PLANT RESEARCH INTERNATIONAL
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Report to the Ministry of Agriculture and Rural Development

Eefje den Belder & Anne Elings

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Wageningen UR Greenhouse Horticulture
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Table of contents

1. Summary

Integrated Pest Management reduces the use of chemicals and therewith the impact of greenhouse horticulture on the environment. It improves working conditions and enables access of Ethiopian products on the world market. In response to such concerns the Ethiopian Horticulture Producers and Exporters Organization (EPHEA) has taken the initiative to develop a Code of Practice, of which Integrated Pest Management forms an integral part. The development of this Integrated Pest Management approach is supported through the Ethiopia-Netherlands Horticulture Partnership Programme.

As a first step on-farm trials at Ethiopian rose farms have been set up to investigate the efficacy of biological control under Ethiopian conditions, and to gain grower's acceptance of IPM. These experiments were started in November 2007.
As next step to diversification of the IPM an on-farm trial at an Ethiopian cutting farm has been set up to investigate the efficacy of biological control under Ethiopian conditions.

The discussion on diversification to other crop-pest combination resulted finally in the choice for the management of whitefly and thrips in plant propagations using a predacious mite together with parasitic wasp.
The on-farm trial started in November 2009, and is now reported until the end of the crop in June 2010. Both the dry winter season with low night-time temperatures and the wetter spring season with lower radiation but higher night-time temperatures are covered.

The results obtained in the on-farm trial so far lead to the following conclusions for herb cuttings in Ethiopia infested with thrips and whitefly:

1. Thrips levels are substantially lower after the release of the predacious mite *Amblyseius swirskii*, than if full chemical control is applied (63 applications).
2. Whitefly levels are higher than if full chemical control is applied (twice a week in total 44 applications), however, the researchers from WUR and the farm managers expected that the predacious mite *Amblyseius swirskii*, parasitic wasp *Eretmocerus eremicus* plus some limited applications of a soft chemicals against whitefly (ovicide/adulticide) may result in a good control.
3. Careful monitoring and intensive communication is essential to take the farm through the transition phase from chemical to integrated pest management.

We recommend to the Ministry of Agriculture and Rural Development:

1. Given the positive results of the on-farm trial, showing the efficacy of the biological pest management system, granting permits in the future for the commercial import of the predacious mite *Amblyseius swirskii* for the control of thrips and whitefly in cuttings is in our view justified.
2. The control of whitefly with parasitic wasps has to be further tested in another set up in which soft chemicals are allowed.
3. Also in a general sense, environmental conditions may reduce the efficacy of the predator or parasitic wasp (e.g., extreme drought, low temperatures), which implies that a grower and the supplier should always be on alert and be prepared to combine biological pest management with compatible chemical corrective measures. This is normal practice in all practically applied ipm systems.
4. In a general sense, it is pointed out that the success of implementation of integrated pest management is enhanced by the commitment of the supplier and the grower alike as well as the way the public sector will facilitate the use of beneficials and the knowledge exchange about IPM.

We thank all those who have co-operated in the research so far: farm owner, managers, scouts and other workers; the Ministry of Agriculture and Rural Development; the Ethiopian Institute of Agricultural Research, specifically the Plant Protection Research Centre; the College of Agriculture and Veterinary Medicine, Jimma University; the Ethiopian Horticulture Producers and Exporters Organization; the Ethiopian Horticulture Development Agency; the Netherlands Embassy at Addis Abeba; Koppert B.V.; and staff at Wageningen University and Research Centre.

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Wageningen,
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2. Introduction

Markets increasingly demand products with low chemical residues. Heavy use of agrochemicals can also be a threat to the environment, and can affect workers' health as well can cause resistance in insect pests. In response to these concerns Integrated Pest Management (IPM) is high on the agenda of the various ministries such as the Ministry of Agriculture and Rural Development (to which the Ethiopian Institute for Agricultural Research belongs) and the Ministry of Trade and Industry. The development of IPM is supported through the Ethiopia-Netherlands Horticulture Partnership Programme and the Ethiopian Horticulture Development Agency. A limited number of suppliers of biological control agents have become active on the Ethiopian market, indicating that the commercial sector sees prospects and is willing to invest.

Biological control of thrips and whiteflies as a part of Integrated Pest Management can present a solution to some of the above mentioned problems, possibly combined with limited applications of 'soft' chemicals. In many countries it has already proven to help growers to develop towards a more sustainable production system. Important natural enemies that have a proven track record for control of thrips and whiteflies in herbs and other crops are the predatory mite *Amblyseius swirskii* and the parasitic wasp *Eretmocerus eremicus*.

> Integrated pest management is a holistic approach to pest control in which multiple practices are implemented throughout the entire production period of the crop. Crop monitoring is the foundation of an IPM programme. Crop monitoring provides heightened awareness of pest presence, activity and control. It addresses the real needs of the crop, reduces pesticide use by eliminating unnecessary, routine applications and assures pesticides applied at the proper life-cycle stage to ensure effectiveness.

A large number of growers in Ethiopia acknowledge the need for adoption of Integrated Pest Management. With the endorsement of a wide range of stakeholders (growers, the Ministry of Agriculture and Rural Development, the Ethiopian Institute for Agricultural Research, the Ministry of Trade and Industry, the Ethiopian Horticulture Producers and Exporters Organization, the Ethiopian Horticulture Development Agency) it was decided in the course of 2009 to conduct an on-farm trial in another crop than rose and to investigate the efficacy of biological control of thrips and whitefly in cuttings under Ethiopian conditions. Up-scaling in terms of acreage and crops were anticipated future developments.

This document reports on the 2009-2010 on-farm trial to investigate the efficacy of biological control of whitefly and thrips in herb cuttings under Ethiopian conditions, and is submitted to the Animal and Plant Health Regulatory Division of the Ethiopian Ministry of Agriculture and Rural Development.

Chapter 3 provides an overview of the set-up, results and conclusions of the on-farm trial. Our conclusions and recommendations are presented in chapter 4. These two chapters should suffice for those focused on the motives behind IPM and the research outcomes. Further in-depth information is provided in the annexes.

3. Field trials

3.1 Introduction: why on-farm trials?

An on-farm trial at Florensis Ethiopia PLC, at Koka, Ethiopia has been set up to investigate the efficacy of Integrated Pest Management under Ethiopian conditions, and to gain grower's acceptance of IPM. In a large-scale trial on this farm, researchers can document actual grower decision-making in the context of agronomic practices. To gain additional information, researchers can design complementary research to control the variable agronomic practices. Further research avenues have been elaborated in den Belder & Elings (2008a).
'Learning by doing' has been an important element of the used approach. The approach includes intensive observations, and relies on observation and monitoring of the state of the crop and the pests. This typically requires new ways of 'making things visible' and feedback loops between the formal research and informal research system:

- Regular field observation and measurement have been the basis for decision-making.
- Record-keeping to make economic results transparent.
- Exchange of information and experience among co-learners.

In November 2009 it was proposed that an on-farm trial in herbs is conducted at a propagation farm at Koka. Several growers at Koka (strawberry farm, poinsettia cuttings, and herb cuttings) were visited in June 2009 (den Belder, 2009). Finally it was at Koka that Florensis could start an on-farm trial before the end of 2009.

A large number of partners collaborated in the on-farm trial:

- Farm owner, managers, scouts and other workers hosted the on-farm trial, took strategic decisions, were responsible for scouting and data collection, and executed the actual pest management.
- The Ministry of Agriculture and Rural Development has been the overall coordinating body and provided the import permits for the beneficials used in the trials.
- The Ethiopian Institute of Agricultural Research, specifically the Research Centre at Nazareth, has been responsible for the scientific evaluation of the trial, and requested the import permits for the beneficials used in the trials.
- The Ethiopian Horticulture Producers and Exporters Organization has played an important facilitator role with regards to process and stakeholders.
- The Ethiopian Horticulture Development Agency, which was established in 2008 by the Ethiopian Government, was one of the stakeholders.
- The Netherlands Embassy at Addis Abeba has been supportive in many ways, at all times.
- Koppert B.V. has supplied the beneficials used in the on-farm trial, and has supplied extensive training and guidance.
- Staff at Wageningen University and Research Centre assisted in data processing and other supportive services.

3.2 Experimental set-up

Florensis at Koka at 1800 meters above sea level produces cuttings for annuals and perennial plants. A small percentage of the perennial plants are herbs. The main pest problems are whitefly and thrips. They grow the mother plants on volcanic ash, and use a drip irrigation system. Solar radiation is reduced by about 30% through the application of chalk and shade nets, which reduces the heat load and ensures a better root development.
Whiteflies infest many species of protected herbs. The presence of whiteflies and/or their sticky honeydew and the associated sooty moulds are unacceptable on fresh cuttings or pot herbs supplied to supermarkets.
The most common whitefly species found on protected herbs is the glasshouse whitefly, *Trialeurodes vaporariorum*. The tobacco whitefly *Bemisia tabaci* can also infest herbs. At Koka it seems a 50-50% infestation. Glasshouse whitefly has a wide host range and commonly-infested herb species include sage, lemon verbena, mint, marjoram, bergamot, basil, balm rosemary, oregano and rue.

The evaluated crops in the trial greenhouse (500 m^2 enclosed) included the following herbs: Oregano, Thymus, Artemisia, Helichrysum, Menthe, Rosmarinus, Salvia, and Satureja (see ANNEX 1).

Amblyseius swirskii (Koppert brand name SWIRSKII MITE) and *Eretmocerus eremicus* (Koppert brand name ERCAL) were introduced conform ANNEX 2.

Experiences elsewhere, and by now also in Ethiopia, have demonstrated the typical features of both species:

Amblyseius swirskii

This predatory mite feeds on whitefly eggs and larvae as well as on thrips larvae. The predator is very similar in appearance to *Amblyseius cucumeris*, which is widely used for thrips control. Optimum temperatures for *A. swirskii* are 25-28°C and the minimum temperature for activity is 10-15°C (van Houten *et al.*, 1995; Messelink *et al.*, 2006). *A. swirskii* on protected herbs e.g. on mint, is successful to both whitefly and thrips. *Amblyseius swirskii* may be difficult to find on herb plants, but might be present on the undersides of young leaves infested with whitefly eggs.

Eretmocerus spp.

This parasitic wasp is similar to *Encarsia* but is yellow in color. It is more effective against the tobacco whitefly than *Encarsia*, and is less susceptible to pesticides. *Eretmocerus spp. (E. eremicus and E. minds)* will also kill glasshouse whitefly, both by host-feeding and by parasitism. Optimum temperatures for *Eretmocerus* are above 20°C (Lopez and Botto, 1997; Greenberg *et al.*, 2002).

Table 1. Overview of pest-predator combinations in the experiments.

	Amblyseius swirskii	*Eretmocerus spp.*
Whitefly	x	x
Thrips	x	

Treatments

The experiment started of with the evaluation of *Amblyseius swirksii* (SWIRSKII MITE) plus *Eretmocerus eremicus* (ERCAL) versus a chemical pesticide control.

Agrochemicals

Towards the end of January 2010 a chemical analysis has been made of Salvia from the IPM plot, to see if any residue could have hindered the early establishment of the biological control agents. These plants came from separation the wall between IPM and control plot. Results of this analysis were received 27 January 2010 (appendix 7).

Comments on the residues found:

- bitertanol, boscalid, carbendazim, fenhexamide, kresoxim-methyl, and propamocarb are fungicides which are safe;
- thiametoxam, clothianidin was sprayed in week 42 (Mid October 2009), before the introduction of the first biological control agents; as this are fungicides, they are safe for pests;
- hexythiazox was sprayed against spider mites, is safe;

- pyriproxyfen, spinosad and buprofezin were sprayed in the control plot. Pyriproxyfen and buprofezin are safe; spinosad might have had a small effect.
- Acefate was not sprayed at all this year. It is difficult to say where the residue is coming from, but it might be possible that the spray boom used in IPM plot, before the start had some acephate. It is known that acephate is very persistent on plants, 8-12 weeks residual effect for *Amblyseius cucumeris*.

After this, the plastic separation wall was checked and improved to avoid drift of sprays from the control plot to the IPM plot.

Table 2. Overview pesticide application in the IPM plot and the chemical plot.

	IPM plot		**Chemical plot**	
Purpose of chemical application	*Number of applications*	*Chemicals used (or part of mix)*	*Number of applications*	*Chemicals used (or part of mix)*
Pest management				
Whitefly	1	Buprofezin (before first introduction biological control agents)	12	thiocyclam hydroxalate, buprofezin, pyriproxyfen, pymetrozine
Whitefly, thrips			28	thiacloprid, abamectin, spinosad, pyrethrin - piperonyl butoxide, Azadirachtin, buprofezin
Whitefly, thrips, spider mite			4	abamectin, azadirachtin
Thrips			31	spinosad, azadirachtin, lufenuron,
Total insecticide applications	**1**		**75**	
Disease management				
Fungi general	13	iprodione, azoxystrobin, trifloxystrobin, chlorothalonil, propamocarb, fosethyl-Al	11	azoxystrobin, iprodione, fenhexamid, potassium phosphite
Powdery mildew	6	boscalid, kresoxim-methyl	5	boscalid, kresoxim-methyl
Root problems	1	fosethyl-Al	1	fosetyl-Al
Total fungicide applications	**20**		**17**	
Grand total	**21**		**92**	

3.3 Scouting

Scouts and farm manager have been trained in the application of natural enemies and in the recognition and monitoring of thrips and whitefly and natural enemies in the crop sticky plates.

Respectively the IPM plot and the pesticide plot were scouted on a weekly basis. From each treatment 40 shoots, randomly taken from the canopy were sampled for the presence/absence of whitefly eggs, larvae and pupae, mummies of *Eretmocerus*, mobile stages of *A. swirskii*, and mobile stage of thrips in the top. Additionally whitefly and thrips adults were counted on 10 sticky traps in respectively the IPM plot and the pesticide plot. See ANNEX 3 for the used scout forms.

Observed data were processed as the percentage of leaflets in the sample with whitefly eggs, larvae plus pupae, thrips in the top, *Eretmocerus* mummies or predatory mites, respectively (Figure 1-2).

The use of pesticides has been recorded for both the IPM as well as for the control block (pesticides applications as usual). Parameters recorded are:

- date of application.
- pesticide trade name and active ingredient.
- quantity applied.
- costs of the chemical treatment according to the calculation of the farm manager is respectively 0.31 and 1.01 € m^{-2}.
- Biological cost is not relevant parameter as we have introduced now, we can give estimate: program would cost 0,50-1 € m^{-2}.

Scouts were getting more and more experienced when carrying out the on-farm trials.

3.4 Climate

Greenhouse environmental data have been recorded as these conditions can influence crop growth, and the population development of spider mite, thrips, predatory mite and parasitic wasp. Daily values on temperature and relative humidity (24 h average, minimum, maximum) have been recorded.

The winter season is the dry season, whereas the summer season is the wet season. We know from other observations in Ethiopia, that due to the cloud cover, radiation levels are lower in summer than in winter. The summer season is more humid than the winter season, with two peaks in the observations. Average indoor temperatures are fairly stable throughout the year, however, temperatures in winter are approximately 5 ^{o}C lower than in early summer. Due to the cloud cover, summer temperatures do not rise very much.

The experiments were started in November 2009, however detailed climate data started in January 2010.

Further details can be found in Annex 4.

3.5 Communication

Annemarie de Theije, Florensis Production Manager, communicated the relevant data on a weekly basis by e-mail to Wageningen UR, Koppert Biological Systems and Dr. Gashaw at the experimental station at Nazareth.

The IPM Alliance is formed by all stakeholders: growers, MoARD, EIAR, Jimma University, the Ethiopian Horticulture Development Agency and EHPEA. The Alliance has met on the farm at Koka. Information and experiences are exchanged, to accelerate the learning process and to ensure interaction between the formal and informal research systems.

3.6 Results

3.6.1 Thrips

In the IPM system, thrips was managed by the introduction of *A. swirksii*. It can be concluded that *A. swirskii* has demonstrated its ability to control thrips under Ethiopian conditions. The mobile thrips populations in the top of the plants fluctuated between 0- and 10% of the leaves infested both in the IPM and pesticide plot. From April onwards the number of adults thrips caught on the sticky traps was much higher in the pesticide plot (between 30-110 thrips per trap) than in the IPM plot (3-30 thrips per trap). In the IPM plot no pesticide applications against thrips were applied while in the control plot in total 63 applications of agrochemicals against thrips were sprayed.

Figures 1 and 2 provide graphs with more detailed information on population development of thrips (quantified through the number of infested leaves and the numbers on the sticky traps).

From November 2009 onwards, the conventional greenhouse received twice a week sprays with agrochemicals. Despite these frequent applications, the thrips population increased and number of infested leaves fluctuated around 10% and thrips on the sticky plates reached high levels, above 100 thrips/plate/week.

Summary observation:
In the herb cuttings thrips infestations are low in case of biological pest management, but cuttings are strongly infected in case of chemical pest management.

From February untill May 2010 the predatory mite population increased to around 40% and increased in June 2010 till nearly 60% incidence on the leaves.

The reasons for the low numbers of predatory mites at the beginning can be various. Perhaps low night temperatures have affected the start of the population build-up. What we see is that the average night temperatures in December 2009 and January 2010 are below 15°C. Optimum temperatures for *A. swirskii* are 25-28°C and the minimum temperature for activity is 10-15°C.

Also, the low reported incidence of the predatory mite *A. swirskii* at the beginning of the trial (Fig. 3) can be caused by their poor visibility on leaves with heavy vein structure. *Amblyseius swirskii* is in many instances difficult to find on herb plants, although it might be present at the lower side of young leaves infested with whitefly eggs. Charles Macharia (Koppert Kenya, personal communication) has had the same experience: poor visability combined with good effects.

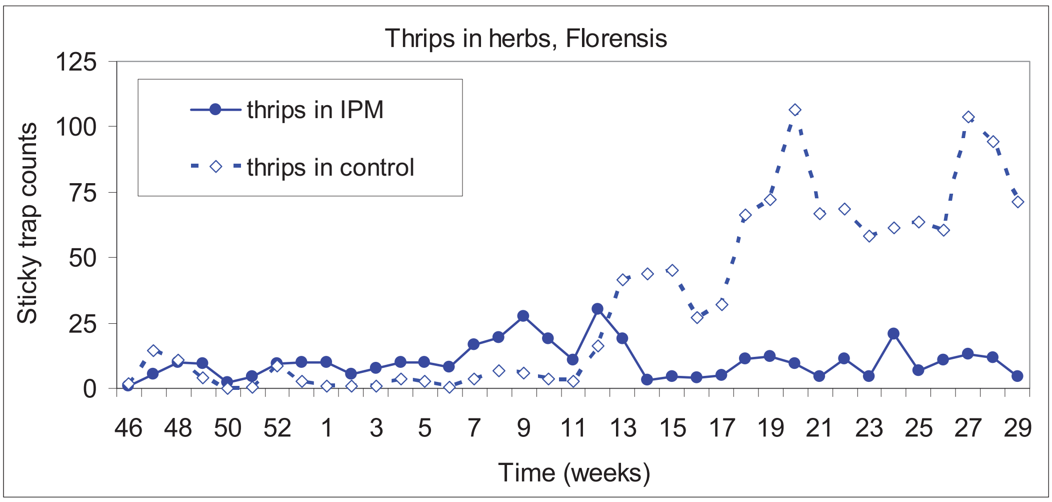

Figure 1. Population development of thrips in IPM house and control house on the sticky traps at Florensis, Koka.

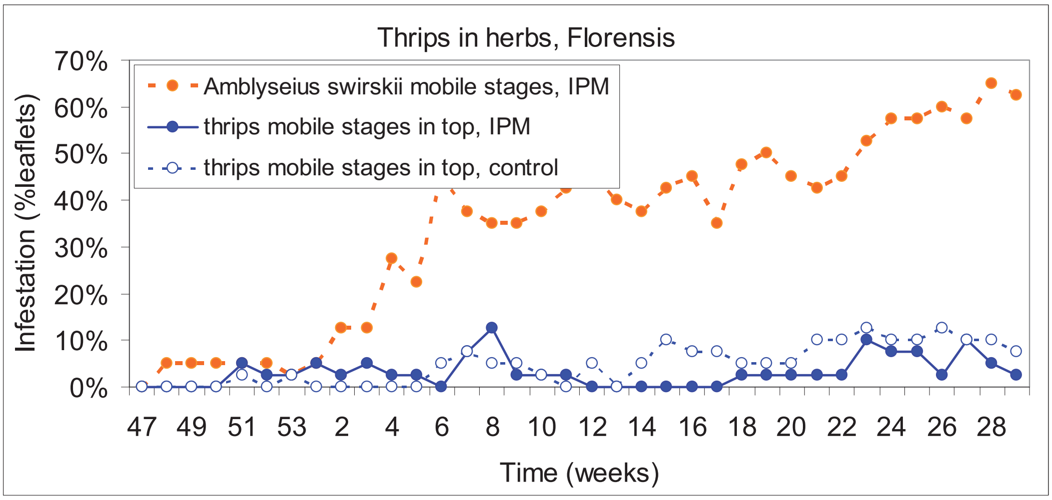

Figure 2. Population development of thrips in IPM house and control house on the plants at Florensis, Koka.

3.6.2 Whitefly

In the IPM system, thrips was managed by the introduction of *A. swirksii* and *Eretmocerus* spp. In this on-farm trial a combination of chemicals were used in the conventional production system:

against thrips:	Spinosad, Azadirachine, Lufenuron,
against whitefly Thiocyclam,	Buprofezin, Pyriproxifen, Pymetrozin,
against both thrips and whitefly:	Azadirachine, Pyrethrines, Thiacloprid, and Abamectin.

Both the number of whitefly larvae plus pupae on the crop and the number of whitefly adults on the sticky plates stayed low during the whole observation period in the control plot, to which with agrochemicals were applied 44 applications against whitefly (see Figure 3 and 4). There is a clear difference between the whitefly peaks as counted on the sticky traps (Figure 3) and on the crop (Figure 4). For several pests/crops combinations it is not exceptional that there is a difference between the peaks on the sticky plates and the observations in the crop. Whitefly adults can be very nervous and frequent walking through the crop may increase the capture on the yellow sticky plates or strips.

In the IPM plot the weekly release of both beneficials resulted in a clear build-up of the predatory mites. In February 2010 predatory mites could be find on about 40% of the leaves and by June 2010 this has increased steadily till 60%. The effects of the parasitic wasp has been more difficult to assess (they eat the young whitefly larvae and parasitize the older larvae). Effects of the parasitic wasps were less clear, and number of mummies reached about 8%.

During the colder period till February 2010 whitefly populations in the IPM and control plot stayed at acceptable levels. We found a steady increase in the incidence of the whitefly eggs, larvae and pupae in the crop and increase in the number of adults on the sticky traps at the beginning of March 2010 (week 10). This was the very moment to apply once or twice a soft chemical compatible with the biological control agents to reduce the population build-up of whitefly (opinion WUR scientists and farm managers Florensis). However the responsible EIAR scientist favoured not to adjust with the pest management protocol, as the original experimental protocol focused on the efficacy of the bca, to be evaluated without serious changes in other pest management strategies. In April-May the whitefly continued to build-up, and reached in July 2010 a 60% incidence level in the crop and more than 400 whiteflies/sticky trap in July, so finally the whitefly population escaped. The combination of both beneficials was finally not sufficient to maintain the whitefly population during the whole observation period at acceptable levels.

Discussions with the farm managers resulted in the conclusion to release the predacious mite *Amblyseius swirskii* at commercial level, and to test a parasitic wasp *Eretmocerus eremicus* or *Encarsia formosa* plus some limited applications of a soft chemicals against whitefly (ovicide/adulticide) in a small area in the same greenhouse.

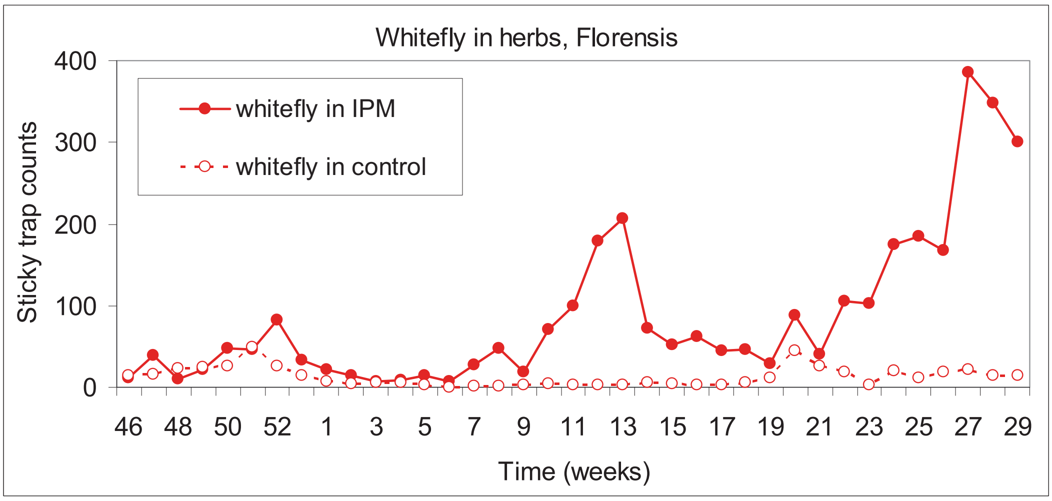

Figure 3. Population development of whitefly in IPM house and control house on the sticky traps at Florensis, Koka.

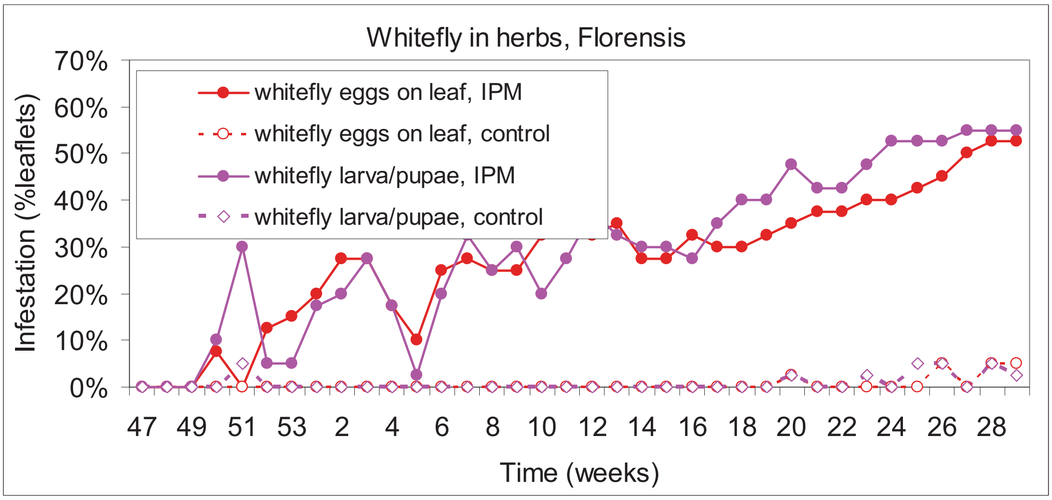

Figure 4. Population development of whitefly in IPM house and control house on the plants at Florensis, Koka.

Component approach versus system approach

This on-farm research trial, in which one or two bca's are tested in a one component approach, has stimulated a fundamental discussion on the strategy of IPM on-farm trials in Ethiopia:

1. An research trial on an experimental station under controlled circumstances, in which the effects of one biological control agent is tested, and the simple one pest-one beneficial is verified and compared with the effect of one chemical.
2. An on-farm IPM trial in which the combination of one, two or three biological control agents plus a limited number of soft

The issue of a system approach versus component approach was to be discussed in workshop in 2010 (den Belder & Elings, 2010). chemicals can shown their efficacy in comparison to the conventional approach.

3.6.3 Risk management

This report does not deal with the issue of responsibility. However, it is very important to draw the following lessons from our experiences:

1. In the long term, IPM may lead to a production increase (as was observed in the case of IPM of red spider mite in rose, den Belder et al, 2009) because
    a. chemicals are not effective due to build-up of resistance against pesticides by the thrips;
    b. due to less frequent chemicals phytotoxicity do not negatively affect the crop.
2. Both point 1a and point 1b must be communicated extremely well, and acknowledged by all parties involved.
3. Balancing the long-term prospect and the short-term risk is of course at the discretion of the grower. It seems logical that the short and long term finances play an important role here, besides aspects such as a healthy working environment, the gain that is made by adhering to a Code of Conduct, etc.
4. Early warnings must be picked up.
5. Although again at the discretion of the grower, it might be advisable to scale up gradually – not all greenhouses at once. While scaling up, more experience is gathered that can be used in implementing IPM in the remaining greenhouses.

Summary observation:
The herb cuttings are almost clean of thrips in case of biological pest management.
A combination of a predatory mite, parasitic wasp and occasional application of a compatible chemicals has to be tested for the control whitefly.

3.6.4 Crop Production

In this stage it is difficult to say something about the crop production and quality, as production records for the various plots were not clearly kept.

3.6.5 Biological control efficacy

The project has shown:
that in herb cuttings *Amblyseius swirskii* can control thrips under various conditions (November 2009-July 2010), whitefly levels are higher than if full chemical control is applied (twice a week in total 44 applications), however, the researchers from WUR and the farm managers expect that a combination of the predacious mite *Amblyseius swirskii*, with a parasitic wasp *Eretmocerus eremicus* (or Encarsia formosa) plus some limited applications of a soft chemicals against whitefly (ovicide/adulticide) may result in a good control.

The project can not quantify the efficacy of the separate biological control agents, and it can not quantify parameters such as the minimum number of biological control agents required under various conditions, the survival rate of the biological control agents, etc. If such knowledge is required, then experiments at a research station are more suitable; on-farm trials are not best suited for this.

4. Conclusions and Recommendations

4.1 Conclusions

The results obtained in the on-farm trial performed over a period of nine months lead to the following conclusions for whitefly and thrips control in propagations of herb plants in Ethiopia:

1. Thrips levels are lower if integrated pest management is applied, than if full chemical control is applied.
2. The predacious mite *A. swirskii* is an effective tool to control thrips.
3. So far, the sole combination the predacious mite *A. swirskii* and the parasitic wasp *E. eremicus* is not an effective tool to control whitefly however
4. in combination with occasional application of soft chemicals the whitefly can be suppressed sufficiently by *A. swirskii* plus *E. eretmocerus* or *Encarsia formosa.*
5. Careful monitoring and intensive communication is essential to take the farm through the transition phase from chemical to integrated pest management.
6. These conditions can be met, and if these conditions are met, biological control of thrips can form the pillar of integrated pest management in cuttings.

4.2 Recommendations for practical implementation of IPM

A number of key factors contribute to the successful implementation of IPM at farm. The most important are:

1. The commitment and patience of staff at the farm (owner, managers, scouts)
2. The commitment of the supplier of beneficials
3. A good understanding of the biology of pests and biological control agents
4. Maximum communication between grower and supplier, on all aspects of the pest management
5. Clear expectations on both sides.

Before the introduction of beneficials, a number of conditions must be considered. These are described by our recommendations.

Experiences from the above described trial combined with those from IPM in herbs in other countries have resulted in the following recommendations:

Grower

1. Develop a practical working manual that can be used by growers as a basis for their IPM approach, and includes standard procedures and a check-list of activities. Farm-specific procedures and activities can be based on this.
2. Develop a comprehensive plan with the supplier on how to control all pests and diseases in the crop. This plan should contain the introduction strategy for the biological control agents and a list of compatible pesticides in order to avoid damage to the beneficial insects. The plan also includes arrangements with regards to expected performance, support and risk sharing.
3. Agree with the supplier and the researcher of EIAR very precisely what exactly is the research question. Is the efficacy of the bca evaluated, or is the IPM system of which the bca is an element evaluated? We recommend the latter option, as this does more justice to the on-farm setting. In the Workshop at EIAR August 2010 this issue was discussed, and a decision will be taken by EIAR.
4. Take sufficient stock of the pesticides needed <u>before</u> starting the IPM, to avoid that certain chemicals are not available at the moment they are needed.
5. Select one or more persons that can be trained for regular scouting.

6. Analyse the pesticides applied during the last three months before the first introduction of predators to make sure there are no toxic residues.
7. Record all scouting data as well as the use of pesticides, and communicate this on a weekly basis to the biological control specialist that gives the advice.
8. Carefully choose the moment to start an IPM programme. It is always best to start in a young crop with a low population of pests are low.
9. Logistics from the airport to the farm need to be well-organized. It is extremely important that the Biological Control Agents reach the farm without delay, and are transported swiftly and under cooled conditions.

Supplier

1. Use the practical working manual as a basis for the IPM approach, with regards to standard procedures activities. Farm-specific procedures and activities can be based on this.
2. Develop a comprehensive plan with the grower on how to control all pests and diseases in the crop. This plan should contain the introduction strategy for the biological control agents, and a list of compatible pesticides in order to avoid damage to the predatory mites or other beneficial insects. The plan also includes arrangements with regards to expected performance, support and risk sharing.
3. Select with the grower the best moment to start an IPM programme, and explain the expected patterns in pest and biological control agent r presence during the first months of establishment.
4. Ensure the analysis of pesticides applied during the last three months before the first introduction of biological control agents to make sure there are no toxic residues. Assist the farm manager in further decision making.
5. Ensure an adequate guidance of the pest management. Details depend upon the specific conditions at a particular farm, but serious attention has to be paid to training in scouting, and frequent communication with regards to any aspect that can be relevant to the success of the pest management. Periodic visits by personnel of the supplier to the farm are required.
6. Logistics need to be well-organized. Beneficials are living organisms, and should arrive to the farm as soon as possible, without delay during transport.

MoARD

1. Given the positive results of the on-farm trials, showing the efficacy of the biological pest management system, granting permits in the future for the commercial import of the predatory mite *Amblyseius swirskii* for the control of thrips in herb cutting is in our view be justified.
2. In a general sense, it is pointed out that the success of implementation of integrated pest management is enhanced by the commitment of the supplier and the grower alike (see recommendations to grower and supplier).
3. Also in a general sense, environmental conditions may reduce the efficacy of the biological control agents (e.g., extreme drought, low temperatures), which implies that a grower and the supplier should always be alert and be prepared to combine biological pest management with chemical pest management.

Key recommendation:
Given the positive results of the on-farm trials, showing the efficacy of the biological pest management system, granting permits in the future for the commercial import of the predatory mite *Amblyseius swirskii* for the control of thrips in herb cutting is in our view be justified.

4.3 The future

4.3.1 IPM of thrips and whitefly

The on-farm trials were designed to carefully to test the effect pest control in herbs. There will always remain questions:

- Is *A. swirskii* alone capable of pest management – for thrips YES, for whitely maybe NO.

These, and possibly more questions, will emerge from time to time. Each time again, the professional skills of both supplier and grower will be needed to make the optimum choices. However, the project has shown that the principle of IPM works against thrips in cuttings in Ethiopia.

The project has shown that the principle of IPM works against thrips in cuttings in Ethiopia.

4.3.2 Other pests and diseases, and crops

After a 9-months trial in cuttings, IPM against thrips can be up-scaled. This development has to be specified in close collaboration with Ethiopian priorities, private sector interests, and chances to successfully implement the technology.

Up-scaling can be in three areas:

1. acreage
   i. larger area with IPM in herb cuttings
   ii. new growers with biological control of thrips in herb propagations, or other corps
2. other pests as sciaridae and shoreflies
3. other crops (e.g. indoor crops as other ornamentals and vegetables[1]).

Up-scaling in terms of acreage is already taking place, and is expected to continue. Now the IPM trials are successful, there may be a rapidly increasing demand for biological control agents. These will have to be imported by a variety of companies (*e.g.*, Koppert (The Netherlands), Real IPM (Kenya), Syngenta (USA), Biobee (Israel).

[1] In the even further future, moving to outdoor vegetables and even other outdoor crops such as cotton, teff and oil seeds is envisaged.

Table 3. Biological systems to be considered for up-scaling Integrated Pest Management in Ethiopian farming.

Pests	**Available biological solutions**
Aphids (various species)	Parasitic wasp *Aphidius ervi* Predatory gall midge *Aphidoletes aphidimyza*
Thrips *(Frankliniella occidentalis)*	Predatory mite *Amblyseius swirskii*[2]
Whitefly (*Trialeurodes vaporariorum*, *Bemisia tabaci*)	Predatory mite *Amblyseius swirskii* Parasitic wasp *Eretmocerus eremicus* Parasitic wasp *Encarsia formosa*
Sciarid flies (Sciaridae) shoreflies	predatory mite *Hypoaspis aculeifer*
	an entomopathogenic nematode *Steinernema feltiae*
Diseases	**Available biological solutions**
Soil borne diseases	*Trichoderma harzianum* T-22
Mildew (powdery, downy)	*Lactoperoxidase* system (Enzicur)[3]
Botrytis	*Lactoperoxidase* system (Enzicur) 2

[2] *Amblyseius swirskii* has been tried on some farms to investigate its effect against spider mite. However so far it has been outcompeted by *Amblyseius californicus*, which performs better on spider mite than *A. swirskii*. Also, the minimum temperature for *A. swirskii* is quite high.

[3] Enzicur is an effective agent. In some rose crops grown under Dutch winter conditions, however, this product has given phytotoxic reactions. When testing in Ethiopia, a difference during the sunny (strong growth) and rainy (reduced growth) season may therefore be observed.

5. Literature

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Annex 1.
Crop/varieties grown in IPM and control plot

T UP IPM AND RESIDU FREE AREA			Number of plots		
CROP	**VARIETY**	**Total Quantity (plants)**	**Total**	**IPM**	**Control**
Origanum	Compactum	240	3		3
Thymus	Albiflorus	240	3		3
Thymus	Red Carpet	360	4		4
Thymus	Compactus	320	4		4
Artemisia	French Dragon	440	5,5	3	2,5
Helichrysum	Silberzwerg	320	4	2	2
Helichrysum	Tall	360	4,5	3	1,5
Mentha	Spicata	360	4,5	3	1,5
Origanum	Gold	240	3	2	1
Rosmarinus	Officionalis	960	12	6	6
Rosmarinus	Blue Rain	480	6	4	2
Salvia	Icterina	400	5	3	2
Salvia	Bicolor	1280	16	8	8
Salvia	Purple Beauty	520	6,5	4	2,5
Salvia	Tricolor	520	6,5	4	2,5
Satureja	Indian Mint	440	5,5	3	2,5
Thymus	Lemon	320	4	2	2
Thymus	Silver Queen	320	4	2	2
Thymus	Aureus	360	4	2	2
Thymus	Doone Valley	480	6	3	3
Thymus	Foxley	480	6	4	2
Thymus	Lemon Variegata	240	3	2	1
TOTAL		**9680**	**120**	**60**	**60**

Annex 2.
Introduction schedule biological agents

product	ERCAL/3000/10strips	Swirski-mite/50.000
delivery date	# of packages	# of packages
16-nov-09	2	1
23-nov-09	2	1
30-nov-09	1	1
7-dec-09	3	1
14-dec-09	2	1
21-dec-09	2	2
28-dec-09	2	2
4-jan-10	2	2
11-jan-10	4	4
18-jan-10	4	4
25-jan-10	4	4
1-feb-10	4	4
8-feb-10	2	2
15-feb-10	2	2
22-feb-10	2	3
1-mrt-10	2	3
8-mrt-10	3	3
15-mrt-10	3	3
22-mrt-10	3	3
29-mrt-10	3	3
7-apr-10	3	3
12-apr-10	3	3
26-apr-10	3	3
3-mei-10	3	3
10-mei-10	3	2
17-mei-10	3	2
26-mei-10	3	2
31-mei-10	3	2
7-jun-10	3	3
14-jun-10	3	3
21-jun-10	3	3

Annex 3.

Scout form

Scout form crop Farm

Scout name Date

present = 1 **absent = 0**

leaf	whitefly adult	whitefly larva	whitefly pupae	Eretmocerus eremicus mummies	Amblyseius swirskii mobile stages	remarks
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
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23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
	0	0	0	0	0	# observations
% 0	0%	0%	0%	0%	0%	
% 1	0%	0%	0%	0%	0%	% presence

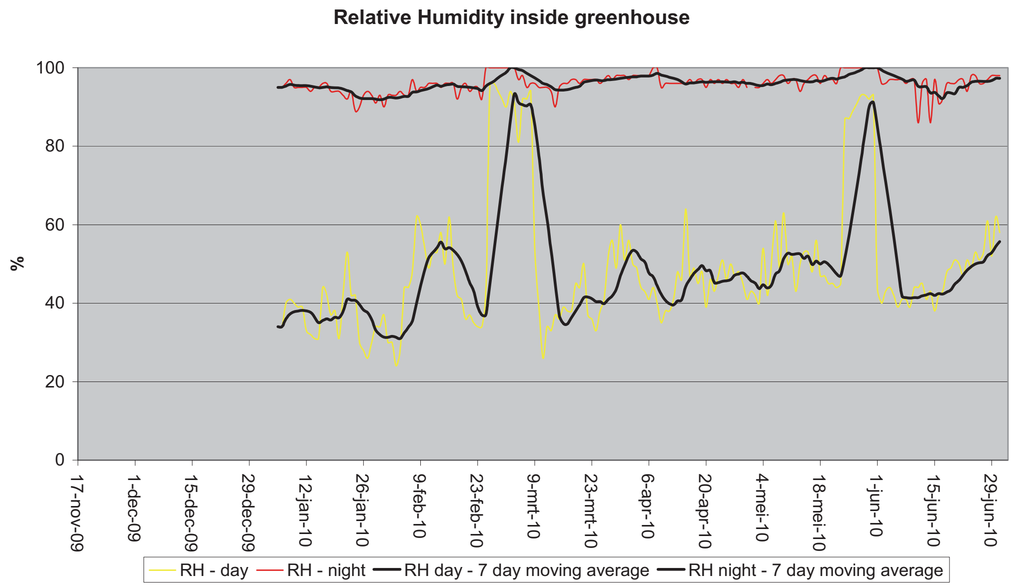
Scout form sticky traps Farm

Scout name Date

fill in **numbers**

trap	whitefly adult	thrips adult	
trap			**with Lurem-TR.**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
trap			**without Lurem-TR.**
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
	#DEEL/0!	#DEEL/0!	

Annex 4.
Climate inside greenhouse at Koka



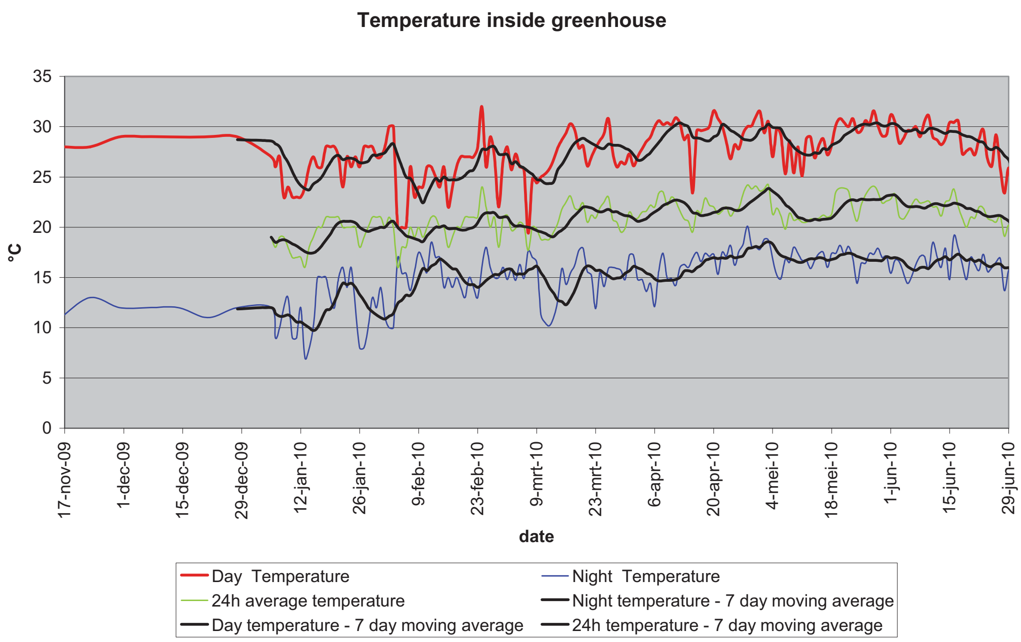


Figure 5. *Greenhouse temperature and relative humidity in 2009 and 2010 in the greenhouse with herbs in the Florensis farm at Koka.*

Annex 5.
Spray records

Spray record Florensis - IPM plot							
date of application	product	target	active ingredient	concentration	application method	treated area	volume applied
15-nov-09	Applaud	whitefly eggs	Buprofezin	250 g/l	spray	500 m2	75 l
19-nov-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*500 ml*
19-nov-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
26-nov-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*500 ml*
26-nov-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
29-nov-09	Rovral Aqua flo	fungus	Iprodione	500 ml/l	spray	500 m2	54 l
3-dec-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*500 ml*
3-dec-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	50 cards
9-dec-09	Teldor	*fungus*	Chloorthalonil	82,50%	spray	500 m2	54 l
10-dec-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*500 ml*
10-dec-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
17-dec-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*500 ml*
17-dec-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
24-dec-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*500 ml*
24-dec-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
24-dec-09	Roller trap	*White fly, thrips*				400 m2	*50 m*
30-dec-09	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
31-dec-09	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
31-dec-09	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
2-jan-10	Nissorun	spidermite	Hexythiazox	100 g/l	spray	500 m2	64 l
2-jan-10	Torque	spidermite	Fenbutatin-oxide	550 g/l	spray	500 m2	64 l
6-jan-10	Nissorun	spidermite	Hexythiazox	100 g/l	spray	500 m2	64 l
6-jan-10	Torque	spidermite	Fenbutatin-oxide	550 g/l	spray	500 m2	64 l
7-jan-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
7-jan-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
13-jan-10	kaliefosfiet	*fungus*				500 m2	200 liter
14-jan-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*4 x 500 ml*
14-jan-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	200 cards
14-jan-10	Roller trap	*White fly, thrips*				400 m2	*100 m*
21-jan-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*4 x 500 ml*
21-jan-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	200 cards
24-jan-10	Ortiva	fungi general	Azoxystrobin	250 g/l	spray 0.5 ml/l		
28-jan-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*4 x 500 ml*
28-jan-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	200 cards
4-feb-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*4 x 500 ml*
4-feb-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	200 cards
9-feb-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
11-feb-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
11-feb-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
17-feb-10	Teldor	*fungus*	Chloorthalonil	82,50%	spray	500 m2	54 l
18-feb-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
18-feb-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	100 cards
21-feb-10	Alliete	*Root problems*	Fosetyl aluminium	800 g/l	drench 0.5 ml/l	200 m2	300 l
25-feb-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
25-feb-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
27-feb-10	Ipprodion	fungus	Iprodione	500 ml/l	spray	500 m2	54 l
4-mrt-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
4-mrt-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards

Spray record Florensis - IPM plot							
date of application	product	target	active ingredient	concentration	application method	treated area	volume applied
10-mrt-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
11-mrt-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
11-mrt-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
17-mrt-10	Previcure-energy	*fungus*	Propamocarc, fosetyl	530, 310 g/l	spray	500 m2	54 l
18-mrt-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
18-mrt-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
18-mrt-10	Lurem						2 pieces
21-mrt-10	Kaliefosfiet	*fungi general*			drench 3 ml/l	400 m2	*900 l*
25-mrt-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
25-mrt-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
27-mrt-10	Nissorun	spidermite	Hexythiazox	100 g/l	spray	500 m2	54 l
27-mrt-10	Torque	spidermite	Fenbutatin-oxide	550 g/l	spray	500 m2	54 l
31-mrt-10	Nissorun	spidermite	Hexythiazox	100 g/l	spray	500 m2	54 l
31-mrt-10	Torque	spidermite	Fenbutatin-oxide	550 g/l	spray	500 m2	54 l
1-apr-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
1-apr-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
2-apr-10	Rovral Aqua flow	fungi general	Iprodione	500 ml/l	spray 1 ml/l	400 m2	60 l
10-apr-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
10-apr-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
14-apr-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
15-apr-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
15-apr-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
27-apr-10	Ortiva	fungi general	Azoxystrobin	250 g/l	spray 0.5 ml/l	500 m2	54 l
29-apr-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
29-apr-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
6-mei-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
6-mei-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
15-mei-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
20-mei-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
20-mei-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
21-mei-10	Ipprodion	fungus general	Iprodione	500 ml/l	spray 1 ml/l	500 m2	60 l
29-mei-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
29-mei-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
3-jun-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*2 x 500 ml*
3-jun-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
6-jun-10	Kaliefosfiet	*fungi general*			drench 3 ml/l	400 m2	*900 l*
9-jun-10	Flint	*fungi general*	Trifloxystrobin	500 g/kg	spray 0.5 ml/l	500 m2	*60 l*
10-jun-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
10-jun-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
17-jun-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
17-jun-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards
23-jun-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
24-jun-10	*swirski-mite*	*thrips/whitefly*	*A. swirskii*	*50.000 As/500ml*		500 m2	*3 x 500 ml*
24-jun-10	Ercal	*thrips/whitefly*	E. eremicus	6000		500 m2	150 cards

Spray record Florensis - control plot

date of application	product	target	active ingredient	concentration	application method	treated area	volume applied
11-nov-09	Evisect	White fly	Thiocyclam hydroxy	50%	spray 0.7 ml/l	400 m2	60 l
14-nov-09	*Evisect*	*White fly*	*Thiocyclam hydroxy*	*50%*	spray 0.7 ml/l	400 m2	*60 l*
18-nov-09	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	60 l
18-nov-09	Acrimectin	*White fly, thrips, spider*	Abamectin	18 g/l	spray 1 ml/l	400 m2	60 l
20-nov-09	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	60 l
20-nov-09	Acrimectin	*White fly, thrips, spider*	Abamectin	18 g/l	spray 1 ml/l	400 m2	60 l
22-nov-09	Ortiva	fungi general	Azoxystrobin	250 g/l	spray 0.5 ml/l	400 m2	70 l
25-nov-09	Nimbicide	*White fly, thrips, spider*	Azadirachtine	0.3 g/l	spray 1.5 ml/l	400 m2	70 l
29-nov-09	Nimbicide	*White fly, thrips, spider*	Azadirachtine	0.3 g/l	spray 1.5 ml/l	400 m2	70 l
2-dec-09	Spruzit	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	70 l
5-dec-09	Spruzit	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	70 l
6-dec-09	Rovral Aqua flow	fungi general	Iprodione	500 ml/l	spray 1 ml/l	400 m2	60 l
9-dec-09	Calipso	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	70 l
12-dec-09	Calipso	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	70 l
16-dec-09	Evisect	White fly	Thiocyclam hydroxy	50%	spray 0.7 ml/l	400 m2	70 l
19-dec-09	Evisect	*White fly*	*Thiocyclam hydroxy*	*50%*	spray 0.7 ml/l	400 m2	*70 l*
20-dec-09	Teldor	fungi general	Fenhexamid	50%	spray 1 ml/l	400 m2	60 l
23-dec-09	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	*70 l*
23-dec-09	Applaud	*White fly*	Buprofezin	250 g/l	spray 0.8 ml/l	400 m2	*70 l*
24-dec-09	Roller trap	*White fly, thrips*				400 m2	*50 m*
26-dec-09	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	*70 l*
26-dec-09	Applaud	*White fly*	Buprofezin	250 g/l	spray 0.8 ml/l	400 m2	*70 l*
30-dec-09	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
2-jan-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
4-jan-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	400 m2	*60 l*
6-jan-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
9-jan-10	Spruzit	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	*70 l*
10-jan-10	Kaliefosfiet	*fungi general*			drench 3 ml/l	400 m2	*900 l*
13-jan-10	Spruzit	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	*70 l*
16-jan-10	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	*70 l*
16-jan-10	Admiral	*White fly*	Pyriproxifen	100 g/l	spray 0.5 ml/l	400 m2	*70 l*
20-jan-10	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	*70 l*
20-jan-10	Admiral	*White fly*	Pyriproxifen	100 g/l	spray 0.5 ml/l	400 m2	*70 l*
23-jan-10	Calipso	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	70 l
25-jan-10	Teldor	fungi general	Fenhexamid	50%	spray 1 ml/l	400 m2	60 l
27-jan-10	Roller trap	*White fly, thrips*				400 m2	*100 m*
27-jan-10	Calipso	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	70 l
30-jan-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
3-feb-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
6-feb-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
10-feb-10	Match	*Thrips*	Lufenuron	50 g/l	spray 2 ml/l	400 m2	*60 l*
13-feb-10	Match	*Thrips*	Lufenuron	50 g/l	spray 2 ml/l	400 m2	*60 l*
14-feb-10	Rovral Aqua flow	fungi general	Iprodione	500 ml/l	spray 1 ml/l	400 m2	60 l
17-feb-10	Acrimectin, Tracer	*White fly, thrips*	Abamectin, spinosad	18 g/l, 480 g/l	spray 1/ 0,3 ml /l	400 m2	60 l
20-feb-10	Acrimectin, Tracer	*White fly, thrips*	Abamectin, spinosad	18 g/l, 480 g/l	spray 1/ 0,3 ml /l	400 m2	60 l
21-feb-10	Alliete	*Root problems*	Fosetyl aluminium	800 g/l	drench 0.5 ml/l	133 m2	200 l
24-feb-10	Spruzit, Attracker	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l, 1 ml/l	400 m2	60 l
25-feb-10	Teldor	fungi general	Fenhexamid	50%	spray 1 ml/l	400 m2	60 l
27-feb-10	Spruzit, Attracker	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l, 1 ml/l	400 m2	60 l

Spray record Florensis - control plot

date of application	product	target	active ingredient	concentration	application method	treated area	volume applied
3-mrt-10	Calipso	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	60 l
6-mrt-10	Calipso, Attracker	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	60 l
10-mrt-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
13-mrt-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
15-mrt-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
17-mrt-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
18-mrt-10	Lurem						*2 pieces*
20-mrt-10	Tracer	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	*60 l*
20-mrt-10	Applaud	*White fly*	Buprofezin	250 g/l	spray 0.8 ml/l	400 m2	*60 l*
21-mrt-10	Kaliefosfiet	*fungi general*			drench 3 ml/l	400 m2	*900 l*
24-mrt-10	Tracer, Attracker	*Thrips*	Spinosad	480 g/l	spray 0.3 ml/l	400 m2	*60 l*
24-mrt-10	Applaud	*White fly*	Buprofezin	250 g/l	spray 0.8 ml/l	400 m2	*60 l*
27-mrt-10	Match, economic	*Thrips*	Lufenuron	50 g/l	spray 2 ml/l	400 m2	*60 l*
31-mrt-10	Match	*Thrips*	Lufenuron	50 g/l	spray 2 ml/l	400 m2	*60 l*
31-mrt-10	Rovral Aqua flow	fungi general	Iprodione	500 ml/l	spray 1 ml/l	400 m2	60 l
2-apr-10	Calipso, economic	white fly, thrips	Thiacloprid	480 g/l	spray 0.5 ml/l	400 m2	60 l
10-apr-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
14-apr-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	401 m2	*71 l*
17-apr-10	Nimbicide	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	401 m2	*71 l*
19-apr-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
21-apr-10	Spruzit, economic	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	*70 l*
24-apr-10	Spruzit, economic	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	*70 l*
28-apr-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	*70 l*
1-mei-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	401 m2	*71 l*
3-mei-10	Ortiva	fungi general	Azoxystrobin	250 g/l	spray 0.5 ml/l	500 m2	54 l
5-mei-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	401 m2	*71 l*
8-mei-10	Calipso, tracer	white fly, thrips	Thiacloprid, Spinosad	480 g/l, 480 g/l	spray 0.5 ml/l	400 m2	60 l
12-mei-10	Calipso, tracer	white fly, thrips	Thiacloprid, Spinosad	480 g/l, 480 g/l	spray 0.5 ml/l	400 m2	60 l
15-mei-10	Spruzit, economic	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	*100 l*
17-mei-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
19-mei-10	Spruzit, economic	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	*100 l*
22-mei-10	Plenum, applaud	*White fly*	Pymetrozin, Buprofezin	50% 250 g/l	spray 0.5 g/l, 0.5 ml/l	400 m2	71 l
26-mei-10	Plenum, applaud	*White fly*	Pymetrozin, Buprofezin	50% 250 g/l	spray 0.5 g/l, 0.5 ml/l	400 m2	71 l
29-mei-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	71 l
2-jun-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	71 l
5-jun-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	71 l
6-jun-10	Kaliefosfiet	*fungi general*			drench 3 ml/l	400 m2	*900 l*
9-jun-10	Calipso, tracer	white fly, thrips	Thiacloprid, Spinosad	480 g/l, 480 g/l	spray 0.5 ml/l	400 m2	60 l
9-jun-10	Calipso, tracer	white fly, thrips	Thiacloprid, Spinosad	480 g/l, 480 g/l	spray 0.5 ml/l	400 m2	60 l
16-jun-10	Spruzit	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide	40, 160 g/l	spray 1 ml/l	400 m2	100 l
19-jun-10	Spruzit, Applaud	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide, buprofezin	40, 160 g/l/ 250 g/l	spray 1 ml/l, 0.5 ml /l	400 m2	70 l
23-jun-10	Spruzit, Applaud	*White fly, thrips*	Pyrethirinen, piperonyl boutoxide, buprofezin	40, 160 g/l/ 250 g/l	spray 1 ml/l, 0.5 ml /l	400 m2	70 l
26-jun-10	Nimbicide, lurem	*Thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	100 l
28-jun-10	Collis	*powdery*	Boscalid, Kresoxim-methyl	200 g/l	spray	500 m2	54 l
30-jun-10	Nimbicide	*White fly, thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	100 l
3-jul-10	Nimbicide	*White fly, thrips*	Azadirachtine	0.3 g/l	spray 3 ml/l	400 m2	100 l

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Rapport

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De resultaten in het rapport hebben alleen betrekking op het onderzochte monster

Monsterinformatie

Product	: Salvia
Variëteit	: Icterina
Leverancier	:
Land van herkomst	:
Monster code	: C19.307
Referentie	:

Resultaat GC-MS (Eigen methode SPV A056) **Resultaat LC-MS/MS** (Eigen methode SPV A090)

Component	Methode	Eenheid	Gehalte	MRL EU
Acefaat	LC	mg/kg	0.01	0.02
Bitertanol	LC	mg/kg	0.02	0.05
Boscalid	LC	mg/kg	0.04	10
Buprofezin	LC	mg/kg	0.04	4.0
Carbendazim	LC	mg/kg	0.01	0.1
Fenhexamide	LC	mg/kg	0.01	30
Hexythiazox	LC	mg/kg	0.24	0.5
Kresoxim methyl	GC	mg/kg	0.02	0.05
Propamocarb	LC	mg/kg	0.10	30
Pyriproxyfen	GC	mg/kg	0.05	0.05
Spinosad	LC	mg/kg	0.02	10
Clothianidin	LC	mg/kg	0.01	
Thiametoxam	LC	mg/kg	0.01	
Thiametoxam (som)	LC	mg/kg	0.02	0.05

Onderzochte componenten zijn weergegeven in de Analyselijst Pesticiden GAC versie 11.0 GC-MS en LC-MS/MS

Akkoord directeur

Dr. J.B.A. van Tol

Bijlagen: bijlage 1 (2 pagina's) Analyselijst Pesticiden GAC Versie 11.0 GC-MS
bijlage 2 (1 pagina) Analyselijst Pesticiden GAC Versie 11.0 LC-MS/MS

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