the new sowing, which will take in 2 weeks time. Therefore, the trial will be started in April with the following sowing. Sowing is done in Debre Zeit.

2.1.1 Farm trial whitefly control with a predator and two parasitoids

Whitefly is an important pest in the production of tomatoes in greenhouses worldwide. Intensive use of agrochemicals has a negative influence on plant growth and production. More over, the fruits have to meet market requirements with respect of maximum residue levels (MRL) of agrochemicals. Whitefly are small insects with sucking mouth parts. They belong to the family *Aleyrodidae* (Suborder *Homoptera*) and are related to other families of sucking insects including aphids, plant hoppers, scale insects and mealy bugs. Adult whitefly are about 1.5 mm long. Whitefly lay eggs on the leaf surface, either on end or on their side. Emergence takes place on the older leaves and a dispersal phase of a few days occurs. About 10% of the population moves up in the same host plant and starts and ovipositing on the younger leaves as a result of a continuous process. Most emerged whiteflies (90%) show first horizontal movement. Thus patches of infestations increase gradually. Longevity of adults whiteflies can be considerable (maximum up to several months).

Whitefly feeding damage can cause economic losses, it is the ability of whiteflies to transmit or spread viruses (that has had the widest impact on global food production). In the tropics and subtropics, whiteflies have become one of the most serious crop protection. In Ethiopia whiteflies can be found on many crops including vegetables.

Greenhouse whitefly (*Trialeurodes vaporariorum*) is a major pest of tomatoes, cucumbers and several other economic plants especially when they are grown in greenhouses. They show consistent preference for certain plant species see in the table below.

Table 1. Host plant preference (% time on plant during 7 to 8 hours observation period) and average number of eggs laid per female during life span and host- plant suitability (% immature mortality, immature development and longevity of T. vaporariorum for three vegetables.

Host plant	Sweet pepper	Tomato	Eggplant
% time on plant	37	82	100
Average of eggs laid per female during life span	12	153	535
% Immature mortality	60	17	13
Immature development time (days)	32	29	28
Longevity (days)	5	36	63

The species can be found on a wide selection of weeds also, including sow thistles (*Sonchus spp.),* milkweed (*Euphorbia*), pepples and mallows (Malva spp). However, the weeds attacked vary per region suggesting that there are local host plant strains. Integrated pest management including biological control of whitefly may be a potential solution for this problem. However, hygiene on the farm is the first step.

How can we prevent whitefly from getting into the crop?

- Adopt between crop hygiene remove all remains of the previous crop and all weeds from the greenhouse. If possible fumigate the greenhouse or keep the greenhouse hot, dry and empty for at least one week. Yellow sticky traps in the empty greenhouse will and kill any adult whitefly.
- Control all weeds on the farm and do not plant flowers around the greenhouse. Ideally have 10 meters of bare ground or have closely- mown grass.
- Propagate plants in a separate greenhouse with screens over all vents and grow each batch in a separate compartment to prevent pests from moving from one to the next. Weeds must be absent in a propagation house.

About 75 species of whitefly predators have been described. Individual predator species in the Family *Anthocoridae*, *Coccinellidae*, *Chrysopidae*, *Hemerobiidae* and most of the *Miridae* are unable to maintain greenhouse whitefly numbers below damaging levels. *Macrolophus* or *Dicyphus* can sufficiently reduce whitefly populations (Onillon, 1990). The spectrum of whitefly pathogens is narrow. Three genera of fungi infecting whitefly are regularly mentioned *Aschersonia*, *Verticillium* and *Paecilomyces*. The high humidity required by these fungi make it difficult to integrate them into greenhouse practice. About 100 species of whitefly parasitoids are known. Van Lenteren (2003) gives an overview of natural enemies commercially applied or under study for biological control *of T. vaporariorum* and *B. tabaci*.

For this situation a combination of the following measures is most likely to be successful:

- the predatory bug *Macrolophus caliginosus* against:
  - eggs and larvae of whitefly (*Trialeurodes vaporariorum* and *Bemisia tabaci*).
- the parasitoid *Eretmocerus eremicus* against:
  - larvae of whitefly (*Trialeurodes vaporariorum* and *Bemisia tabaci*).
- the parasitoid *Encarsia formosa* against:
  - larvae of whitefly (*Trialeurodes vaporariorum* and *Bemisia tabaci*).

The parasites *Eretmocerus* and *Encarsia* is e.g. on the market as a mixed product.

Jittu Horticulture PLC in Awassa has expressed its interest to work on these problems through a IPM trial with biological control agents in order to bring down the Maximum Residue Levels according the international standards for tomatoes. Hence wants to request the Ministry of Agriculture to grant permits for the import of the following beneficials to perform a trial in greenhouse tomatoes:

- *Macrolophus caliginosus* (Mirical).
- *Eretmocerus eremicus* (in Enermix).
- *Encarsia Formosa* (in Enermix).

The mode of action respectively agents:

Macrolophus caliginosus

Macrolophus caliginosus Wagner (Heteroptera: Miridae) is a predatory bug, which has proven to be effective in controlling insect pests of greenhouse vegetables (eggplant, tomato, and cucumber) especially whiteflies. Adult predatory bugs and nymphs search actively for their prey, insert their sucking mouthparts and suck out the contents. Visual effect: If whitefly eggs, larvae or pupae are eaten by a predatory bug, only the skin remains usually in its original form with a tiny hole where the mouthpart of the predatory bug have been inserted. The developmental period of this predator varies due to factors such as host plants, temperature, relative humidity (RH), habitat and most importantly the predators' species. The temperature for example, can influence the growth rate of an insect significantly.

Encarsia formosa

Female adult parasitic wasp parasitizes the larva of the whitefly. Host feeding also takes place. Visual effect: After 2-3 weeks, the first parasitized pupae can be seen in the crop. Parasitized pupae of *Trialeurodes vaporariorum* and *Bemisia tabaci* turn black and light brown in colour respectively. The adult parasitic wasp emerges from the pupa through a round hole.

Eretmocerus eremicus

E. eremicus attacks whiteflies (Homoptera: Aleyrodidae) including greenhouse whitefly (*Trialeurodes vaporarium*), sweetpotato whitefly (*B. tabaci*), silverleaf whitefly (*Bemisia argentifolii*), and bandedwinged whitefly (*T. abutlonea*). Female adult parasitic wasp parasitizes the larva of the whitefly. Host feeding also takes place. Visual effect: after about 2 weeks, the first parasitized pupae can be seen in the crop. The parasitized whitefly pupa turns yellow in color and is independent of species. The adult parasitic wasp emerges from the pupa through a round hole. This wasp thrives at higher temperatures than *Encarsia*.

Advantages

Eretmocerus is *Encarsia formosa's* welcome assistant in whitefly control because of the following advantages:

- If the whitefly population is big (high insect pressure), *Eretmocerus* will perform more host feeding.
- At high temperatures, *Eretmocerus eremicus* lives longer than Encarsia, and works better.
- *Eretmocerus californicus* is more resistant to pesticides than *Encarsia*, which is more compatible with integrated pest management.
- Both greenhouse whitefly and sweetpotato whitefly can be parasitised by *Eretmocerus eremicus*.
- Parasitised pupae are very easy to recognize due to their yellow colour.

We thoroughly discussed the various practicalities with the farm manager:

- To avoid influence (infestations, pesticides) from the other crops the tomato propagation as well as the production will be located in such place that side effects from the conventional propagations and productions will be reduced as much as possible.

- Soft chemicals will be in stock (Eefje will ask Koppert to make the list and check together with Jan) e.g. are there enough soft products against e.g. caterpillars, aphids and leaf miners at the farm and against the various fungal diseased as late blight, *Phythopthora infestans*, etc.).
- Eefje has suggested using a separate mobile sprayer exclusively for the spraying of the trial so side effects from unknown chemicals can be avoided.
- Eefje already agreed with Koppert that training for the scouts will be organized by Koppert Kenya.
- This includes; how to release the beneficials (right height in crop, location in crop, in shade no in sun), how to monitor the whiteflies in the crop and on the yellow sticky traps, where to look for the parasitized pupae, discussion on the consequences of **leaf management** (ideally leaves should be left on the plants until Encarsia have hatched from the black scale). To maximize Encarsia population growth it is helpful to know when the parasite has emerged from the black scale.
- Finally a very simple but adequate scheme will be used for the monitoring for whitefly (on plants and yellow sticky traps) as well as a simple scouting format to fill in so averages on adults per trap/plant and averages on presence/absence of Macrolophus and averages on presence/absence of parasitized whitefly pupae can be calculated.
- Eefje has invited Dr Ferdu to send a researcher and two students. Also the EDHA and EPHEA will be invited.
- Mr. Amara will organize the permit paperwork and if there are questions Wageningen UR can backstop this. Mr. Amara will be also the contact person who will organize the monitoring, completion of the scouting formats and will send the data to Koppert and Wageningen UR.
- Measurement of production per square meter will be calculated from predefined number of plants.

Monitoring methods for whitefly

Whichever method is used, staff training will be required in order to establish common ground for assessment of numbers.

- As workers progress down a row performing regular tasks e.g. removing laterals or twisting them roughly assess the number of whitefly adults seen. No active searching but noting those whiteflies when disturbed. The whitefly number is recorded on a sheet none, not many, many swarms (or with smileys). It is a useful aid.
- When performing regular tasks along rows staff can use brightly coloured tags. Different colors can be used for different problems as whitefly, *Botrytis* and virus.
- Grid map recording: staff who works on the crop are supplied with a grid map they can fill in the grid map with none, not many and swarms on the grid map. A new grid is started every week. At the end of the week the manager uses the map(s) to locate and check the problem area. The grid map also provides a pictorial map of pests throughout the growing season.

In larger greenhouses communication can be an issue. So marking pest hot spots with brightly colored tags helps those involved workers those spraying or releasing natural enemies.
These above mentioned methods are useful for conventional pest management; rational pest management as well as integrated pest management using natural enemies.

Assessment of whitefly numbers, use of yellow sticky traps and monitoring *Macrolophus*, *Encarsia* and *Eretmocerus* will be trained by Koppert.

Other issues

- The climate at the farm is good for (fruit) vegetable production, although winter night temperatures may be a little low (5 ^{o}C has been occurring recently).
- Climate data can be made available.
- If climate is made available, Anne can estimate potential production of e.g. tomato and sweet pepper.
- Tomato yields approximately 50 kg fresh m^{-2}, and sweet pepper 12 kg m^{-2}. Tomato yields are good, but sweet pepper yields can be better. Sweet pepper suffers from high Na levels in the water.
- The water contains high amounts of Na, from which the plants suffer. For this reason, 3.5-4 cc per J is irrigated, resulting in about 8 liter m^{-2} day^{-1}. For the moment, some chemical is used to bind Na. This is a

temporary solution. For the future, a rain water tank will be constructed, and rain water tank will be mixed with well water to obtain better irrigation water.
- Debris (removed tomato leaves) should be brought far away and preferably burned. Otherwise this will be a source of infection.
- The major reason for IPM is the fact that for (fruit) vegetables, MRL levels are important for export. In this regard, (fruit) vegetables are more vulnerable than flowers.
- Nematodes:
  - Various root stocks are evaluated. None of them is fully resistant, so far.
  - Varietal resistance breaks down at temperatures > 30 °C. This may require some further thinking. The irrigation water comes from a well, and is cool. Also, greenhouse temperatures are not exceptionally high. In any case, plants will be moved in a later phase from Debre Zeit (where they are sown) to Awassa. They have then a greater evaporative cooling capacity.
  - 'Marigolds Tagetes spp.' might be an option.

2.2 Linssen Roses

Wednesday January 12, 2011

Mr. Peter Linssen

LinssenRoses Ethiopia PLC at Holeta is MPS socially qualified and has a Fair-trade label.

It will shortly start with IPM of red spider mite in roses, for two reasons:
- Fair-trade demands. In the future, spraying will simply not be acceptable any longer. Without certification, the products will not be traded any longer. In a more general sense, the farm is actively taking measures to protect and enhance the environment in and around the farm e.g. wetlands will be developed for treating waste water according to the previous mentioned MPS label. Pesticides banned in Europe and those mentioned by the various guidelines (code of practice for sustainable flower production, EPHEA see table 3?? and for pesticide to avoid table 4??) are not used.
- Re-entry times in the crop make it impossible to spray in the morning. Spraying in the evening causes wet leaves in the night, which introduces the risk of Botrytis.

Linssen will start with biological control using *Phytoseiulus persimilis* against spider mite and eventually thrips. The use of beneficials requires no safety or re-entry periods allowing continued harvesting without danger to the health of personnel working in the greenhouse.

The first orders for predators (*Phytoseiulus persimilis*) have been placed with BioBee from Israel. IPM will start in one greenhouse, and other greenhouses will be added once they are clean from incompatible chemicals. Then, a total of 50 ha will be under IPM. Training and supervision will be organized in-house, as it is too important to be trusted to others. About 15 scouts are available.

After years of expansion (the farm was established in 2004), one year will be used for improved management and quality. The route followed is: Code of Practice -> MPS socio-qualified -> FairTrade.

At Linssens' farm they use a strictly organized monitoring scheme developed by the plant protection team (plant protection leader, spray leader and scouts in total 15 persons). Each morning scouts supplied with an observation format check the greenhouses they are responsible for. They use a format in which per row pests and diseases are noted. At the end of the morning the plant protection leader and the whole team use the observation results to locate and check the problem areas and then decide on a line of treatment such as spot spraying or spraying the whole bay/greenhouse. Inspecting day by day the observation results, the plant protection leader is able to gauge whether numbers of pests or diseases are increasing or decreasing and therefore the effectiveness of the treatments.

- For IPM to be successful, regular and reliable technical support is essential.
- Regular visits are crucial for success especially during the early phase of a biocontrol programme.

General impression: LinssenRosen is a well-managed farm that is devoted to sustainability and therefore to IPM. The management is solid, and organizes well its scouting, training and logistics of the predators.

2.3 ET Highland

Thursday January 13, 2011

Ms. Emebet Tsegaye, Farm Manager
Mr. Wondwossen Legesse, Crop Protection Manager

At ET Highlands a trial started in week 46, November 2007 in compartment 2 with rose variety Valentino.
This trial knows four phases see for details the various trial reports in 2008 and 2009. Since 2008 the whole farm is under spider mite IPM and only small introductions of both predatory mites *Phytoseiulus persimilis* and *Amblyseius cucumeris* on the 'hot spots" are released. Emebet and Wondwossen showed us compartment 2 (still with the same plants and six years old now). The crop is green, full, regular, and with very good long stems. We discussed also mass rearing of predatory mites as *Phytoseiulus persimilis*.

2.4 Awassa University

Monday January 10, 2011
With Mr. Yeraswork Yilma, Ministry of Agriculture

Dr. Ferdu Azerefegn, Head, Department of PLHG, Awassa University

Dr. Ferdu will lead the white fly experiment at Jittu Farm, and will therefore develop the research plan. He would like to involve students in the trial, and also let them participate in the Koppert training. The duration of the experiment remains to be seen. The duration of the import permit is 6 months, but is easily extended.

Dr. Jibra, entomologist, will also participate in the trial.

2.5 Minstry of Agriculture

Mr. Yeraswork Yilma

Mr. Yeraswork Yilma accompanied us on a number of visits. A large number of issues were discussed in the meantime.

Assistance in development of Guidelines may be requested.

2.6 Netherlands Embassy

Tuesday January 11, 2011

Mr. Geert Westenbrink, Agricultural Counselor

Project progress and future directions were discussed.

2.7 EHPEA

Ms. Glenn Humphries, Training Officer (Tuesday January 11, 2011, Saturday January 15)

The following was discussed and/or decided:

- Contract issues between EHPEA and Wageningen UR, as far as the IPM project is concerned. [***follow-up required***]
- Hortiflora: The IPM project can join the EHPEA stand. It would be nice to provide the following: a poster, leaflets, a rose plant + insects + predators, binoculars, microscope (via diplomatic pouch). We could also organize an IPM seminar, with speakers for EIAR, Florensis, and others. ***[follow-up required]***
- PUM: Training for plant protection managers, spraying managers on monitoring
    - Including technical scouting skills.
    - Relate disease with climate so they can make a decision for application.
    - Before the end of April. [***follow-up required***]

Some remarks on monitoring

The more consistent the monitoring process the accurate and useful is the information, so particular effort is needed to ensure that different staff count and record the information in the same way. Use the method or combination of methods that best suits their level of co-operation and skills and that which best matches the scale of the growing operation.

- A combination of methods is better than only relying on one.
- The below mentioned methods are additions to the list Glenn has elaborated.

Depending on the crop

- Row by row monitoring of pest as workers progress down a row performing regular tasks can be useful. This does not involve actively searching for the pest. At the end of the row none, not many and many can be recorded e.g. with smileys.
- Tagging infested areas with brightly colored peg or tag to mark the problem plants or areas.
- A grid map of the greenhouse (renewed every week) is useful to locate and check the problem. A grid map provides a pictorial map of pests throughout the growing season, increase and decrease in area.
- In larger operations communication can be an issue. Marking hot spots with brightly coloured tags helps all those involved workers, those spraying etc.
- More detailed instant information depends on the pest-crop combination. See for the details Glenn's list.

Mr. Tsegaye Abebe, General Director (Friday January 14)
Mr. Tilaye Bekele, Executive Director (Saturday January 15)

Arrangements were made with regards to the finalization and payments of the 2009 and 2010 contracts.
Mr. Tilaye Bekele, whom we had not met before, was briefly introduced to the IPM project activities.

2.8 MarginPar Plc.

Wednesday January 12, 2011

Mr. Hayo Hamster

MarginPar produces flowers, peas and sugar snaps for export. The company operates in a coordinated manner, in terms of varieties and timing) from Ethiopia, Kenya, Zambia and Tanzania. There is disease pressure (black spot, rust, powdery mildew), but only limited pest pressure (some pests), due to the high altitude. Therefore, there is little need for heavy spraying and consequently alternative approaches to heavy spraying.

Weeds are removed by hand, not by herbicides. Nets are placed above the crop to protect against hail and sunshine.

2.9 EHDA

Due to a busy agenda of Mr. Gossaye Dechasa, an appointment arranged through The Netherlands Embassy was not possible. We made a phone call on Saturday, which appeared not to be at an appropriate moment. We agreed that from Wageningen, a brief update by e-mail would be sent.

2.10 EIAR

Dr. Adefris Teklewold, Deputy Director for Crops (Friday January 14)
Dr. Dereje Gorfu, IPM coordinator (Friday January 14)
Dr. Melaku Alemu, Coordinator of Plant Protection and Biotechnology Research (Saturday January 15)

Dr. Adefris Teklewold is Deputy Director for Crops, and is ultimately responsible for, amongst others, the IPM activities within EIAR. Dr. Melaku Alemu coordinates one of the case teams within Crops, viz. the one of Plant Protection and Biotechnology. The IPM activities within this group have been delegated to Dr. Dereje Gorfu. Correspondence should primarily be with the latter, with cc to Dr. Melaku Alemu.

In the view of Dr. Dereje, it is important to invest, through training, in persons. Knowledgeable persons have the skills to develop and execute projects, and to attract hardware. Apart from training future scientists at universities such as Jimma, and development of a good IPM curriculum, the currently active scientists might benefit from more concerted attention within EIAR on IPM. Wider exchange of thoughts and interaction with the international scientific community could bring IPM science at EIAR further.

Import permit and registration procedure

Ethiopia is sensitive to investors, and wants to be supportive and have swift procedures. Therefore, the procedures for import permit and registration have to be carefully considered. One the one hand, the country should deliver to needs of investors, and do this in the right way. On the other hand, the correct steps should be taken to safeguard the country from unwanted processes or products. The question emerges what exactly has to be tested: the efficacy, the contamination? Whereas smallholders have to be protected, large commercial farms are subjected to market mechanisms. A distinction could be made between established and not-established products. The first group could be allowed for application in horticulture, while the second group might require more elaborate testing. The development of simple framework for environmental risk assessment for exotic bca's can be useful.

Dr. Adefris mentioned that a group of national and international specialists could be brought together to discuss this matter and develop recommendations. The benchmark should be similar to Kenya. In a second phase, the discussion with the Ministry of Agriculture could be opened.

Mr. Geert Westenbrink suggested the following:
- develop terms of reference.
- give a budget estimate.
- develop more elaborate programme, for funding from either the partnership, or the pesticide legislation project.

[follow-up required]

Systems approach

IPM research requires a systems approach (in our view); although we are aware that some other scientists favour the single-component approach (see trip report August 2010). Dr. Adefris confirmed that this has been a concern. It was agreed that a proposal on a systems approach workshop would be developed and submitted. The most appropriate moment would be July or August, when university staff is available.
[follow-up required]

Training at CDI

A new scientist, preferably young, will be sought.
Arrange through Dr. Melaku.

Mass rearing

EIAR has identified some local predators, however, fails to attract commercial partners that are interested. This is a broader issue within the Ethiopian system: how to commercialize research results in public-private partnerships.
[follow-up required]

In addition, Dr. Adefris requested the advice of Wageningen UR on mass rearing issues. It would be best to organize this as general as possible, for example by involving interested growers.
[follow-up required]

2.11 Jimma University

Eefje and Mr. Dhuguma (former dean of the College of Agriculture and Veterinary Medicine of the Jimma University and actually doing his PhD at Wageningen UR) discussed the possibilities for cooperation. Mr. Dhuguma has suggested including an IPM case in his PHD work. Eefje see good possibilities for cooperation and support his idea. Duguma will discuss it with his co-promotor Siebe Vellinga.

2.12 BASF

Eefje has contacted Mr. Bert Ralph Ottens from BASF, one of the chemical industries active in Ethiopia (this was suggested by Mr. Geert Westenbrink). The BASF team is small (three persons) their HQ is in Addis. He explained that there are good possibilities to improve pesticide use e.g. the improvement of active ingredient/specific pest or disease combinations instead of ‘old’ products.

3. Itinerary

Saturday 8 Jan	Evening	Flight Amsterdam – Nairobi - Addis Abeba
Sunday 9 Jan	Morning + Afternoon	Pick-up Mr. Yeraswork Yilma, Minsitry of Agriculture Travel to Awassa
	Evening	Dinner with Mr. Jan Prins, General Manager Jittu Farm
Monday 10 Jan	Morning	Mr. Jan Prins, General Manager Jittu Farm Dr. Ferdu Azerefegn, Head, Department of PLHG, Awassa University
	Afternoon	To Addis
	Evening	Report writing
Tuesday 11 Jan	Morning + afternoon	Mr. Geert Westenbrink, Agricultural Councellor Glenn Humphries, Training Officer EHPEA (over lunch)
	Evening	Glenn Humphries, Training Officer EHPEA (over dinner)
Wednesday 12 Jan	Morning	Peter Linssen, Linssen Roses
	Afternoon	Hayo Hamster, MarginPar PLC
	Evening	
Thursday 13 Jan	Morning	Prepration up-coming meetings
	Afternoon	Ms. Emebet Tesfaye, Farm Manager & Mr. Wondwossen Legesse, Crop Protection Manager, ET Highland
	Evening	
Friday 14 Jan	Morning	Mr. Geert Westenbrink, Agricultural Councellor Mr. Duguma Adugna, PhD Researcher Jimma University / Wageningen UR Mr. Tsegaye Abede, Director EHPEA
	Afternoon	Dr. Dereje Gorfu, EIAR, IPM coordinator Dr. Adefris Teklewold, EIAR, Deputy Director for Crops Mr. Duguma Adugna, PhD Researcher Jimma University / Wageningen UR
	Evening	
Saturday 15 Jan	Morning	Dr. Melaku Alemu, EIAR, Coordinator of Plant Protection and Biotechnology Research Mr. Tilaye Bekele, Executive Director & Glenn Humphries, Training Officer, EHPEA
	Afternoon	Telephone call Mr Gosaye (EDHA) Report writing
	Evening	Departure Addis Abeba
Sunday 16 Jan	Morning	Arrival Amsterdam - Wageningen

4. Literature

Belder, E. den & A. Elings, 2007a.
A Research and Development Plan for the Introduction of Integrated Pest Management in the Ethiopian Rose Sector. Trip Report January 2007. Plant Research International, Wageningen.

Belder, E. den & A. Elings, 2007b.
A Research and Development Plan for the Introduction of Integrated Pest Management in the Ethiopian Rose Sector. Trip Report September 2007. Plant Research International, Wageningen.

Belder, E. den & A. Elings, 2008a.
A Research and Development Plan for the Introduction of Integrated Pest Management in the Ethiopian Rose Sector. Trip Report January 2008. Plant Research International, Wageningen.

Belder, E. den & A. Elings, 2008b.
On-farm evaluation of integrated pest management of red spider mite in cut roses in Ethiopia. Report to the Ministry of Agriculture and Rural Development. Plant Research International, Wageningen.

Belder, E. den & A. Elings, 2008c.
On-farm evaluation of integrated pest management of red spider mite in cut roses in Ethiopia. 2nd Report to the Ministry of Agriculture and Rural Development. Plant Research International, Wageningen.

Belder, E. den, A. Elings, Y. Yilma, M. Dawd & F. Lemessa, 2009.
On-farm evaluation of integrated pest management of red spider mite in cut roses in Ethiopia. Final report to the Ministry of Agriculture and Rural Development. Plant Research International, Wageningen.

Belder, E. den & A. Elings, 2010a .
The introduction of Integrated Pest Management in the Ethiopian Horticultural sector. Plant Research International, Wageningen.

Belder, E. den & A. Elings, 2010b.
Report on "Workshop on the achievements and future direction of Integrated Pest Management in Horticulture under the auspicies of the Ethiopian-Netherlands Partnership programme. Plant Research International, Wageningen.

Belder, E. den & J. Elderson, 2010c.
Bacillus thuringiensis strains and its toxicity. Plant Research International, Wageningen.

Elings, A., 2008.
The Introduction of Integrated Pest Management in the Ethiopian Rose Sector. Trip Report June 2008. Plant Research International, Wageningen.

Klerkx, L. & C. Leeuwis, 2008.
Balancing multiple interests: Embedding innovation intermediation in the agricultural knowledge infrastructure. Technovation 28: 364–378.

World Health Organization, 2005.
WHO Guidelines to Classification.