HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Integrated pest management in sweet pepper
Application of pesticides and use of biological control against thrips

Mission Report 14

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Bleiswijk, Lembang, March 2008.





The purpose of the HORTIN II programme is to contribute to the development of cost effective high quality value chains for the selected commodities hot pepper, shallot and sweet pepper. Among others this can be achieved when technology development takes place in close collaboration between public institutions, farmers and private companies.

In Indonesia, the programme is carried out by the Indonesian Vegetable Research Institute (IVEGRI) in Lembang. In the Netherlands Applied Plant Research (APR), WUR-Greenhouse Horticulture (GH) and Agricultural Economics Research Institute (AEI), all part of Wageningen University and Researchcentre, are the principal partners.

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Executive summary

A visit to Indonesia was made by Marieke van der Staaij from March 3 till March 14 2008.
The purpose of the visit was participating in carrying out experiments to obtain permits for importing predators to control thrips in sweet pepper.
The experiments were carried out in the laboratory at IVEGRI Balitsa and the field at ASB Farm Cigugurgirang in cooperation with Dr. Laksminiwati Prabaningrum (IVEGRI) and Ir. Tonny K. Moesakan (IVEGRI).
March 11 2008 a presentation on control of pests and diseases in sweet pepper was held at a workshop for growers, extension workers and researchers.

1. Introduction

Sweet pepper growers in Indonesia have problems in controlling *Thrips parvispinus.* The growers routinely spray pesticides which results in high residues on the fruits. These fruits are rejected by export markets.
Topics of an IPM training for growers, who are members of Cooperation Mitra Sukamaju at Pasirlangu Village, Cisarua Sub District, Bandung Barat District on West Java, are; chemical control, spraying techniques, residue of pesticides and biological control.
In collaboration IVEGRI, PT Joro, Bank of Indonesia and Hortin conduct the training on implementation of IPM and conduct an experiment to test the efficacy of predators from The Netherlands against trips.
The purpose of the visit to IVEGRI from March 3 till March 14 was:
Help finding solutions to control trips in sweet pepper with the experience from the situation in the Netherlands and in doing so reduce the use and the amount of chemical pesticides.
Assisting with the field- and lab-experiments: to establish the efficacy of *Amblyseius swirskii* and *Orius laevigatus* against *Thrips parvispinus* in sweet pepper, to establish whether the predators are able to pass the screen of the greenhouse and to determine the life cycle of the predators on pollen and trips larvae.
Discuss the methods of application of pesticides.

2. Report

2.1. Journey to Indonesia

March 3 and 4: Journey from Amsterdam to Jakarta.

March 5: Arrival at IVEGRI (Balitsa (Lembang)).
The predators from The Netherlands had arrived a few weeks earlier so the lab- and field experiments were already started. The lab-experiment with *Orius laevigatus* was stopped. All the bugs were dead due to unknown circumstances. The lab-experiment with *Amblyseius swirskii* was restarted the day I arrived in Lembang (the first experiment was carried out with the storage mites (food for *A. swirskii*) instead of the predatory mite). The field experiment at ASB Farm at Cigugurgirang Village started directly after arrival of the predators in Indonesia (approximately February 20).
For the workshop on March 11 I was asked to give a presentation on control of pests and diseases in sweet pepper which I worked on in the afternoon.

March 6: Visit to the ASB Farm at Cigugurgirang Village where the field experiment was carried out. The whole morning and part of the afternoon we counted trips and predators on the sweet pepper plants. Later on we went to Pasirlangu Village and attended the meeting of the sweet pepper growers. During the IPM training three examinations are held and this day they had the second examination. All growers passed the exam.
We visited one of the sweet pepper farms. The number of applications of pesticides was decreased since my visit in December 2007. This was due to the use of sulphur against powdery mildew and a more effective way of applying pesticides against trips.

March 7: Religious holyday (Day of silence for the Hindu community). I worked on the presentation for the workshop of next week.

March 8 and 9: Weekend.
Saturday morning Dr. L. Prabaningrum picked up my presentation. She will translate the presentation in to Indonesian.
Sunday we visited the Volcano Tangkuban Parahu and walked all the way down into one of the craters. It was very impressive.

March 10: In the morning we checked the lad-test with *A. swirskii* and counted the number of eggs.
In the afternoon we visited two packing stations. The first one was Grace a relatively small station. Approximately 70 growers deliver and trade their fruits and vegetables through this station. We also visited the tomato farm which is part of the organisation.

The second one, Bimandiri, was much bigger. More than 100 fruits and vegetables are marketed here. The fruits and vegetables are sorted, packed and for a large number of supermarkets the orders for the next day are made up.

March 11: Workshop.
Three presentations were given for growers, extension workers, researchers. About 60 people attended the meeting.
Programme:
Welkom by Dr. L. Prabaningrum Nita)
Presentation by Dr. N. Gunadi (IVEGRI) – "Hasil-hasil penelitian pada tanaman paprika di Balitsa dan di Cigugur (Juni 2007 – Februari 2008)".
Presantation by R. Maaswinkel (Wageningen UR Greenhouse Horticuture) - "Kesimbangan tanaman untuk budidaya paprika di Indonesia".
Presentation by M. van der Staaij (Marieke) (Wageningen UR Greenhouse Horticuture) - "Pengendalian hama dan penyakit pada tanaman paprika".(Appendix 1.)

Nita and Marieke answering questions during the workshop

At the end of the day we visited a strawberry farm.

March 12 and 13:
Both days we started with checking the lab-test and after that we went to the location of the field-trail and counted the thrips and predators in the greenhouse.

2.2. Lab experiment

In order to determine the life cycle adult female mites (*A. swirskii*) were placed in small plastic containers with wet cotton on small peaces of black paper with pollen. The containers were covered with insect screen. Each day the number off eggs were counted. The experiment was started on Wednesday. In the following weeks each day the number of eggs was checked. The mites were fed on pollen. The mite started laying eggs immediately.
The second week of my stay in Indonesia a new lab-experiment was started with eggs.
The lab-experiment with *Orius laevigatus* was stopped. All bugs were dead. It was not clear what caused this mortality.
It was not possible to get a new shipment of *O. laevigatus* from The Netherlands due to strict import regulations in Indonesia.

2.3. Field experiment on sweet pepper

The field-trail was carried out at ASB Farm at Cigugurgirang Village. Beginning of January the use of pesticides in the 20 compartments with Agronet Screen (568 holes/cm²) was stopped. At the moment of the introduction of *A. swirskii* and *O. laevigatus* the newly grown leaves of the sweet pepper plants will be free of pesticides which could influence the results of the experiment.
Four treatments in five replicates were carried out::

A. Introduction of *A. swirkii*
B. Introduction of *O. laevigatus*
C. Introduction of *A. swirskii* and *O. laevigatus*
D. Control (no predators)

The start of the experiment was postponed because the biological control agents from The Netherlands did not arrive at the right time.
At the moment of the introduction of the predators the number of trips already was high in all compartments. The damage to the plants and fruits was severe. Besides *Thrips parvispinus* some other species, in very small numbers, were recorded on the plants.
The number of thrips and predators on shoots, upper leaves and in flowers was recorded.
The predatory mite *A. swirskii* had established it self very fast. Except in the flowers mites were found on almost all shoots and leaves. Not only adults were seen but also eggs and the week after there were small larvae/nymphs. In one week time the population increased three to four times.
Not only in the laboratory but also in the field there was a problem with *O. laevigatus*. The first week there were still a few predatory bugs. The next week none were found. Part of the problem was the shortage of flowers. Due to the damage of the plants caused by the high population of trips and the large number of small fruits the sweet pepper plant s stopped growing and producing flowers. *Orius.laevigatus* normally lives in flowers. Shortage of flowers made the population die out. The first week I advised the researchers to remove all small, very damaged, fruits. In this way the plants cloud recover, start growing again and make new flowers. For *O. laevigatus* this was probably too late.
The conclusion that *O. laevigatus* cannot survive the tropical conditions in Indonesia is premature. In a healthy, good growing crop with flowers it is possible that the predatory bug can survive and that the population can increase.

To control pests it is better to have more than one biological control agents. A combination of swirskii and laevigatus should give the best control of trips. A. swirskii, or other predatory mites, mostly live on the leaves and O. laevigatus lives in the flowers. Both predators feed on different stage of the trips population.

One of the compartments for the field trail with A. swirskii and O. laevigatus

2.4 Application of chemical pesticides

The application of pesticides in Indonesia is conducted by handheld spray guns. Working with these apparatus is hard labour and the use of pesticides per m² is high. In The Netherlands the growers normally use a spray bar when applying pesticides.
To compare both techniques a spray bar from The Netherlands will be send to Indonesia.
Experiments will be carried out in which the efficacy, against trips or powdery mildew, of the spray bar will be tested in comparison with the handheld spray gun.
Important factors in these experiments are:

- spray pressure (max. 8 bar on the spray bar)
- amount of spray liquid
- amount of pesticide
- walking speed during application
- number of applications during growing season
- results against trip or powdery mildew

The spray bar also can be used for demonstration during the IPM training course.

Spray bar for Indonesia

Appendix 1

Presentation: Indonesia, Lembang, March 11, 2008

Control of pests and diseases in sweet pepper

Pengendalian hama dan penyakit pada tanaman paprika

Lembang- Bandung, Indonesia, March 11, 2008

Marieke van der Staaij
Wageningen UR, Greenhouse Horticulture

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Different choices/ Beberapa pilihan

- **Chemical control**
  - According to the calendar
  - After scouting/monitoring
- **Biological control**
  - Parasites : wasps
  - Predators : mites and bugs
  - Pathogens : fungi, bacteria, viruses and nemathodes
- **IPM (Integrated Pest Management)**
  - Combination of chemical and biological control

- **Pengendalian kimiawi**
  - Sistem kalender
  - Berdasarkan pengamatan
- **Pengendalian hayati**
  - Parasitoid : Lebah
  - Predator : Tungau & Kepik
  - Patogen : Jamur, bakteri, virus nematoda
- **PHT (Pengendalian Hama Terpadu)**
  - Kombinasi pengendalian secara kimiawi dan hayari

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Why searching for other ways of pest control?

Mengapa kita mencari cara lain dalam pengendalian hama ?

- **Pest resistance**
  - spider mite
  - white flies, leafminers, trips, aphids
- **Marketing**
  - environmental labels (minimal damage to nature)
  - people's health

- **Hama sudah resisten**
  - Tungau
  - Kutukebul, pengorok daun, trips, kutudaun persik
- **Pemasaran**
  - Label ramah lingkungan
  - Kesehatan manusia

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Success depends on.....

Keberhasilan tergantung pada ....

"... the field of integrated control can be successfully exploited only when there is a continuum of interest and involvement between research and extension workers and the growers on the nurseries where ideas are tested ..."

"... keberhasilan pelaksanaan PHT akan tercapai jika terdapat keinginan yang kuat dan terus menerus dan adanya kesamaan ide antara peneliti, penyuluh lapangan dan petani..."

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"... an insecticide should be more toxic to the pest than to the key predator(s) with the largest possible difference between the respective LD_{50}'s ..."

Testing pesticides on both pest and natural enemies

"... Suatu jenis pestisida harus lebih toksik terhadap hama daripada terhadap predator dengan perbedaan nilai LD_{50} yang cukup besar ..."

Pestisida harus diuji terhadap hama dan musuh alaminya

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THE START

Awal

- Introduction of *Phytoseiulus persimilis* for spider mite control in cucumber
- Introduction of *Encarsia formosa* for control of white fly in tomato

- Introduksi predator *Phytoseiulus persimilis* untuk mengendalikan tungau merah pada mentimun
- Introduksi parasitoid *Encarsia formosa* untuk mengendalikan kutukebul pada tanaman tomat


Phytoseiulus persimilis


Encarsia formosa

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MOST SUCCESSFUL IPM CROP

Penerapan PHT yang paling sukses

- **Sweet pepper**
  - bad host plant for whitefly
  - good host plant for aphids
  - biological control of spider mites, thrips, aphids and Noctuids
  - natural control of leafminers and aphids
  - integrated control during about 90% of the season

- **Paprika**
  - Bukan tanaman inang kutukebul
  - Tanaman inang bagi kutudaun
  - Pengendalian hayati, tungau, trips, kutudaun, ulat grayak
  - Pengendalian hayati pengorok daun dan kutudaun
  - PHT digunakan 90% dalam satu musim tanam

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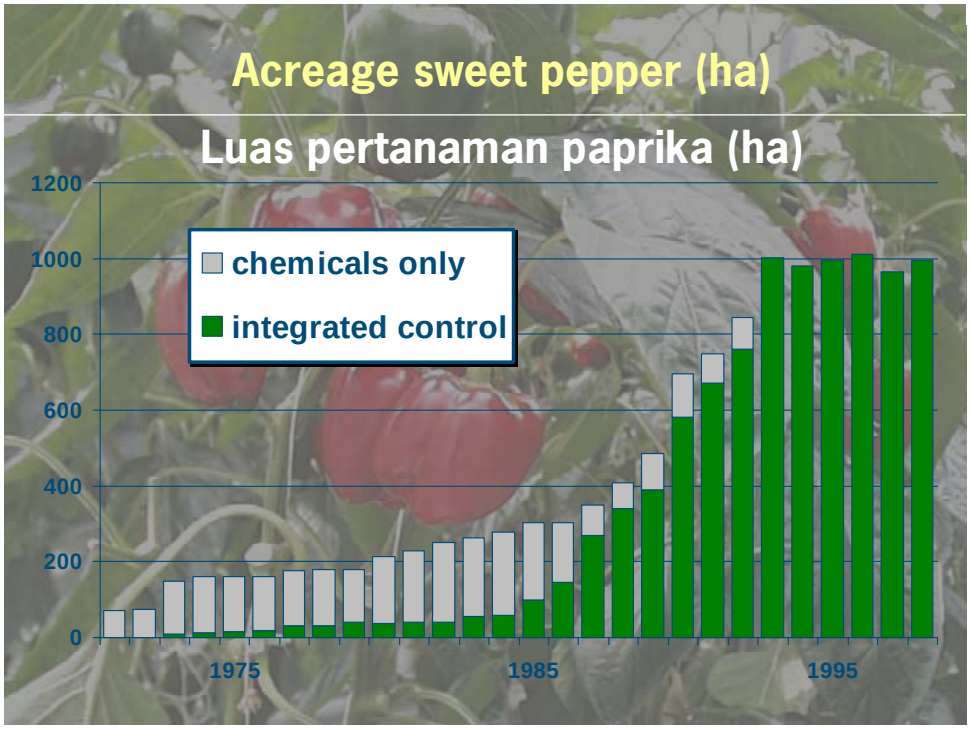
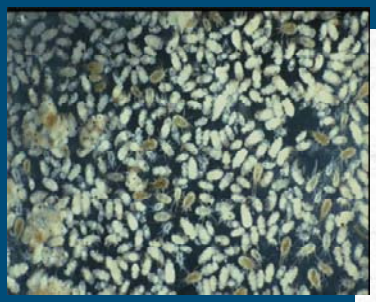
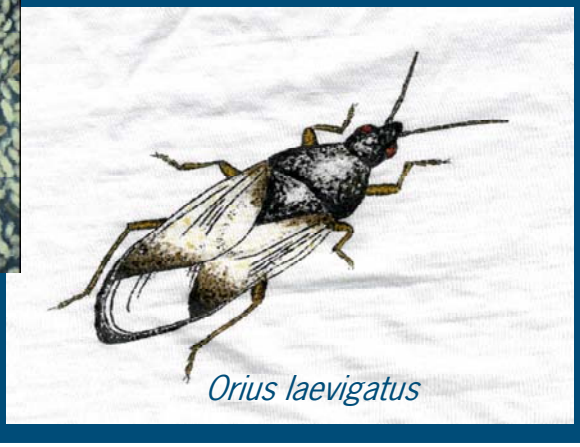


Biological control of thrips in sweet pepper:

Pengendalian hayati trips pada tanaman paprika



Amblyseius cucumeris



Orius laevigatus

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New predator

Predator baru

2005 : *Amblyseius swirskii*

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

- Pest or disease
- Pesticide
- Mode of action of the pesticide
- Resistance management
- Effect on biological control agents
- Dosage
- Application technique

- Hama atau penyakit
- Pestisida
- Cara kerja pestisida
- Pengelolaan ketahanan
- Pengaruhnya terhadap musuh alami
- Dosis
- Teknik aplikasi pestisida

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

- Dosage:

"always use the recommended dosage"

Risks of lower dosages: creating resistant insects, mites and fungi

Risks of higher dosages: Problems with residues on fruits and vegetables

- Dosis:

"selalu gunakan dosis sesuai rekomendasi"

Resiko jika menggunakan dosis rendah : memacu timbulnya resistensi OPT

Resiko jika menggunakan dosis tinggi : residu pestisida pada buah dan sayuran

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

Methods of application

- Direct
  - High-volume crop spraying (800 – 2500 l/ha)
  - Low-volume crop spraying (40 – 100 l/ha)
  - Drip-irrigation
- Indirect
  - Low-volume aerial treatment (till 10 l/ha)

Cara aplikasi

- Langsung
  - Volume besar (800 – 2500 l/ha)
  - Volume kecil (40 – 100 l/ha)
  - Irigasi tetes
- Tidak langsung
  - Penyemprotan udara dengan volume kecil (10 l/ha)

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

spray gun

spray mast

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

LVM

Fogging-apparatus

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

Factors influencing efficacy

- Spray pressure
- Execution time
- Type of nozzle
- Air support
- Penetration
- Deposition

Faktor-faktor yang mempengaruhi efikasi

- Tekanan semprot
- Waktu penyemprotan
- Jenis spuyer
- Angin
- Penetrasi
- Deposisi

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

Penetration and deposition

- **Penetration**:
  The spray liquid penetrates through the vegetation
- **Deposition**:
  The spray liquid covers the upper-side and lower-side of the leaves

Penetrasi dan deposisi

- **Penetrasi**
  Cairan semprot menembus ke dalam pertanaman
- **Deposisi**:
  Cairan semprot menutupi permukaan atas dan permukaan bawah daun

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

Technique Teknik	penetration penetrasi	deposition	
		upper/ atas	lower/ bawah
Spray gun	+	+	+
Spray mast	+	+	+/-
LVM	+	+	-
Fogging	+	+	-

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

Where is a pest or disease located?

- **Upper-side of the leaves**
  - Powdery mildew in tomato and cucumber
- **Lower-side of the leaves**
  - Powdery mildew in sweet pepper
  - Larvae of white fly (exclusively)
  - Aphids (mainly)
  - Spider mites (mainly)
  - Thrips (mainly)

Di mana hama dan penyakit berada ?

- **Permukaan atas daun**
  - Embun tepung pada tomat dan mentimun
- **Permukaan bawah daun**
  - Embun tepung pada paprika
  - Larva kutukebul
  - Kutudaun
  - Tungau
  - Thrips

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Chemical control of pests and diseases

Pengendalian kimiawi hama dan penyakit

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Effect of pesticides on beneficial organisms

Pengaruh pestisida terhadap organisme berguna

The effect of pesticides are tested according to the guidelines of IOBC (working group "Pesticides and Beneficial Organisms")

Mortality in IOBC-classes

1 = harmless (<25%)

2 = slightly harmful (25 - 50%)

3 = moderately harmful (51 - 75%)

4 = harmful (>75%)

Pengaruh pestisida menurut IOBC

Kelas mortalitas menurut IOBC :

1 = tidak membunuh (<25%)

2 = agak membunuh (25 - 50%)

3 = membunuh (51 - 75%)

4 = sangat membunuh (>75%)

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Effect of pesticides on predatory bugs and mites

Pengaruh pestisida terhadap predator

Pesticide	IOBC-class	
	Orius laevigatus	*Amblyseius* spp
difenoconazole	1	2
fenarimol	1	1
hexaconazole	1	1
zwavel	*	3/4*
abamectin	4	4
fipronil	4	4
imidacloprid	4/1	4/1
pyrethoids	4	4
pyridaben	1*	4
spinosad	1	1

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Costs of biological control in The Netherlands

Biaya pengendalian hayati di Belanda

- *A. cucumeris* 0,08 euro cent/mite Rp. 10,8/ ekor
  dosage/ dosis : 100 ekor/ m2
- *A. swirskii* 0,2 euro cent/mite Rp. 27/ ekor
  dosage/ dosis : 100 ekor/ m2
- *O. laevigatus* 7,3 euro cent/bug Rp. 985,5/ ekor
  dosage/ dosis : 1 ekor /m2

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SCOUTING & MONITORING

Pemantauan

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