Horizon 2020

Call: H2020-MSCA-ITN-2018

(Marie Skłodowska-Curie Innovative Training Networks)

Topic: MSCA-ITN-2018

Type of action: MSCA-ITN-ETN

(European Training Networks)

Proposal number: 813050

Proposal acronym: InsecTRAIN

Deadline Id: H2020-MSCA-ITN-2018

Table of contents

How to fill in the forms?

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the previous steps in the submission wizard.

Proposal ID **813050** *Acronym* **InsecTRAIN**

1 - General information

Topic	MSCA-ITN-2018
Call Identifier	H2020-MSCA-ITN-2018
Type of Action	MSCA-ITN-ETN
Deadline Id	H2020-MSCA-ITN-2018

Acronym	InsecTRAIN
Proposal title	Innovative training network to develop toolboxes for sustainable insect pest management

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months	*48*
Panel	ENV - Environmental and Geosciences (ENV)

Please select up to 5 descriptors (and at least 3) that best characterise the subject of your proposal, in descending order of relevance. Note that descriptors will be used to support REA services in identifying the best qualified evaluators for your proposal.

Descriptor 1	*Agriculture production systems (crops), including fertilisation*	Add	
Descriptor 2	*Population biology, population dynamics, population gene*	Add	Remove
Descriptor 3	*Species interactions (e.g. food-webs, symbiosis, parasitis*	Add	Remove
Descriptor 4	*Systems evolution, biological adaptation, phylogenetics, s*	Add	Remove
Descriptor 5	*Comparative, evolutionary and population genomics*	Add	Remove

Free keywords	*Chemical Ecology, Integrated pest management, Insect pests, Agriculture, Crop protection, plant genetics, metabolomics, molecular genetics*

Abstract

Harmful insects account for up to 25% of crop losses and pose a major threat to the global challenge of securing viable food production. The urgent need to develop alternative pest management strategies is magnified by the governmental policies banning the use of conventional insecticides, the societal demand for decreasing chemical residues in food and evolution of insecticide resistance in pest insects. InsecTRAIN aims to train a new generation of entrepreneurs and researchers in the field of sustainable pest management by integrating knowledge of pest insects and their interactions with crop plants, thus filling the void of practically non-existing interactions between the disciplines of plant breeding and insect chemical ecology, and contributing to UN Sustainable Development Goals 2 and 15.
Through training in plant and insect genetics, chemical ecology of plant – insect interactions and integrated insect pest management, InsecTRAIN promotes thinking outside the box, and provides students with state-of-the-art research and key transferable skills. In addition to these training goals, InsecTRAIN has three research goals: 1) To develop a toolbox to identify plant genes regulating volatiles conferring pest insect resistance; 2) To develop an insect chemical ecological toolbox to determine variable responses of pest insects to plant volatiles; 3) To develop an implementation toolbox to test

key volatiles useful in pest management strategies that do not harm beneficial insects. As these tools can be directly implemented in industrial and academic R&D programs, and potential end users are part of the consortium, InsecTRAIN will fulfill key industrial and societal needs. The long-term impact of InsecTRAIN is to establish a strong and long-lasting international network between academia and industry, and to deliver future international leaders in the field of sustainable agriculture, both in the scientific community and as founders of innovative companies and products.

Remaining characters 0

Has this proposal (or a very similar one) been submitted to a H2020-MSCA-ITN call? (•) Yes ( ) No

Please give the proposal reference or contract number.	
764953	

Proposal ID **813050** *Acronym* **InsecTRAIN**

Declarations

1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal.	☒
2) The information contained in this proposal is correct and complete.	☒
3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).	☒

4) The coordinator confirms:

- to have carried out the self-check of the financial capacity of the organisation on http://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or	○
- is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or	◉
- as sole participant in the proposal is exempt from the financial capacity check.	○

5) The coordinator hereby declares that each applicant has confirmed:

- they are fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- they have the financial and operational capacity to carry out the proposed action.	☒

The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him/her and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

Personal data protection

The assessment of your grant application will involve the collection and processing of personal data (such as your name, address and CV), which will be performed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the purposes and means of the processing of your personal data as well as information on how to exercise your rights are available in the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Detection and Exclusion system of the European Commission (EDES), the new system established by the Commission to reinforce the protection of the Union's financial interests and to ensure sound financial management, in accordance with the provisions of articles 105a and 108 of the revised EU Financial Regulation (FR) (Regulation (EU, EURATOM) 2015/1929 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU, EURATOM) No 966/2012) and articles 143 - 144 of the corresponding Rules of Application (RAP) (COMMISSION DELEGATED REGULATION (EU) 2015/2462 of 30 October 2015 amending Delegated Regulation (EU) No 1268/2012) for more information see the Privacy statement for the EDES Database).

Information on participants

Participants number	Organisation legal name	Academic Sector	Role of Participants		Country	Partner Organisation
			Provide training	Host secondmends		
1	UNIVERSITEIT VAN AMSTERDAM	true	Yes	Yes	NL	
2	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUN	true	Yes	Yes	DE	☐
3	ENZA ZADEN RESEARCH & DEVELOPMENT BV	false	Yes	Yes	NL	☐
4	SVERIGES LANTBRUKSUNIVERSITET	true	Yes	Yes	SE	☐
5	RIJKSUNIVERSITEIT GRONINGEN	true	Yes	Yes	NL	☐
6	BASECLEAR BV	false	Yes	Yes	NL	☐
7	TECHNISCHE UNIVERSITAET MUENCHEN	true	Yes	Yes	DE	☐
8	CARDIFF UNIVERSITY	true	Yes	Yes	UK	☐
9	BIOBEST BELGIUM NV	false	Yes	Yes	BE	☐
10	FREIE UNIVERSITAET BERLIN	true	Yes	Yes	DE	☐
11	WAGENINGEN UNIVERSITY	true	Yes	Yes	NL	☐
12	KOPPERT BV	false	Yes	No	NL	☒
13	CAREERS RESEARCH AND ADVISORY CENTRE	false	Yes	No	UK	☒
14	YELLOW RESEARCH	false	Yes	No	NL	☒

2 - Administrative data of participating organisations

Coordinator

PIC	***Legal name***
999985708	*UNIVERSITEIT VAN AMSTERDAM*

Short name: UvA

Address of the organisation

Street SPUI 21

Town AMSTERDAM

Postcode 1012WX

Country Netherlands

Webpage www.uva.nl

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... yes
Research organisation ..... yes
Legal person ..... yes
Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2007 - no
SME self-assessment ..... unknown
SME validation sme ..... 2007 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Institute for Biodiversity and Ecosystems Dynamics ☐ not applicable

☐ Same as organisation address

Street: Science Park 904

Town: Amsterdam

Postcode: 1098XH

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

Title: Prof.

Sex: ○ Male ◉ Female

First name: **Astrid** Last name: **Groot**

E-Mail: **a.t.groot@uva.nl**

Position in org.: Full Professor

Department: IIBED Institute for Biodiverisy and Ecosystems Dynamics ☐ Same as organisation

☐ Same as organisation address

Street: Science Park 904

Town: Amsterdam Post code: 098XH

Country: Netherlands

Website: www.uva.nl

Phone: +31613538282 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Jacco	KONIJN	j.l.konijn@uva.nl	+31613538282
Geeta	Janssen-Moerahoe	s.moerahoe@uva.nl	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **MPG**

Participant

PIC	***Legal name***
999990267	*MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV*

Short name: MPG

Address of the organisation

Street HOFGARTENSTRASSE 8

Town MUENCHEN

Postcode 80539

Country Germany

Webpage www.mpg.de

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... yes

Legal person ..... yes

Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2015 - no

SME self-assessment ..... 2015 - no

SME validation sme ..... 2007 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Max Planck Institute for Chemical Ecology ☐ not applicable

☐ Same as organisation address

Street: Hans Knoell Str. 8

Town: Jena

Postcode: 07745

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

Title: Prof.

Sex: (•) Male ( ) Female

First name: **Markus** Last name: **Knaden**

E-Mail: **mknaden@ice.mpg.de**

Position in org.: Senior Researcher

Department: Max Planck Institute for Chemical Ecology [ ] Same as organisation

[ ] Same as organisation address

Street: Hans Knoell Str. 8

Town: Jena Post code: 07745

Country: Germany

Website: www.ice.mpg.de

Phone: +493641571401 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
942427751	*ENZA ZADEN RESEARCH & DEVELOPMENT BV*

Short name: Enza Zaden R&D B.V.

Address of the organisation

Street HALING 1 E

Town ENKHUIZEN

Postcode 1602 DB

Country Netherlands

Webpage www.enzazaden.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Academic Sector ..... no

Enterprise Data

SME self-declared status ..... 2013 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research & Development ☐ not applicable

☒ Same as organisation address

Street: HALING 1 E

Town: ENKHUIZEN

Postcode: 1602 DB

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **Enza Zaden R&D B.V.**

Person in charge of the proposal

Title: Dr. | Sex: ○ Male ◉ Female

First name: **Petra** | Last name: **Bleeker**

E-Mail: **p.m.bleeker@uva.nl**

Position in org.: Senior Scientist

Department: Research & Development ☐ Same as organisation

☒ Same as organisation address

Street: HALING 1 E

Town: ENKHUIZEN | Post code: 1602 DB

Country: Netherlands

Website: www.enzazaden.com

Phone: +31228350100 | Phone 2: +xxx xxxxxxxxx | Fax: +xxx xxxxxxxxx

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **SVERIGES LANTBRUKSUNIVERSITET**

Participant

PIC	***Legal name***
999887350	*SVERIGES LANTBRUKSUNIVERSITET*

Short name: SVERIGES LANTBRUKSUNIVERSITET

Address of the organisation

Street ALMAS ALLE 8

Town UPPSALA

Postcode 750 07

Country Sweden

Webpage http://www.slu.se

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... yes
Research organisation ..... yes
Legal person ..... yes
Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2016 - no
SME self-assessment ..... 2016 - no
SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Department of Plant Protection Biology ☐ not applicable

☐ Same as organisation address

Street: Sundsvägen 14

Town: Alnarp

Postcode: SE-23053

Country: Sweden

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **SVERIGES LANTBRUKSUNIVERSITET**

Person in charge of the proposal

Title: Prof.

Sex: (•) Male ( ) Female

First name: **Peter** Last name: **Anderson**

E-Mail: **peter.anderson@ltj.slu.se**

Position in org.: Professor

Department: Department of Plant Protection Biology ☐ Same as organisation

☐ Same as organisation address

Street: Sundsvägen 14

Town: Alnarp Post code: SE-23053

Country: Sweden

Website: www.slu.se

Phone: +4640415299 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
999989782	*RIJKSUNIVERSITEIT GRONINGEN*

Short name: RIJKSUNIVERSITEIT GRONINGEN

Address of the organisation

Street Broerstraat 5

Town GRONINGEN

Postcode 9712CP

Country Netherlands

Webpage www.rug.nl

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... yes
Research organisation ..... yes
Legal person ..... yes
Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2015 - no
SME self-assessment ..... 2015 - no
SME validation sme ..... 2007 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Center for Behaviour and Life Science ☐ not applicable

☐ Same as organisation address

Street: Nijenborgh 9

Town: Groningen

Postcode: 9747AG

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **RIJKSUNIVERSITEIT GRONINGEN**

Person in charge of the proposal

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Jean Christophe** Last name: **Billeter**

E-Mail: **j.c.billeter@rug.nl**

Position in org.: Assistant Professor

Department: Center for Behaviour and Life Science ☐ Same as organisation

☐ Same as organisation address

Street: Nijenborgh 9

Town: Groningen Post code: 9747AG

Country: Netherlands

Website: www.rug.nl

Phone: +31503637851 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
950325200	*BASECLEAR BV*

Short name: BASECLEAR BV

Address of the organisation

Street EINSTEINWEG 5

Town LEIDEN

Postcode 2333 CC

Country Netherlands

Webpage www.baseclear.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Academic Sector ..... no

Enterprise Data

SME self-declared status ..... 2012 - yes

SME self-assessment ..... unknown

SME validation sme ..... 2012 - yes

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research & Development ☐ not applicable

☒ Same as organisation address

Street: EINSTEINWEG 5

Town: LEIDEN

Postcode: 2333 CC

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **BASECLEAR BV**

Person in charge of the proposal

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Danny** Last name: **Duijsings**

E-Mail: **danny.duijsings@baseclear.nl**

Position in org.: Head of Research & Development

Department: Research & Development ☐ Same as organisation

☒ Same as organisation address

Street: EINSTEINWEG 5

Town: LEIDEN Post code: 2333 CC

Country: Netherlands

Website:

Phone: Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
999977463	*TECHNISCHE UNIVERSITAET MUENCHEN*

Short name: TUM

Address of the organisation

Street Arcisstrasse 21

Town MUENCHEN

Postcode 80333

Country Germany

Webpage www.tum.de

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2012 - no

SME self-assessment ..... 2012 - no

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Biotechnology of Natural Products ☐ not applicable

☐ Same as organisation address

Street: Lisel-Beckmann Str. 1

Town: Freising

Postcode: 85354

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

Title: Prof.

Sex: (•) Male ( ) Female

First name: **Wilfried** Last name: **Schwab**

E-Mail: **wilfried.schwab@tum.de**

Position in org.: Associate Professor

Department: Biotechnology of Natural Products ☐ Same as organisation

☐ Same as organisation address

Street: Lisel-Beckmann Str. 1

Town: Freising Post code: 85354

Country: Germany

Website: www.bina.wzw.tum.de

Phone: +498161712912 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
999979694	*CARDIFF UNIVERSITY*

Short name: CARDIFF UNIVERSITY

Address of the organisation

Street NEWPORT ROAD 30-36

Town CARDIFF

Postcode CF24 ODE

Country United Kingdom

Webpage www.cardiff.ac.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2015 - no

SME self-assessment ..... 2015 - no

SME validation sme ..... 2007 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: School of Chemistry ☐ not applicable

☐ Same as organisation address

Street: Park Place

Town: Cardiff

Postcode: CF10 3AT

Country: United Kingdom

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **CARDIFF UNIVERSITY**

Person in charge of the proposal

Title: Prof. Sex: (•) Male ( ) Female

First name: **John** Last name: **Picket**

E-Mail: **pickettj4@cardiff.ac.uk**

Position in org.: Professor of Biological Chemistry

Department: School of Chemistry [ ] Same as organisation

[ ] Same as organisation address

Street: Park Place

Town: Cardiff Post code: CF10 3AT

Country: United Kingdom

Website: www.cardiff.ac.uk

Phone: +447720430117 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Wynand	Van Der Goes Van Nate	vandergoesvannaterswm@cardiff.ac.uk	

Participant

PIC	***Legal name***
968729592	*BIOBEST BELGIUM NV*

Short name: BIOBEST BELGIUM NV

Address of the organisation

Street ILSE VELDEN 18

Town WESTERLO

Postcode 2260

Country Belgium

Webpage www.biobest.be

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Academic Sector ..... no

Enterprise Data

SME self-declared status ..... 2011 - yes

SME self-assessment ..... unknown

SME validation sme ..... 2011 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research & Development ☐ not applicable

☒ Same as organisation address

Street: ILSE VELDEN 18

Town: WESTERLO

Postcode: 2260

Country: Belgium

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **BIOBEST BELGIUM NV**

Person in charge of the proposal

Title: Prof. Sex: (•) Male ( ) Female

First name: **Felix** Last name: **Wackers**

E-Mail: **felix.wackers@biobest.be**

Position in org.: Director Research & Development

Department: Research & Development ☐ Same as organisation

☒ Same as organisation address

Street: ILSE VELDEN 18

Town: WESTERLO Post code: 2260

Country: Belgium

Website: www.biobest.be

Phone: +3214257980 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
999994826	*FREIE UNIVERSITAET BERLIN*

Short name: FUB

Address of the organisation

Street KAISERSWERTHER STRASSE 16-18

Town BERLIN

Postcode 14195

Country Germany

Webpage www.fu-berlin.de

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... yes

Research organisation ..... yes

Legal person ..... yes

Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2016 - no

SME self-assessment ..... 2016 - no

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Applied Zoology/Animal Ecology ☐ not applicable

☐ Same as organisation address

Street: Haderlebener Str. 9

Town: Berlin

Postcode: 12163

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

Title: Prof.

Sex: (•) Male ( ) Female

First name: **Monika** Last name: **Hilker**

E-Mail: **hilker@zedat.fu-berlin.de**

Position in org.: Head of Department

Department: Applied Zoology/Animal Ecology ☐ Same as organisation

☐ Same as organisation address

Street: Haderslebener Str. 9

Town: Berlin Post code: 12163

Country: Germany

Website: www.bcp.fu-berlin.de

Phone: +493083855913 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
999981634	*WAGENINGEN UNIVERSITY*

Short name: WU

Address of the organisation

Street DROEVENDAALSESTEEG 4

Town WAGENINGEN

Postcode 6708 PB

Country Netherlands

Webpage http://www.wageningenur.nl/nl.htm

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... yes
Research organisation ..... no

Legal person ..... yes
Academic Sector ..... yes

Enterprise Data

SME self-declared status ..... 2015 - no
SME self-assessment ..... 2015 - no
SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Plant Breeding ☐ not applicable

☐ Same as organisation address

Street: Droevendaalsesteeg 1

Town: Wageningen

Postcode: 6708PB

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **WU**

Person in charge of the proposal

Title: Prof. Sex: ○ Male ◉ Female

First name: **Guusje** Last name: **Bonnema**

E-Mail: **guusje.bonnema@wur.nl**

Position in org.: Group Leader

Department: Plant Breeding ☐ Same as organisation

☐ Same as organisation address

Street: Droevendaalsesteeg 1

Town: Wageningen Post code: 6708PB

Country: Netherlands

Website: www.wur.nl

Phone: +31317484028 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
972264466	*KOPPERT BV*

Short name: KBV

Address of the organisation

Street VEILINGWEG 14

Town BERKEL EN RODENRIJS

Postcode 2651 BE

Country Netherlands

Webpage www.koppert.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Academic Sector ..... no

Enterprise Data

SME self-declared status ..... 2011 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: R&D Entomology ☐ not applicable

☒ Same as organisation address

Street: VEILINGWEG 14

Town: BERKEL EN RODENRIJS

Postcode: 2651 BE

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **KBV**

Person in charge of the proposal

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Tom** Last name: **Groot**

E-Mail: **tgroot@koppert.nl**

Position in org.: Manager R&D Entomology

Department: R&D Entomology ☐ Same as organisation

☒ Same as organisation address

Street: VEILINGWEG 14

Town: BERKEL EN RODENRIJS Post code: 2651 BE

Country: Netherlands

Website: www.koppert.nl

Phone: Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
943516091	*CAREERS RESEARCH AND ADVISORY CENTRE (CRAC) LIMITED (THE)*

Short name: CRAC-VITAE

Address of the organisation

Street 22 SIGNET COURT SWANN ROAD

Town CAMBRIDGE

Postcode CB5 8LA

Country United Kingdom

Webpage www.crac.org.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... yes

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Academic Sector ..... no

Enterprise Data

SME self-declared status ..... 2013 - no

SME self-assessment ..... unknown

SME validation sme ..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name ☒ not applicable

☐ Same as organisation address

Street *Please enter street name and number.*

Town

Postcode

Country

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

Title: Mrs

Sex: ○ Male ◉ Female

First name: **Alison** Last name: **Michell**

E-Mail: **alison.mitchell@vitae.ac.uk**

Position in org.: Director of Development

Department: - ☐ Same as organisation

☒ Same as organisation address

Street: 22 SIGNET COURT SWANN ROAD

Town: CAMBRIDGE Post code: CB5 8LA

Country: United Kingdom

Website: www.vitae.ac.uk

Phone: +441223 460277 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Participant

PIC	***Legal name***
998263279	*YELLOW RESEARCH*

Short name: YR

Address of the organisation

Street HERENGRACHT 495

Town AMSTERDAM

Postcode 1017BT

Country Netherlands

Webpage www.yellowresearch.nl

Legal Status of your organisation

Research and Innovation legal statuses

Public body ..... no

Non-profit ..... no

International organisation ..... no

International organisation of European interest ..... no

Secondary or Higher education establishment ..... no

Research organisation ..... no

Legal person ..... yes

Academic Sector ..... no

Enterprise Data

SME self-declared status ..... 2008 - yes

SME self-assessment ..... unknown

SME validation sme ..... 2008 - yes

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name ☒ not applicable

☐ Same as organisation address

Street *Please enter street name and number.*

Town

Postcode

Country

Dependencies with other proposal participants

Character of dependence	***Participant***	

Proposal ID **813050** *Acronym* **InsecTRAIN** *Short name* **YR**

Person in charge of the proposal

Title: Mrs

Sex: ○ Male ◉ Female

First name: **Lotte** Last name: **Jaspers**

E-Mail: **jaspers@yellowresearch.nl**

Position in org.: Founding Partner

Department: - ☐ Same as organisation

☒ Same as organisation address

Street: HERENGRACHT 495

Town: AMSTERDAM Post code: 1017BT

Country: Netherlands

Website: www.yellowresearch.nl

Phone: +3120422.1115 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Proposal ID **813050** *Acronym* **InsecTRAIN**

3 - Budget

Researcher Number	Recruiting Participant (short name)	Planned start month	Duration (months)
1	Enza Zaden R&D B.V.	7	36
2	UvA	7	36
3	WU	7	36
4	TUM	7	36
5	BASECLEAR BV	7	36
6	CARDIFF UNIVERSITY	7	36
7	SVERIGES LANTBRUKSUNIVERSITET	7	36
8	UvA	7	36
9	FUB	7	36
10	SVERIGES LANTBRUKSUNIVERSITET	7	36
11	MPG	7	36

Proposal ID **813050** *Acronym* **InsecTRAIN**

Researcher Number	Recruiting Participant (short name)	Planned start month	Duration (months)
12	RIJKSUNIVERSITEIT GRONINGEN	7	36
13	BIOBEST BELGIUM NV	7	36
14	CARDIFF UNIVERSITY	7	36
15	CARDIFF UNIVERSITY	7	36
Total			540

Participant Number	Organisation Short Name	Country	IOEI	No of researchers	Number of person.months	Researcher Unit Cost			Institutional Unit Cost		TOTAL
						Living allowance	Mobility Allowance	Family Allowance	Research, training and networking costs	Management and overheads	
1	UvA	NL	no	2	72	254039,76	43200,00	18000,00	129600,00	86400,00	531239,76
2	MPG	DE	no	1	36	114188,40	21600,00	9000,00	64800,00	43200,00	252788,40
3	Enza Zaden R&D B.V.	NL	no	1	36	127019,88	21600,00	9000,00	64800,00	43200,00	265619,88
4	SVERIGES LANTBRUKSUN	SE	no	2	72	286765,92	43200,00	18000,00	129600,00	86400,00	563965,92
5	RIJKSUNIVERSITEIT GRO	NL	no	1	36	127019,88	21600,00	9000,00	64800,00	43200,00	265619,88
6	BASECLEAR BV	NL	no	1	36	127019,88	21600,00	9000,00	64800,00	43200,00	265619,88

Proposal ID **813050** *Acronym* **InsecTRAIN**

Participant Number	Organisation Short Name	Country	IOEI	No of researchers	Number of person.months	Researcher Unit Cost			Institutional Unit Cost		TOTAL
						Living allowance	Mobility Allowance	Family Allowance	Research, training and networking costs	Management and overheads	
7	TUM	DE	no	1	36	114188,40	21600,00	9000,00	64800,00	43200,00	252788,40
8	CARDIFF UNIVERSITY	UK	no	3	108	493717,68	64800,00	27000,00	194400,00	129600,00	909517,68
9	BIOBEST BELGIUM NV	BE	no	1	36	117720,00	21600,00	9000,00	64800,00	43200,00	256320,00
10	FUB	DE	no	1	36	114188,40	21600,00	9000,00	64800,00	43200,00	252788,40
11	WU	NL	no	1	36	127019,88	21600,00	9000,00	64800,00	43200,00	265619,88
12	KBV	NL	no	0	0	0,00	0,00	0,00	0,00	0,00	0,00
13	CRAC-VITAE	UK	no	0	0	0,00	0,00	0,00	0,00	0,00	0,00
14	YR	NL	no	0	0	0,00	0,00	0,00	0,00	0,00	0,00
Total				15	540	2002888,08	324000,00	135000,00	972000,00	648000,00	4081888,08

4 - Ethics

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		**Page**
Does your research involve human participants?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		**Page**
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA		**Page**
Does your research involve personal data collection and/or processing?	○ Yes ◉ No	
5. ANIMALS		**Page**
Does your research involve animals?	◉ Yes ○ No	B2-15
Are they vertebrates?	○ Yes ◉ No	
Are they non-human primates?	○ Yes ◉ No	
Are they genetically modified?	○ Yes ◉ No	
Are they cloned farm animals?	○ Yes ◉ No	
Are they endangered species?	○ Yes ◉ No	

Bemisia tabaci, Tuta absoluta, Plutella xylostella, Drosophila suzukii, Macrolophus pygmaeus, Bombus terrestris, Diadegma insulare, Trichopria drosophilae. These are all common, non-endagered, invertabrate species.

6. THIRD COUNTRIES		Page

In case non-EU countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?	○ Yes ◉ No	
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	○ Yes ◉ No	
Do you plan to import any material - including personal data - from non-EU countries into the EU?	○ Yes ◉ No	
Do you plan to export any material - including personal data - from the EU to non-EU countries?	○ Yes ◉ No	
In case your research involves low and/or lower middle income countries, are any benefits-sharing actions planned?	○ Yes ◉ No	
Could the situation in the country put the individuals taking part in the research at risk?	○ Yes ◉ No	
7. ENVIRONMENT & HEALTH and SAFETY		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants?	○ Yes ◉ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	○ Yes ◉ No	
Does your research involve the use of elements that may cause harm to humans, including research staff?	○ Yes ◉ No	
8. DUAL USE		Page
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required?	○ Yes ◉ No	
9. EXCLUSIVE FOCUS ON CIVIL APPLICATIONS		Page
Could your research raise concerns regarding the exclusive focus on civil applications?	○ Yes ◉ No	
10. MISUSE		Page
Does your research have the potential for misuse of research results?	○ Yes ◉ No	
11. OTHER ETHICS ISSUES		Page
Are there any other ethics issues that should be taken into consideration? Please specify	○ Yes ◉ No	

I confirm that I have taken into account all ethics issues described above and that, if any ethics issues apply, I will complete the ethics self-assessment and attach the required documents. ☒

How to Complete your Ethics Self-Assessment

5 - Call Specific Questions

Extended Open Research Data Pilot in Horizon 2020

If selected, applicants will by default participate in the Pilot on Open Research Data in Horizon 2020[1] , which aims to improve and maximise access to and re-use of research data generated by actions.

However, participation in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. After the action has started, participants will formulate a Data Management Plan (DMP), which should address the relevant aspects of making data FAIR – findable, accessible, interoperable and re-usable, including what data the project will generate, whether and how it will be made accessible for verification and re-use, and how it will be curated and preserved. Through this DMP projects can define certain datasets to remain closed according to the principle "as open as possible, as closed as necessary". A Data Management Plan does not have to be submitted at the proposal stage.

Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be penalised for opting out.

We wish to opt out of the Pilot on Open Research Data in Horizon 2020.	○ Yes	◉ No

Further guidance on open access and research data management is available on the participant portal: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm and in general annex L of the Work Programme.

[1] *According to article 43.2 of Regulation (EU) No 1290/2013 of the European Parliament and of the Council, of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006.*

START PAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

Innovative Training Networks (ITN)
Call: H2020-MSCA-ITN-2017

PART B

This proposal is to be evaluated as:

[ETN]

Table of Contents

LIST OF PARTICIPATING ORGANISATIONS

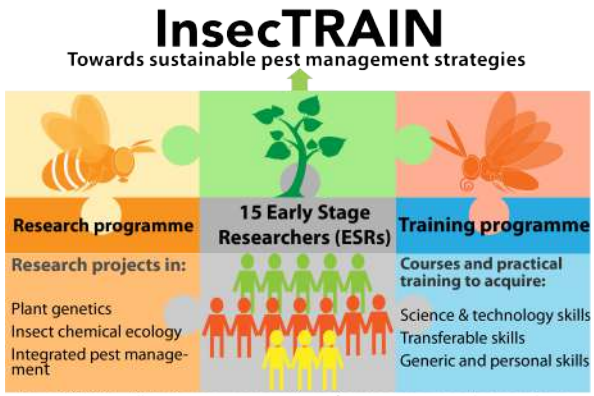
Consortium Member	Legal Entity Short Name	Acade-mic	Non-acade-mic	Awards Doctoral Degrees	Country	Scientist-in-Charge	Role of Partner Organisation
Beneficiaries							
1. Universiteit van Amsterdam	UvA	X		Yes	NL	Astrid Groot, Rob Schurink	
2. Max Planck Gesellschaft	MPG	X		No	DE	Markus Knaden, Bill Hansson, David Heckel	
3. ENZA Zaden	ENZA		X	No	NL	Petra Bleeker	
4. Sveriges Lantbruksuniversitet	SLU	X		Yes	SE	Peter Anderson, Teun Dekker	
5. Rijksuniversiteit Groningen	RUG	X		No	NL	Jean -Christophe Billeter	
6. Baseclear	Baseclear		X	No	NL	Danny Duijsings, Walter Pirovano	
7. Technische Universität München	TUM	X		Yes	DE	Wilfried Schwab	
8. Cardiff University	CU	X		Yes	UK	John Pickett Wynand van der Goes van Naters	
9. BioBest	BioBest		X	No	BE	Felix Wäckers	
10. Freie Universität Berlin	FUB	X		Yes	DE	Monika Hilker	
11. Wageningen University & Research	WUR	X		Yes	NL	Guusje Bonnema, Joop van Loon	
Partner Organisations							
1.Koppert biological Systems					NL		Training
2.Vitae/CRAC					UK		Training
3.Yellow Research BV					NL		Training

Data for non-academic beneficiaries:

Name	Location of research premises (city / country)	Type of R&D activities	No. of full-time employees	No. of employees in R&D	Web site	Annual turnover (in Euro)	Enterprise status (Yes/No)	SME status (Yes/No)
BaseClear BV	Leiden, NL	biotechnology, bioinformatics	50	5	www.baseclear.com	7.2M	yes	yes
ENZA Zaden	Enkhuizen, NL	Biotechnology & vegetable breeding	1600	800	www.enzazaden.com	220M	yes	no
Bio Best	Westerlo, BE	Insect production (pollination and biocontrol)	500	28	www.biobest.be	50M	yes	no

1. Excellence

1.1.1 *Introduction, objectives and overview of the research programme*



InsecTRAIN will train a new generation of entrepeneurs and researchers committed to developing sustainable pest management strategies by integrating multi-level knowledge of crop plants-pest insects interactions.

Harmful insects account for up to 25% of crop production losses[1] and thus pose a major threat to the crucial, global challenge of securing viable food production in face of a growing world food demand. Insects damage crops directly by feeding and indirectly by serving as Trojan horses delivering plant pathogens. Major insect pests have developed resistance to most present-day insecticides, and deployment of those that are still effective -on which current production is largely dependent (e.g. neonicotinoids)- is currently restricted and to be banned by 2020 due to rising concerns about their impact on ecosystems. Thus, Europe faces unprecedented demands to **improve crop protection strategies**, and needs to solve the challenge of maintaining food security by producing more food with less insecticides, as ordered by the EU Sustainable Use Directive for reducing insecticide use[2] and international policy directives, like the UN Sustainable Development Goals (SDGs)[3] and the FAO vision for Sustainable Food and Agriculture[4]. Innovative approaches in food crop production that support an increase in yield and a decrease in environmental pressure are thus urgently needed to protect the environment and biodiversity, and to abolish hunger (as stated in SDG#15 & 2). **InsecTRAIN** aims to contribute to these goals.

Natural variation in production of attractive or repellent volatile compounds in wild plants **has highly promising potential** for plant resistance breeding and disrupting plant-insect interactions[5]. Most wild plant species can defend themselves against pests by producing a wide variety of natural defence compounds, some of which repel pest insects and attract beneficial ones, so-called infochemicals. However, centuries of yield-focused breeding has eliminated the production of infochemicals in many crop plants, including tomato, strawberry and cole crops[6], leading to lowered crop plant defence against pest insects. At present, our ability to exploit the potential of natural variation in production of attractive or repellent plant volatile compounds is greatly constrained by our inability to truly understand the complex interactions between plants, pest insects and beneficial insects (pollinators and natural enemies). Therefore, research on host plant infochemicals used by pest insects has resulted in only few successful pest management strategies (e.g. the push-pull strategy developed by Beneficiary 8[7]). There is thus an urgent need for new approaches and for an integrated understanding of causes and consequences of natural variation in infochemical production by crop plants, variation in responses in pest insects, and their interactions with beneficial insects, which **requires a new generation of researchers with currently unavailable inter-disciplinary skills.**

The partners of **InsecTRAIN** will work synergistically to generate a cohort of well-trained young scientists with inter-disciplinary skills in plant and insect genetics, chemical ecology of plant – insect interactions and integrated insect pest management. Researchers with such a broad spectrum of training are lacking due to the fragmentation of these fields in Europe and because the need, nature and magnitude of the new skills required are emerging only now. The **InsecTRAIN** network will equip our Early Stage Researchers (ESRs) with the unique combination of skills essential to become future research leaders to drive this crucial research field forward and accelerate the development of novel pest management strategies and plant infochemical production platforms, which can be demonstrably cheaper and more effective than conventional pest management[8] .

InsecTRAIN has assembled a multi-disciplinary and intersectoral team of internationally renowned **academic** and **industrial** partners with expertise in plant and insect genetics, chemical ecology of plant – insect interactions and plant breeding that share a common goal to exploit the potential of natural variation in production of attractive or repellent volatile compounds into applicable strategies for sustainable crop protection and pest management. The **unique intersectoral activities of InsecTRAIN will provide an innovative multi-disciplinary research and training platform** for 15 ESRs. It is our vision to train these researchers with a suite of **experimental and theoretical** skills and provide experience of **working in industrial settings** to a) harness the great potential of this multidisciplinary field for new industrial applications and b) help shape the societal aspects these technologies face, including developing more effective and safer pest management strategies than the currently used insecticides. The Individual Research Projects (IRPs) of each ESR are tightly connected to the

[1] Oerke J. 2006. Crop losses to pests. *J Agricult Sci 144: 31-43*
[2] http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32009L0128
[3] http://www.un.org/sustainabledevelopment/
[4] http://www.fao.org/sustainability/background/en/
[5] Pickett JA & Khan ZR. 2016. *New Phytologist* Tansley review 212: 856–870.
[6] VanDoorn A & DeVos M. 2013. *Front Plant Sci 4: 222*
[7] Pickett JA et al. 2014. Push-pull farming systems. *Curr Opin Biotechnol 26*: *125-132.*
[8] Midega CAO et al. 2018. *Crop Protection 105: 10-15*

InsecTRAIN objectives, applying state-of-the-art technologies towards innovative key scientific questions.

The innovative aspects of **InsecTRAIN's** research are enhanced by a comprehensive training program that transfers the methodological know-how of our researchers to the ESRs. It fosters the ability of the ESRs to work in multi-disciplinary teams and intersectoral environments and to effectively disseminate multi-level knowledge on insect pest management, integrating both plants and insects perspectives, to end-uses, i.e. farmers, pest managers and policy makers. The training programme of **InsecTRAIN** specifically aims to develop plant and insect genetic and chemical ecology toolboxes, and uses metabolic engineering approaches and functional analyses to develop sophisticated pest management strategies that do not have adverse impacts on beneficial insects.

N**etwork activities are strengthened by our 4 world leading industrial partners through their innovation in the plant breeding and biotechnology areas**. The industrial partners will contribute to training with engineering-driven approaches of the application-related goals of **InsecTRAIN** to produce integrated pest management strategies and enabling the identification and field-use of infochemicals. To enhance the integration and the intersectoral aspect of every IRP, each ESR has a joint supervisor from academia and industry (Table 1.2a).

Current state-of-the-art - limitations and opportunities for InsecTRAIN

***Plant research and insect chemical ecology – development and challenges*:** Plant researchers and breeders, and insect chemical ecologists have independently gained fundamental insights into a) plant responses to insect attacks[9] and b) insect behavioral and evolutionary responses to plant defences[10]. The **InsecTRAIN** training programme aims to bring these two fields together, specifically to determine the processes that underlie host plant shifts and insect adaptations to plant infochemicals and how insects cope with variation in these plant infochemicals. As plant volatiles also affect beneficial insects, including predatory insects that play a crucial role in biological control against pest insects, and pollinators that are key to 80% of crops, it is essential to study the responses of these beneficial insects to the potentially useful plant infochemicals, to ensure the development of pest management strategies that do not harm beneficial insects.

New methodological opportunities exist for precisely targeted discovery of infochemicals that mediate the interactions of the crop plant with pest and beneficial insects, including pollinators and predatory biocontrol insects[11], by using e.g. new electrophysiological techniques to identify the sensory receptor in the insect coupled to advanced chemical analyses to identify the plant infochemical[12]. Genome editing techniques and bioassays of both insect sensory receptors and plants metabolic pathways responsible for the infochemical production will then be deployed in laboratory settings to causally connect the insect sensory receptor and the plant infochemical to firmly establish the potential value of such infochemicals for exploitation in sustainable agriculture and horticulture. This demonstration will then facilitate practical development by new breeding technologies that aim to enhance or reduce the production of the target infochemical by the crop plant[13].

InsecTRAIN's major aim is to educate a new cohort of scientists who are not only specialists in plant and insect genetics, but can combine their acquired skills with chemical ecology and thus, will be able to construct plant and insect specific toolkits that tailor responses towards application-driven goals defined by our commercial partners. Core **application driven goals** are implementation of the genetic toolbox in the metabolic pathways of cole, tomato and strawberry infochemicals and implementation of an ecological toolbox in the form of infochemical blends whose efficacy in shaping plant – insect interactions is determined in wind tunnels and (semi)field assays (see Table 1.1c).

InsecTRAIN will fill an important void and European societal challenge by developing toolkits and pest management strategies from the commercially valuable products. We will achieve this goal by educating a generation of scientists with multi-disciplinary experimental skills who have been trained in an intersectoral environment with strong industrial settings and who are able to use a unique platform that exploits inexpensive compounds that can be deployed for environmentally safe, robust and reliable pest management.

Research objectives

The **scientific objective of InsecTRAIN's research** is to determine the causes and consequences of natural variation in infochemical production by crop plants, variation in responses in pest insects, and their interactions with beneficial insects, to rewire and engineer plant responses into controllable enablers for effective pest management. The specific research objectives (RO) are:

RO 1: To develop a toolbox to identify plant genes regulating volatile attractants/repellents of pest insects.

RO 2: To develop a chemical ecology toolbox to determine variable response of pest insects to plant cues.

RO 3: To develop an implementation toolbox to test key infochemicals useful against pest insects, while not harming beneficial insects.

[9] Kant MR et al. 2015. *Ann Bot. 115:1015-51.*
[10] Reinecke A & Hilker M. 2014. *Annu. Plant Rev. 47: 115 – 154.*
[11] Pickett JA & Khan ZR. 2016. *New Phytologist* Tansley Review 212: 856–870)
[12] Lebreton et al. 2017 *BMC Biology* 15: 88; Keesey et al. 2017 *Nature Comm* 8: 265
[13] Pickett JA & Khan ZR. 2016. *New Phytologist* Tansley Review 212: 856–870; Li et al. 2017 *PNAS* 114: E7205-E7214

The specific objectives of each ESR's Individual Research Plan (IRP) are introduced in Section 3.1. The specific training objectives of **InsecTRAIN** are detailed in Section 1.2.

Overview of the research programme

To achieve our objectives, we have assembled a network of exceptional scientists with complementary expertises covering plant and insect genetics, chemical ecology of plant – insect interactions and field entomology. We will develop a creative research environment for inter-disciplinary and intersectoral training of the ESRs, closely linked with industrial stakeholders to develop practical application of our research programme. The research is embedded in 3 Research Training work packages (WPs) (see Fig. 1 and Table 1.1a) where, together, the ESRs will work on IRPs relevant for each RO mentioned above – and 3 WPs dedicated to the training, outreach and management of the programme and research results. Each of the 15 ESRs will focus on his/her specific research question within one of these WPs (see Section 3.1.4), while also being involved in the other WPs through the training programme (see Figure 1), including three network-wide summer schools (see 1.2.1) and secondments (see Table 1.2a). All 15 ESRs recruited by **InsecTRAIN** will contribute to the 3 scientific/research training WPs as shown in Figure 1 and Table 1.1a, and will focus on integrating the needs of plant breeders with the knowledge gained by the insect chemical ecologists. Identification of the genes underlying biosynthesis and emission of plant volatiles relevant to insect behaviour will lead to the development of molecular markers which will facilitate rapid application in breeding programmes and the opportunity for validation in realistic field environments. Our developed toolboxes can also be implemented in other crops than the 3 targeted here.

The **InsecTRAIN network** is built around a strong core of beneficiaries and partners with an established collaboration in research and the successful training of young researchers in other big consortia (e.g. MSCA-ITN PlantHUB, MSCA-ITN PlantID, MSCA-ITN BINGO, MSCA-ITN CropStrengthen, NWO-TTW GAP (Green defense Against Pests), and South West Biosciences Doctoral Training Partnership (SWBio DTP). These established connections help minimise risks (specified in Table 3.2a). All projects can start immediately from the onset of the funding period. The Beneficiaries and partners of **InsecTRAIN** constitute a unique and exceptionally strong consortium in the fields of plant and insect chemical ecology. The academic partners (UvA, RUG, FUB, SLU, MPG, WUR, TUM, CU) contribute to state of the art expertise in plant genetics, insect chemical ecology and field entomology. The commercial Beneficiaries and partners (ENZA, Baseclear, BioBest, Koppert) will ensure that all students are exposed to and trained in entrepreneurship, and delivery of practical and cost-effective solutions well suited to the demands and needs of the customer and the cropping system.

InsecTRAIN partners work at the frontiers of their fields contributing to the development of high-resolution technologies and providing a powerful toolkit for the ESRs. Milestones have been defined to maximise the possibilities of breakthroughs through cooperation between the ESRs and partners (see Table 3.1c). Different parts of the programme are connected through intimate collaboration established through network-wide training events and secondments (see Table 1.2a). To maximise collaboration between ESRs, the IPRs are connected, but in a way that avoids critical interdependencies that could jeopardize the training due to delays of another IRP. For example, the insect chemical ecology ESRs and implementation ESRs will work closely together and with the plant genetic ESRs, but the beneficiaries and partners already have solid preliminary data in all three fields, so that each ESR can start with these data.

By **close collaboration between academia and industry** through cutting-edge research, diverse training courses and secondments, **InsecTRAIN** will provide an inter-disciplinary personal development and training programme (cf. section 1.2.) for each ESR that complements their research experiences. Furthermore, the *trans-national mobility* is designed to improve the employability of our ESRs and enhance their future career prospects.

1.1.2 Research methodology and approach

The **InsecTRAIN** programme is grouped into 6 WPs (Figure 1 and Table 1.1b) – three of which specifically address our research objectives (Table 1.1a). ESRs are in multiple WPs, as shown in Figure 1.

WP1 (Plant genetic toolbox): To determine which host plant volatiles emitted from the plants are used by the pest insects, plant volatiles will be isolated and extracted from above-ground plant organs (flowers, fruits and leaves) of different cultivars and accessions of tomato, cole and strawberry, which are high value crop plants (Table 1.1a). The volatile metabolome of the different plant samples will be analysed and identified (Table 1.1a). These volatiles will be tested in WP2 for their effects on insects, physiologically and behaviourally, to discover the key components and blends that elicit attraction (Table 1.1a). Candidate genes involved in the metabolic pathways of these host-plant volatiles eliciting attraction will be identified making use of intra-specific crosses, quantitative genetics, transcriptomic and bioinformatic analyses. To functionally characterize the candidate genes involved in the formation of relevant plant volatiles, these genes will be either overexpressed or their expression downregulated using *Agrobacterium tumefaciens*, which will also give insight in possible pleiotropic effects on the phenotype of the plant. Methodologies of WP1 in which ESR 1-4 will be trained are:

- ***Chemical ecological analyses***: Plant volatile collections and GC-MS analyses to identify host plant volatiles
- ***Genetic analyses***: Quantitative Trait Loci (QTL) approaches, using segregating populations stemming from

intra-specific crosses (available, or made at the breeding companies) to pinpoint causal metabolites and genes. This will be combined with RNAseq (transcriptomics) to identify the gene(s) underlying the QTL (eQTL).

- ***Bioinformatics***: Using transcriptome data to identify the genes responsible for the volatiles eliciting attraction, and potentially the regulators of the plant volatile metabolic pathways. Data will be subjected to association and regression analyses using a systems biology approach. Gene families for the biosynthesis of most volatiles are known and this knowledge will be incorporated in these studies.
- ***Functional analyses***: Transient expression using *A. tumefaciens* to determine enzymatic activities and product formation. Stable genetic modifications also using *A. tumefaciens* for overexpression, for knocking down gene expression using RNAi, or for knocking out gene expression using CRISPR-Cas9.

ESR 5 will immediately start developing implementation of this genetic toolbox based on genes already identified by consortium members in the metabolic pathways of cole conferring resistance to the diamondback moth[14 15 16]. Based on this model, similar toolboxes will be established for tomato and strawberry, for which consortium members have already solid starting genetic data[17 18 19].

Table 1.1a WP1-3 Goals and targets

WP1 GOAL: A toolbox to identify plant genes regulating volatile attractants/repellents of pest insects		
CROP	**EU MONETARY LOSSES**	**GENE IDENTIFICATION AGAINST WHICH PEST**
Tomato	17.5 billion Euros/yr	Metabolites conferring resistance against tomato leaf miner (ESR1) and whitefly (ESR2)
Cole	3.4 billion Euros/y	Metabolites conferring resistance against the diamondback moth (ESR3, ESR5)
Strawberry	3.3 billion Euros/y	Metabolites conferring resistance against the spotted wing fruit fly (ESR4)
WP2 GOAL: A chemical ecology toolbox to determine variable response of pest insects to plant cue		
PEST	**ECONOMICAL RELEVANCE**	**DETERMINATION OF WHAT**
Whitefly *Bemisia tabaci*	Devastating crop pest worldwide, virus vector, developed insectide resistance	Electrophysiological responses to tomato volatiles and genetic variation (ESR6)
Tomato leaf miner *Tuta absoluta*	One of the most problematic tomato pest as indicated by breeders and growers	Physiological responses to tomato volatiles, genetic variation, behavioural plasticity (ESR7)
Diamondback moth *Plutella xylostella*	Most damaging cabbage pest worldwide, developed resistance to most insecticides, can radiate to new host plants	Electrophysiological responses to cabbage volatiles (ESR9), genetic variation (ESR8), behavioural plasticity (ESR10)
Spotted wing fruit fly *Drosophila suzukii*	Invasive and detrimental strawberry pest and other small fruits; insecticides cannot be applied on ripe fruits	Physiological responses to strawberry volatiles (ESR11), genetic variation (ESR12), behavioural plasticity (ESR11,12)
WP3 GOAL: An implementation toolbox to test key infochemicals useful against pest insects, while not harming beneficial insects		
BENEFICIAL INSECT	**ECOLOGICAL RELEVANCE**	**DETERMINATION OF WHAT**
Mirid Bug *Macrolophus pygmaeus*	Key natural predator of the tomato leafminer in tomato	Behavioural responses to tomato volatiles in (semi)field settings (ESR13)
Buff-tailed bumblebee *Bombus terrestris*	Pollinator of tomato	Behavioural responses in (semi)field settings (ESR13)
Parasitoid wasp *Diadegma insulare*	Main parasitoid wasp attacking diamondback moth larvae in cabbage	Behavioural responses in lab assays and (semi)field settings (ESR15)
Parasitoid wasp *Trichopria drosophilae*	Pupal parasitoid and main natural enemy of the spotted wing fruit fly	Physiological and behavioural responses in lab and (semi)field settings (ESR14)

WP2 (Insect chemical ecology toolbox): Physiological responses of selected pest insects to plant volatiles will be tested by gas-chromatography (GC) coupled to electroantennographic detection (GC-EAD) to determine the active compounds detected by the insects (Table 1.1a). The identity of and variation in the olfactory receptors involved will be determined by transcriptomic and bioinformatic analyses. Attraction to host plant volatiles sources will be identified in wind tunnel experiments, while oviposition behaviour will be assessed in specifically designed cage experiments. Synthetic blends of electrophysiologically active compounds will be made and tested in behavioural assays. Behavioural analyses will be conducted in wind tunnels and (semi)field assays. Genetic variation between populations will be distinguished from behavioural plasticity through selection experiments and genetic analysis (QTL and Genome Wide Association Studies (GWAS)). ESRs 6-12 will be trained in:

- ***Chemical ecological analyses***: GC-EAD to identify which plant compounds are sensed by the insects
- ***Genetic analyses***: QTL, GWAS, RNA-seq, to identify genomic loci underlying variation in attraction/repellence in the pest insects to host plant volatiles.

[14] Degenhardt J et al. 2003. *Curr Opin Biotechnol. 14:169-76*
[15] Kos M et al. 2013. *Pest Manag Sci. 69: 302-11.*
[16] Pickett JA & Khan ZR. 2016. *New Phytologist* Tansley review 212: 856–870.
[17] Bleeker PM et al. 2012. *Proc Natl Acad Sci USA 109: 20124-20129.*
[18] Glas JJ et al. 2012. *Int J Mol Sci. 13:17077-103.*
[19] Aharoni A et al. 2004. *Plant Cell 16:3110-31.*

- ***Bioinformatic analyses***: genomics & transcriptomics to identify candidate genes and variation in insect olfaction and attraction.
- ***Behavioural analyses:*** lab bioassays, wind tunnel and (semi)field experiments, to determine the level and extent of plasticity and learning in the pest insects in relation to host plant volatiles.
- ***Functional analyses***: genetic modifications through CRISPR-Cas9, RNAi to functionally analyse the candidate genes and assess pleiotropic effects.

WP3 (Implementation toolbox): Attraction, repellence and retention to the main predators and parasitoids of the pest insects and of pollinators of the three crops (Table 1.1a) will first be tested through laboratory trials, including olfactometer studies in which plants and plant volatile extracts will be tested to quantify responses to the emitted plant volatiles in the key beneficial insects. In semi-field experiments, plant patches will be created consisting of undamaged plants, or of a mix of herbivore damaged and undamaged plants, using those plant accessions that are potentially useful in pest management against the pest insects. Visitation by pollinators will be assessed based on direct observations, colour marks, and bite marks. Distribution of pest natural enemies will be assessed by using sentinel traps and direct observations. The specific research methods ESR 13-15 will learn are:

- ***Chemical ecological analysis***: GC-EAD to identify host plant volatiles detected by beneficial insects.
- ***Behavioural analyses:*** lab bioassays to screen which potential plant accessions likely have an attractive effect on beneficial insects, and (semi)field experiments to confirm laboratory screens in a realistic field situation.

WP4 (Dissemination & outreach): Outcomes from the project that are of relevance to commercial agriculture will be communicated to farmers through the established marketing approaches developed by Enza, Biobest, CU (all beneficiaries) and Koppert (partner), through articles in the industry and farming press and through websites and social media. Whenever possible, the ESRs will be stimulated to conduct development trials with pioneer growers to evaluate new treatments under commercial conditions. These activities will refine and improve marketability of pest management approaches developed by the project, and provide valuable exposure of ESRs to the reality of commercial farming and growers requirements. All ESRs will gain experience in dissemination and outreach by:

- ***Organising two workshop meetings*** (at the end of summer school 2 and 3) with growers and other stakeholders to jointly determine how best to incorporate knowledge from **InsecTRAIN** into their horticultural/agricultural systems to reduce losses to pest insects.
- ***Communicating*** (potentially) useful results through the **InsecTRAIN** website, social media, stakeholders and end users, a number of which are already part of the consortium. The dialogue with stakeholders through the workshop meetings will allow co-production and co-design with end users, and it will provide valuable exposure of ESRs to the reality of commercial farming and growers' requirements. The comple-mentarity of academic and industrial skills, as well as scientific and soft skills, will benefit all ESRs as well as other students who can join the training activities. The research results will be disseminated and exploited (Section 2.3).

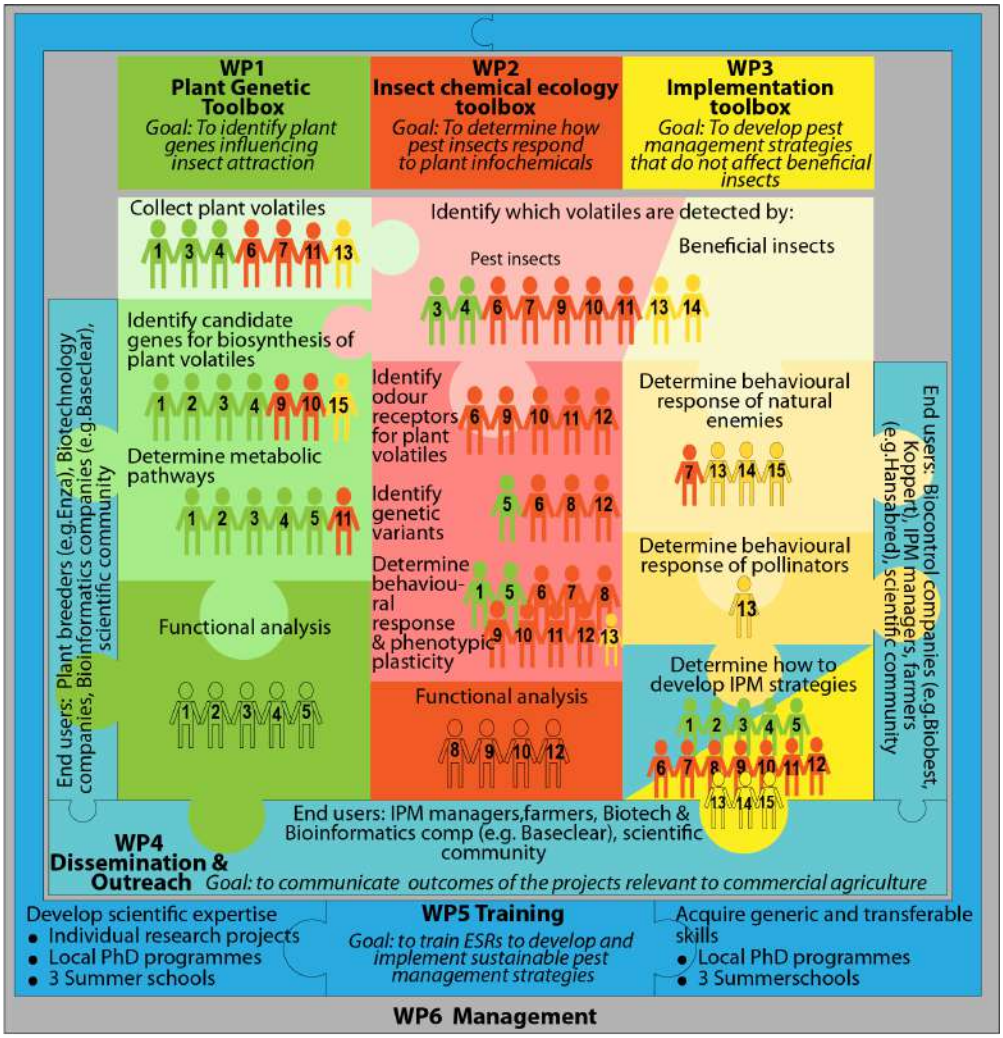


Figure 1 Overview of all work packages of InsecTRAIN with the main goals and analyses

WP5 (Training) and WP6 (Management): In addition to the specific trainings and summer schools, **Insec-TRAIN** will also use the project management structure that is part of any large project, as a training opportunity. ESRs will actively take part in the management activities, using the expertise, available facilities and experience of WP6 staff at UvA:

- ESRs will ***help writing and editing progress*** reports for the European Commission.
- ***Organising the symposia*** is the main responsibility of the ESRs.
- ***The outreach activities*** (see Section 2.3.1) in disseminating results through the **InsecTRAIN** website, social media channels, presentations in their institutions and at conferences are the main responsibility of the ESRs.

All these activities are valuable contributions to training the ESRs in modern project and research management.
In addition to the WPs, **InsecTRAIN** offers 3 summer schools, where all above methods will be trained (see 1.2.1).

Table 1.1b Work Package (WP) List

WP No.	WP Title	Lead Beneficiary	Start Month	End month	Activity Type	Lead Beneficiary Short Name	ESR involvement
1	Plant Gene ID Toolbox	3	7	42	Research	ENZA	1,2,3,4,5
2	Insect Chemical Ecology Toolbox	4	7	42	Research	SLU	5, 6, 7, 8, 9, 10, 11, 12
3	Field testing &Implementation	8	7	42	Research	Biobest	13, 14, 15 & all
4	Dissemination & Outreach	8	7	48	Dissemination	CU	All
5	Training	1	7	48	Training	UvA	All
6	Management	1	1	48	Management	UvA	All

1.1.3 Originality and innovative aspects of the research programme

InsecTRAIN offers a **novel cutting-edge research programme** that will (a) **train** students in state-of-the-art biological sciences that range from molecular biology to behavioural ecology and field testing, (b) **integrate** research on crop species with research on pest- and beneficial insects, which is a unique combination, and (c) **link** lab-bench science to field-ecology science and sustainable insect pest management. Thus, **InsecTRAIN** will provide valuable intersectoral knowledge to all ESRs for bridging research and implementation.

InsecTRAIN's innovation also results from its **pioneering approach** that merges the fragmented scientific expertise in plant genetic and insect chemical ecology research, and fills a critical gap in European researcher training to educate the next generation of scientists able to address research questions in both biology and industrial plant breeding and biotechnology relevant to the societal issue of food safety and food security. Integration of these research areas is a clear advance compared to single-focused doctoral programmes and will drive the next generation of science and technology research leaders and entrepreneurs in Europe. The project differs fundamentally from the MC-ITN programmes BINGO (Breeding Invertebrates for Next Generation BioControl) and BIG4 (focusing on the evolution of insects from the four biggest insect orders to enhance knowledge, sustainable use and preservation of the fascinating insect diversity) in its aim to develop sustainable pest management strategies by integrating multi-level knowledge of pest insects and their interactions with crops. Specifically, the **InsecTRAIN** training programme consists of **interdisciplinary** scientific methods (plant chemistry and genetics, insect chemical ecology, behavioural biology, genetic analysis and manipulation, bioinformatics and genomics, and field testing), as well as necessary soft skills (management, communication and outreach).

The **InsecTRAIN** ESRs will be **fully integrated with the industrial sector** to understand this area's needs and challenges and to foster the development of novel applications and required researcher skill sets. To ensure this aim, we have engaged beneficiary and partner companies with immediate relevance, application pathways and for the research results and deployment of the ESR skills:

- ***ENZA Zaden* is an R&D intensive,** international leader in vegetable seeds, with state of the art facilities, and whose mission is to constantly come up with improved crop-plant varieties through targeted introgression of traits present in the germplasm (i.e. using the available natural variation).
- ***Baseclear*** offers a state-of-the-art environment in bioinformatics, as this company is at the forefront of new developments in genomic and transcriptomic analysis.
- ***Biobest*** is renowned and specialised in developing innovative solutions for effective natural crop pollination and biological pest/disease management. Biobest is an internationally operating company, active in over 60 countries. Biobest has pioneered bumblebee pollination and a range of crop protection innovations. The R&D department employs 28 researchers, fully geared to supervise ESRs.
- ***Koppert*** is market leader in providing biological control agents worldwide. Over 300 specialised advisors assist growers in the use of biological control to protect their crops.

The **InsecTRAIN** research programme aims at substantial research, but also integration and training to tackle challenges with high industrial and socio-economic impact for which no solutions are currently available. To the best of our knowledge, there is no other European programme focusing on a similar topic and scope. The ESRs will

use the most advanced methodologies and will be guided by internationally renowned experts from both academic and non-academic sectors towards innovative solutions with major impact for the European economy (Table 1.1b and c). The main objectives are given in Table 1.1a, an overview of the supervisors of each ESR is in Table 1.2a.

Table 1.1c Innovative aspects of the InsecTRAIN research programme

WP	Main objective	Main Innovations	Applications
All	Provide 15 ESRs with an innovative and multi-disciplinary research training through cross-sector and cross-border mobility.	- Education of ESRs in molecular biology / biochemistry AND ecology by teaching : (i) novel technologies in molecular biology and chemistry, (ii) recognize ecological problems and (iii) apply molecular /chemical knowledge in ecological setting.	-Significant enhancement of the employ-ability and career perspectives of ESRs - New cohort of future, highly creative entrepreneurs and research leaders incrop protection and insect pest management.
1	Develop a toolbox to identify plant genes regulating volatile attractants/repellents of pest insects.	Newly identified plant infochemicals are associated with synthesis genes that will, when unknown, be identified via RNA-Seq and bioinformatics, via their induction causing discernible increase in expression levels. Confirmation by genome editing and bioassay.	Promising new infochemicals confirmed by genome editing will be targeted in new breeding programmes for sustainable agricultural exploitation against pest insects without harming beneficial insects.
2	Develop a chemical ecology toolbox to determine variable response of pest insects to plant cue.	Determine subdivisions of olfactory systems that serve to recognise hosts and non-host plants and obtain small component blends of attractive and repellent infochemicals.	Suites of newly identified infochemical blends driving insect behaviour to be exploited for sustainable agricultural use against pests and not harm beneficial insects.
3	Develop an implementation toolbox to test infochemicals against pest insects, while not harming beneficial insects.	In extension of WP2, this process is applied comparatively between pests and beneficial insects to maximise value and minimise adverse effects.	In addition to influencing pest population dynamics, promote ecosystem services provided by pollinators and biological control agents.

1.2 Quality and innovative aspects of the training programme

For the training programme of **InsecTRAIN**, tailor-made courses have been designed to target the main structural barriers that currently exist in this interdisciplinary field (see Tables 1.2b and1.2c). These courses aim to meet the needs of the individual ESRs throughout their progression in the programme.

- The **InsecTRAIN** training programme provides essential transferable skills (management, communication and outreach) in which ESRs will be thoroughly educated (see also 2.1) and of **interdisciplinary** scientific methods (phytochemistry, chemical ecology, behavioural biology, sensory physiology, genetic and functional analyses, molecular biology, bioinformatics and genomics). To maximise integration from all different angles, **InsecTRAIN** training consists of pest-insect specialists, plant specialists and beneficial-insect specialists.
- The training programme of **InsecTRAIN** is **intersectoral**, as our network consists of internationally renowned academic partners and innovative industrial partners from highly successful companies. Thus, this consortium comprises leading organisations in European academic and non-academic sectors, offering a unique and broad doctoral training setting for researchers to develop their skill-sets for application in both academic and industrial sectors, thereby improving their employability and enhancing their career perspectives.
- The training programme of **InsecTRAIN** is **gender** balanced: The coordinator of **InsecTRAIN** (Dr. Astrid Groot), recently promoted to full professor, is a recipient of a MacGillavry Fellowship, a recruitment programme for top-level female talent, and she is actively involved in the Women-in-Science programme at the UvA. Within the consortium of 12 Beneficiaries, three more Beneficiaries are headed by internationally renowned female leaders that can serve as role-model (ENZA: Dr. Petra Bleeker, WUR: Dr. Guusje Bonnema, FUB: Dr. Monika Hilker). All Beneficiaries within **InsecTRAIN** have been trained in unconscious bias. To ensure equal treatment, the selection panel will have an adequate gender balance (see 3.2.7 for further details).
- With the **multitude of industrial partners**, ESRs will benefit from access to key know-how present in these companies otherwise not accessible for academic professionals.
- Besides taking part in the overarching training activities with focus on interdisciplinary skills, each ESRs will be receiving individual training by being embedded in the various research groups as well as industry (see Table 1.2a). All **InsecTRAIN** academic and industrial Beneficiaries are geared to train students to become internationally respected researchers, with high-impact publications and long-standing international collaborations, in **both academia and industry** (see also Table 1.3).

The training programme will address the shortage in researchers able to combine cutting-edge research expertise and environmental/ecological demands with commercial vision for the industrial implementation of engineered

- and thoroughly researched **pest management strategies**.

Innovative training objectives

In the novel, interdisciplinary training programme of **InsecTRAIN**, the ESRs will benefit from the interplay of excellent basic research supervised by the academic partners and more applied research in leading companies in the area of crop protection, addressing pest management from four different angles: plants, pest insects and their natural enemies, and the complex interactions between them. Specifically, the ESRs will receive a training programme with the following **Training Objectives** (TO):

TO1: To enhance attractiveness of a career at the forefront of academic and industrial research. All ESRs

will be offered a structured training programme by leading academic **plus** industrial researchers through thorough on the job training with state-of-the-art equipment and facilities in research skills. *i.e.* developing research questions with hypotheses that can be tested, developing, executing and analysing experiments that address and aim to answer the research questions, and communicating the research results through publications in peer-reviewed open-access journals and at conferences and workshops (among others, those that are organised and are part of **InsecTRAIN**).

TO2: To provide excellent, multidisciplinary and intersectorial training in a) chemical ecology and behaviour: To develop sustainable counter strategies against pest insects, information on the profile of plant volatiles and the olfactory tuning of the pest insect is needed. All ESRs will be trained in physiological and behavioural analysis, both in lab and field, to design experiments that are ecologically meaningful; **b) in genomics and bioinformatics:** since genomes of many plant and insect species are or are becoming available, it is necessary to educate the new generation of researchers in genomics and bioinformatics: how to analyse giga/terabytes of information and extract useful information for further research, how to annotate genes and link putative enzyme activities to the genes, how to map metabolic networks to genome maps, how to integrate different data types (genomic, transcriptomic, metabolic, phenotypic) and visualise these in a web-based interface.

TO3: To create an active, sustainable network of young researchers through training in transferable skills, dissemination & outreach. The Beneficiaries, partners and ESRs personal contacts, support and expertise will contribute to the future of European pest management. All **InsecTRAIN** ESRs will be trained in implementing their results in possible marketable products and communicating their results to end users. Furthermore, the ESRs will take turn in joining the supervisory board to learn about all aspects of research management (see also Section 3.2.2). This 'training on the job' will be guided by the main project supervisor of each project. ESRs will thus learn to meet deadlines, how to produce high quality deliverables and to report effectively.

Table 1.2a Recruitment deliverables per beneficiary, with supervision and secondments

			Beneficiaries											Partners				
ESR	Recruiting beneficiary	Planned starting month	UvA	MPG	Enza	SLU	RUG	BC	TUM	CU	BioB	FUB	WUR	Kop-pert	Vitae	YR	Univ	FSU
1	ENZA	7	C,S,P		M						S			G	G	G		
2	UvA	7	M,P		C,S					S			C	G	G	G		
3	WUR	7		S				C,S	C		S		M	G	G	G		
4	TUM	7		S				C,S	M		S		C	G	G	G		
5	BC	7	S					M	C,S, P				C,S	G	G	G		
6	CU	7	C,S					C,S		M,P				G	G	G		
7	SLU	7	C,S		C,S	M,P					S			G	G	G		
8	UvA	7	M,P	C,S				C,S				S	S	G	G	G		
9	FUB	7			C,S	S	C					M,P		G	G	G		
10	SLU	7		M			C,S		C,S		S			G	G	G		P
11	MPG	7		C,S		C,S	M,P	S						G	G	G		
12	RUG	7				M,P								G	G	G		
13	BioB	7	S						S	S	M		C,S	G	G	G	P	
14	CU	7	C				C,S			M,P	S			G	G	G		
15	CU	7							C,S	M,P	C,S			G	G	G		
		M: Main supervisor, C: Co-supervision, S: Secondment, P: PhD awarding institution, G: Generic Skills																

1.2.1 Overview and content structure of the training

Going local: All ESRs will enrol in a doctoral training programme at their host institution, and will receive local training in scientific, technical and generic skills in this institution and that of his/her interdisciplinary secondment (see Table 1.2a). All our university partners have signed the Erasmus Charter for Higher Education, which sets out the fundamental principles and the requirements for PhD programmes. The academic institutions have **well-established and structured PhD programmes**, including mandatory training courses, which vary

Table 1.2b Main network-wide training events, conferences and contribution of beneficiaries

#	Main Training Events & Conferences	ECTS	Lead Institution	Project Month
1	**1st InsecTRAIN summer school**	*Location: Alnarp, Sweden*		
	Management & ESR introduction	---	UvA	7
	Course 1: Insect chemical ecology	5	SLU	
	Course 2: Project management	1	Vitae	
2	**2nd InsecTRAIN summer school**	*Location: Wageningen, The Netherlands*		
	Management & ESR project progress	---	UvA	19
	Course 3: Bioinformatics	2	Baseclear	
	Course 4: Genetic engineering	2	WUR	
	Course 5: and publication writing skills	1	Write-it-right	
3	**3rd InsecTRAIN summer school**	*Location: Amsterdam, The Netherlands*		
	Management & ESR project progress	---	UvA	31
	Course 6: R&D crop protection products	2	Koppert	
	Course 7: Commercialisation & IPR	0.5	Yellow Research	
	Course 8: Presentation and media skills	0.5	Hoekstra	
4	**Secondments**	2 per month	All beneficiaries	

depending upon local university requirements. Our partners award **ECTS credits** for the different elective courses that are **mutually recognised** by other universities across Europe. The recruited ESRs will have the opportunity to **learn cutting-edge technologies** in the participating laboratories and in different disciplines (see partner profiles in B5 for details on available equipment in the partner facilities) and technical skills, ranging from plant and insect genetics to insect behavioural and field ecology. All of our university partners offer **local activities for researchers**, such as **postgrad forums and academic writing workshops**, in which the fellows can participate based on interest and skills. These modules provide all ESRs with a set of core skills that will augment **InsecTRAIN**`s network-wide training designed to complement and enhance rather than duplicate local training.

Going global: InsecTRAIN entails three summer schools, containing a total of 8 courses specifically geared for InsecTRAIN, which are obligatory for all ESRs and open to other European PhD students. Summer school A consists of courses 1 and 2, summer school B consists of courses 3-5 and summer school C consists of courses 6-8, as specified below. The ECTS credits for each activity are specified in Table 1.2b. The purpose of the *Management & ESR progress* meetings (2 days each) at the beginning of each summer school is to encourage communication and collaboration between all ESRs and PIs. On day 1, each ESR will give a 15 minute presentation on the project progress made (total: 15 x 15 = ~ 4 h), followed by 60-minute scientific WP roundtable discussions, chaired by the WP leader. On day 2, the Supervisory and Management Board meetings will be held with the participation of two ESR representatives (see also 3.2.4).

Table 1.2c Specifications of the **InsecTRAIN** courses

Course no.1	Title: **Insect chemical ecology**
Organisers PIs InsecTRAIN *Skills* Scientific ★★★★★ Technical ★★★☆☆ Transferable ★☆☆☆☆	*Description* – Two week course – Summer school 1 The InsecTRAIN PIs and invited leading experts will give lectures on the theoretical and technological advances made within and outside insect chemical ecology, and how quantitative genetics can help in this field. This already well-established and highly successful course employs a diverse suite of teaching and learning activities, including lectures, student presentations (both poster and oral), literature discussion seminars, lab demonstrations and exercises, and a mini research project.

Course no.2	Title: **Project Management**
Organiser Vitae *Skills* Scientific ★★☆☆☆ Technical ★☆☆☆☆ Transferable ★★★★★	*Description* – Two day course – Summer school 1 - https://www.vitae.ac.uk/ A two-day project management training will focus on how to organise research projects, including effective planning of activities, time management, effective communication, and dealing with setbacks. The training will be based on the well-established Vitae suite of programmes on how to become an effective researcher for doctoral researchers and research staff. This course will also contain a half day bias-training, focusing on recognising and countering unconscious prejudices and bias, related to recruiting, collaborating in projects and managing staff.

Course no.3	Title: **Bioinformatics**
Organiser Baseclear , ENZA, WUR *Skills* Scientific ★★★★★ Technical ★★★★☆ Transferable ★☆☆☆☆	*Description* – One week course – Summer school 2 This course will introduce the ESRs to the basics of bioinformatics analyses, specifically geared to the needs of their project, and is an adaptation of already existing courses at Leiden University for Applied Science. The course will include the following subjects: 1) Analyzing DNA-sequences; 2) Genetic structure (CpG islands, telomeres, ribosomal RNA, BLAST); 3) Genetic diversity (Hapmap, population stratification (PCA), GWAS (chi2,OR), haplotyping).

Course no.4	Title: **Genetic engineering**
Organisers TUM, UvA, ENZA, WUR, RUG *Skills* Scientific ★★★★★ Technical ★★★★☆ Transferable ★☆☆☆☆	*Description* – One week course – Summer school 2 In this era of genomics, transcriptomics and proteomics, many different molecular techniques have been developed that are important tools to functionally analyse and characterise identified genes and genetic pathways. As these techniques are also necessary to develop novel and innovative pest management strategies, InsecTRAIN will train ESRs in the most important genetic engineering techniques that are currently used in plant and insect research, specifically agroinfiltration and *Agrobacterium*-mediated transformations (in plants), RNA interference and CRISPR-Cas9 (in both plants and insects).

Course no.5	Title: **Proposal and publication writing**
Organiser Write it Right *Skills* Scientific ★★☆☆☆ Technical ★★★☆☆ Transferable ★★★★★	*Description* – Two day course – Summer school 2 - http://write-it-right.org Course to improve writing skills for (scientific) publications and project proposals. The ESRs will learn to write clear technical English, structure documents effectively, enhance titles and graphics to make output with an impact. This course will also include a 0.5 day poster-training, to learn how to create an effective, visually attractive and informative scientific poster for sessions in conferences. Taking part in poster competitions is part of this training.

Course no.6	Title: **R & D of biological crop protection products**
Organiser Koppert *Skills* Scientific ★★★☆☆ Technical ★★★★☆ Transferable ★★★★★	*Description* – One week course – Summer school 3 Course to train the ESRs in the hurdles and opportunities for academic innovation, potentially their own, to reach an end product. It will introduce the R&D process of selecting and developing new biological control agents, risk assessment and registration issues, intellectual property protection, access and benefit sharing (Nagoya protocol), and the use of biological control in practice. Experts from within the company will provide a broad overview of the R&D process for new crop protection products – from early research to field development and market launch.

Course no.7	Title: **Commercialisation and Intellectual Property (IP)**
Organiser Yellow Researc	*Description* – One day course – Summer school 3 - http://www.yellowresearch.nl
Skills Scientific ★★☆☆☆ Technical ★★☆☆☆ Transferable ★★★★★	Course focusing on European market and laws. This course is specifically targeted at Academia to Industry relationships. Various exploitation strategies will be discussed, Intellectual Property Rights issues, as well as effective dissemination strategies. Open science, open access and open innovation are key elements in this course.

Course no.8	Title: **Presentation and Media Skills**
Organiser Hoekstra	*Description* – One day course – Summer school 3 - http://www.mediatraining.nl/
Skills Scientific ★☆☆☆☆ Technical ★★☆☆☆ Transferable ★★★★★	Course to provide insight in journalistic methodologies and approaches. As InsecTRAIN works in the field of food security and safety, connecting biodiversity and ecosystem services with Life Science approaches, which are sensitive topics to policy makers and the general public, it is highly relevant that the ESRs learn how to handle press and media.

1.2.2 Role of non-academic sector in the training programme

Participation of industrial beneficiaries: (see also Table 1.3 and section 3.2):

ENZA (Bleeker) will coach ESR1 full-time, host ESRs 2, 7, 9, 10, 13 and 15 for secondments, to teach ESRs genetic analyses of plant varieties. These ESRs will work in a multidisciplinary environment in which researchers from the Cell Biology, Biochemistry, Phytopathology, Bioinformatics, Statistics and Molecular Biology departments work closely together. Regular meetings will be held to monitor the progress of each PhD students' research plan. Enza will also co-teach course 4 'Genetic engineering'. Enza will also significantly contribute to the training and dissemination of results (WP4, WP5) by helping the ESRs to interact with breeders around the world to learn about the different challenges that vegetable crops need to endure and on how (academic) knowledge helps to create improved crop varieties.

Baseclear (Duijsings, Pirovano) will coach ESR5 full-time, host ESRs 3, 4, 6, 8 and 12 for secondments, to teach ESRs bioinformatics skills. The ESRs at Baseclear will work in a top-level molecular biology lab infrastructure, including the latest sequencing technologies offered by Illumina, Pacific Biosciences and Oxford Nanopore Technologies, and focused on consultancy and support to customers both in academia and industry. Regular meetings will be held to monitor the progress of each PhD student's research plan. Baseclear will also teach course 3 "Bioinformatics". Baseclear will also significantly contribute to the training and dissemination of results (WP4, WP4) by offering the ESRs access to a genomic knowledge and resource network within the University of Applied Sciences in Leiden and Leiden University.

Biobest (Wäckers, Pozo) will train ESR13 full-time, host ESRs 4, 7, 11, 14 and 15 for secondments, to teach behavioural analyses specifically aimed at beneficial insects, including the main predators and parasitoids of pest insects that are used in biological control programmes, as well as pollinators. Collaboration with academic groups is an integral part of the R&D philosophy and Biobest frequently hosts multiple graduate and postgraduate students, offering the ESRs the opportunity to work together with our academically trained researchers, as well as with technical field staff. As the R&D headquarters are in Belgium and additional R&D staff is located in several subsidiaries, including in France and Spain, the ESRs have the opportunity to conduct semi-field experiments under different environmental conditions. Biobest will also significantly contribute to the training and dissemination of results (WP4, WP5) by helping communicating results to end users, farmers and growers.

Participation of industrial partners:

Koppert (Tom Groot) will give course 6 "Research and development for biological control agents", will help develop and evaluate potential business plans of ESRs in course 7, and will be part of the supervisory board. Koppert is experienced trainer of both master and PhD students and is Beneficiary of the MC-ITN programme 'Bingo'. Whenever a product within InsecTRAIN has potential to be marketed, Koppert will assist in bringing it to the market.

Vitae is dedicated to realizing the potential of the ESRs, and will give course 2 "Project management". In addition, during the complete InsecTRAIN programme, ESRs have supported use of the Vitae Researcher Development Framework and Personal Career Development Planner to review their personal and professional development. Through the Supervisory Board, Vitae will provide external feedback on the professional development and progression of the fellows as well as providing placement opportunities.

Yellow Research will teach course 7 "Commercialisation and Intellectual Property (IP)" and monitor the progress of the ESRs with regard to market opportunities and commercial application of research results and provide training on IPR issues and commercialisation strategies through the Supervisory Board.

Quality of the supervision

Our experience: Of the 15 ESRs, 12 have academic beneficiaries as main supervisors and 3 are supervised by the non-academic beneficiaries (ESR1 at Enza, ESR5 at Baseclear, and ESR13 at Biobest; see Table 1.3). The main supervisors (PIs) have key qualifications that reflect the core topic of the respective ESRs and will allocate at least 10% of their time to this task. All **InsecTRAIN** supervisors, main supervisors and co-supervisors have extensive experience in thesis supervision (from BSc to PhD) and academic training – teaching,

course/programme development and/or coordination – at all levels. The academic supervisors have on average supervised 13 PhD students in their careers demonstrating their experience (see Table 1.3). The non-academic supervisors all have long-standing experience in MSc and/or PhD supervision. Details on partners are given in B5. To ensure that ESRs benefit optimally from the synergies of the strong **InsecTRAIN** network, each ESR will have two co-supervisors with complementary qualifications with key relevance to the topic, and one extra supervisor from the **InsecTRAIN** consortium. Thus, each student has a committee of 3 supervisors, both from academia and industry. For details on supervision and meetings of ESRs and supervisors, see 3.2.2. and 3.2.4.

Our quality: The Beneficiaries and partners of **InsecTRAIN** constitute a unique and exceptionally strong consortium in the field of plant and insect chemical ecology. The academic partners (UvA, CU, RUG, FUB, SLU, MPG, WUR, and TUM) contribute state of the art expertise in plant and insect genetics chemical ecology of plant – insect interactions and field entomology. The commercial Beneficiaries and partners (Baseclear, BioBest, ENZA, Vitae, Hansabred and Koppert) will ensure that the students are exposed to and trained in entrepreneurship, production at scale and delivery of practical and cost-effective solutions well-suited to the demands and needs of the customer and the cropping system. Specifically, **InsecTRAIN** consists of internationally renowned **plant beneficiaries,** specialised in the following areas:

- UvA (Schuurink): genomics, transcriptomics and metabolomics of plant traits conferring resistance to insects (in tomato)
- Enza (Bleeker): detecting quantitative trait loci (QTL) in vegetable crop varieties and accessions
- TUM (Schwab): biochemical, genetic and metabolic pathway analysis of host plant odours (strawberry)
- WUR (Bonnema): genetic analysis (genomics, transcriptomics and QTL) in Brassicaceae

The internationally renowned **insect chemical ecologists** each have their own special skills as well:

- UvA (Groot): Genetic analysis of chemical and behavioural variation in insects
- MPICE (Knaden): Neurophysiological and behavioural assays to test odour detection, integration and valence
- MPICE (Heckel): Quantitative genetics on resistance mechanisms in pest insects
- FUB (Hilker): Chemical, physiological and behavioural analysis of plant-insect interactions
- SLU Alnarp (Anderson, Dekker): Behavioural plasticity and learning in insects related to host plant volatiles
- RUG (Billeter): Insect neurogenetics and molecular genetics
- Biobest (Wäckers, Pozo): Natural pollination and biological control of pests and diseases
- WUR (van Loon): Electrophysiological and behavioural assays to test insect responses to plant volatiles
- CU (Pickett, vdGoes vNaters): Behavioural and ecological role of infochemicals, identification of chemical signals involved in the chemical ecology of pests, biosynthesis of chemical signals.

In addition, the **InsecTRAIN** consortium includes **Baseclear** (Pirovano, Duijsings), specialised in comparative meta-genomics and meta-transcriptomics analyses, data visualisation using web-based interfaces. Internationally renowned specialist in sustainable crop management is **John Pickett**, the co-developer of the successful push-pull strategy in wheat against the stem borer. The addition of the two key companies specialised in biological control of pest insects and diseases, **Biobest** and **Koppert**, and the worldleading strawberry breeding company **Hansabred** as External Advisory Board member, gives **InsecTRAIN** the added value of testing all possible solutions in an ecological context to ensure that pest insects are disrupted, while beneficial insects are not.

1.2.2 Qualifications and supervision experience of supervisors

Table 1.3 Qualifications and supervision experience of supervisors

ESR	Main supervisor (organisation)	Daily supervisor(s)	H-index	# Students supervised	# Papers	Highest journal
1	ENZA	Petra Bleeker	14	2 PhD s, 10 MScs	16	PNAS
2	UvA	Rob Schuurink	30	13 PhDs	63	PNAS
3	WUR	Guusje Bonnema/Joop van Loon	25/42	10 PhDs/25 PhDs	30/170	Nature Gen/Nat Chem. Biol.
4	TUM	Wilfried Schwab	20	32 PhDs, 10 MSc	155	Nature Genetics
5	Baseclear	Danny Duijsing/Walter Pirovano	10,13	15 MSc/10 MSc	12/21	Dev Cell/PNAS
6	CU	John Pickett	60	>20 PhDs	526	Nature
7	SLU	Teun Dekker	19	10 PhDs, 7 MSc	47	Current Biology
8	UvA	Astrid T. Groot	24	10 PhDs, >20 MSc	80	Nature
9	FUB	Monika Hilker	36	30 PhDs, >60 MSc	142	Nature
10	SLU	Peter Anderson	27	19 PhD, 17 MSc	82	Ecology Letters
11	MPG	Markus Knaden Bill Hansson David Heckel	19 50 43	6 PhDs, 8 MSc 29 PhDs, >40 MSc 25 PhDs	50 349 174	Science Nature Nature
12	RUG	J-C Billeter	17	9 PhDs, >20 MSc	24	Nature
13	Biobest	Felix Waeckers/Maria Pozo	50/10	14 PhDs, >30 MSc/ 5 MSc	154/20	Science/Mol. Ecology
14	CU	Wynand vdGoesvN	11	3 PhDs	19	Nature
15	CU	John Pickett	60	> 20 PhDs	526	Nature

1.3 Quality of the proposed interaction between the participating organisations

As described under 1.2 and in Table 1.2a, the networks involved in supervision of each ESR will ensure synergy, frequent interactions and close collaboration between Beneficiaries and Partners through joint project planning, trainings, manuscript writing and dissemination. All participants will have in-depth involvement and contribute to more than one ESR project, either as main supervisor, co-supervisor and/or by hosting a secondment. This arrangement will stimulate inter-disciplinary thinking and novel research approaches and contribute to building a strong network beyond the **InsecTRAIN** programme period. Additionally, at the annual symposia organised by the ESRs, all partners will be able to discuss achievements and challenges.

The training programme in terms of research-oriented courses will largely be developed, coordinated and run jointly by the Beneficiaries and partners. Three Beneficiaries (1, 2, 4) will contribute to course 1 *Insect chemical ecology and genetics*, three (6, 7, 11) to course 3 *Bioinformatics*, and four (1, 3, 5, 7, 11) to course 4, *Genetic engineering*. Partner organisation Koppert will give and host course 6 *Research and development for crop protection products.* The courses focusing on more generic skills (i.e. course 2 *Project Management*, course 5 *Proposal and publication writing*, course 7 *Commercialisation & IPC*, and course 8 *Presentation and media skills)* will be hosted by partner organisations Vitae and Yellow Research, as well as external training suppliers Write-it-right, and Hoekstra Media training. The unique course curriculum developed for **InsecTRAIN** will ensure that the skills obtained for next generation pest management will be disseminated and communicated to the public, and result in innovative and competitive European enterprises that will ensure high quality of agricultural crops in an environmentally sustainable way. Beneficiaries and partner organisations not involved in courses will contribute to the training programme through hosting of secondments, providing tools and training (see section 1.2).

1.3.1 Contribution of all participating organisations to the research and training programme

Each ESR will meet with her/his main supervisor on a (bi)weekly basis (2-4x/month), and with the committee every three months (mostly through skype meetings). Feedback from the whole consortium will be given to each ESR during the summer schools in months 7, 19 and 31, and in the skype meetings in months 13, 25 and 37. See 3.2 for more details. All ESRs will receive a PhD degree and hence be enrolled in a University offering a doctoral programme. Those ESRs not hosted by a university will be enrolled at one of the universities (see Table 1.2a).

1.3.2 Synergies between participating organisations

InsecTRAIN consists of a unique combination of plant breeders (both academic (WUR, TUM, UvA) and commercial (Enza), insect chemical ecologists and geneticists (MPG, FUB, SLU, UvA, WUR, RUG, CU), bioinformaticians (Baseclear) and Beneficiaries and partners specialised in sustainable crop protection through biocontrol agents (Biobest and Koppert). Synergies exist at different levels, i.e among the plant breeders, among the insect ecologists and between the plant and insect researchers. Each of the Beneficiaries have their own specialized skills that together allow to address the research questions from different angles, using complementary techniques and approaches, as specified in Table 3.4.

1.3.3 Exposure of recruited researchers to different environments, and the complementarity thereof

Interdisciplinary environments: **InsecTRAIN** will train a new generation of researchers in an interdisciplinary way, who will be trained by both academic and industrial top partners that form a **natural synergy**, to enhance and **stimulate interactive thinking and working in networks**, which is necessary to develop long-term sustainable solutions in pest management. Students in **InsecTRAIN** will specialise in a discipline (genetics, entomology, plant metabolomics, bioinformatics), and will be able to place their knowledge in a multidisciplinary context through interactions with the other students and partners in **InsecTRAIN** and their participation in summer schools. This unique combination of skills and interactions between disciplines will greatly enhance the **career opportunities** of the students, and foster the discovery of innovative pest management tools.

Intersectoral environments: All ESRs will do their secondments at a different sector than that of their primary host, so that **industry goes to university and vice versa** (inter-sectoral secondments). This will ensure close collaborations and interactions between all academic and non-academic Beneficiaries and Partners of the InsecTRAIN network, and exposure of all ESRs to the industry. **InsecTRAIN** has three non-academic Beneficiaries and three non-academic Partners. The ESRs will benefit from the interplay of excellent basic research at the academic partners and applied science in leading companies in the area of crop protection. The academic Beneficiaries consist of universities that are mainly focused on fundamental research (UvA, RUG, FUB, TUM, CU), universities that are mainly focused on agricultural research (WUR, SLU), institutes that are fundamental (MPG), and applied companies of different sizes and commercialisations (ENZA, Baseclear, Biobest). InsecTRAIN will thus educate innovative researchers who can **integrate knowledge** from different disciplines and address problems as challenges, both **scientifically as commercially**.

2 Impact

The overarching scientific goal of **InsecTRAIN** is to generate deep insights into the complex infochemical responses and interplay between crops and insects though host plant volatiles, and to rewire and engineer plant

responses into controllable enablers for effective pest management. Our scientific approach has the potential to identify processes that are critical for industry in **effective crop protection and management.** To address this complex scientific problem, **InsecTRAIN** combines the complementary expertise of leading European groups in complementary scientific disciplines. The multi-disciplinary expertise of our team members merges this exceptional breadth of topics into a multifaceted multi-disciplinary and inter-sectoral training programme for our ESRs, thus overcoming the current fragmentation of the plant and insect research fields in Europe. The **InsecTRAIN** network as a whole has clear added value compared to a single-organisation or national-only training environments, as no current single organisation in Europe is able to cover such a range of expertise and training courses provided by our network. **InsecTRAIN** is a metabolic engineering and biology-driven training network that will **make use of new omics technologies and approaches, combined with latest advancements in infochemical predictive modelling to investigate integrated responses in plant-insect interaction.** The research and training combine all aspects in modern experimental disciplines with theoretic approaches towards industrial applications. The **balanced ratio of academic and industrial partners** shapes **InsecTRAIN** as a truly inter-disciplinary project offering unique intersectoral training for our ESRs. Our industrial partners have experience in the application of emerging and cutting-edge technologies, which puts a new dimension to the project: **using academic infochemical and metabolic engineering approaches to controllable and effective crop protection systems for industrial exploitation and applications**. Several applications in **InsecTRAIN** were defined to be of major interest for our industrial and commercial partners (see Table 1.1c), assuring an **immediate link to industrial needs**. The methodologies required for the success of **InsecTRAIN** are established and the relevant expertise of the consortium partners is available, thus ensuring the timeliness of the proposed research and training activities and increasing the potential for integration of important scientific problems with potential impacts in food and agricultural industries.

2.1 Enhancing the career perspectives and employability of researchers and contribution to their skills development

Where is the future? The academic-industry partnership of **InsecTRAIN** addresses a widely recognised issue in PhD training programmes: although most PhD students leave science after graduation (e.g. Netherlands 2013: 80%[20],), the PhD programmes usually produce PhDs whose specialised knowledge is of limited relevance to the world outside of academia[21]. To a large extent, academic programmes do not effectively and explicitly the academic work-force for industrial innovation. The **InsecTRAIN** programme builds on the premise that **discovery-based innovation forms the basis for academy-industry synergy**. To reach this goal, it is of utmost importance that the ESRs not only receive scientific training, but also become equipped with skills and a mindset to fast-track innovation into practical solutions. **InsecTRAIN** is set up such that 15 ESRs will obtain intersectoral skills to be employable in academia as well as the private sector, and monitors the activities of the individual fellows to achieve the desired skill level to succeed either in academic institutes, in industry, or in founding enterprises.

Need for funding early-stage researchers: **For realistic career opportunities in the field of sustainable agriculture**, it is important to educate students in plant and pest biology, plant volatile emissions and their effects on insect populations, and to endow them with good basic understanding of bioinformatics, genomics and quantitative genetics. Similarly, it is essential that students trained in bioinformatics, as proposed for the student unravelling biochemical pathways that affect volatile emissions, have affinity with plants and their interaction with the biotic world. **InsecTRAIN** has exactly this goal: students specialise in a discipline (genetics, entomology, metabolomics, bioinformatics), but are able to place their knowledge in a multidisciplinary context through their interactions with the other students in **InsecTRAIN** and their participation in training sessions. This unique combination of skills and interactions between different disciplines will greatly enhance the career opportunities of the students, both in the public and private sector.

Career Perspective: The involvement of three different industrial partners at level-1 and three industrial partners at level-2, as well as the training provided by these partners, will make the ESRs familiar with the research challenges and opportunities in the private sector, and will stimulate the entrepreneurial mind-set of the ESRs. Furthermore, the high scientific calibre of the consortium ensures that students will be strongly encouraged to work towards results with high-impact publications, and that they will be immersed in world-leading research targeted by the programme. Finally, the frequent meetings, the secondments, and the summer schools will familiarise the ESRs with the mobility of researchers and research jobs within the EU, and provide the ESRs with a network for later career development. These skills and experiences will increase the employability of the ESRs **in both the public and private sector** (specified in Table 2.2), extended significantly beyond what a regular university-based PhD training can offer.

[20] Facts and Figures Academic Careers in The Netherlands, http://www.rathenau.nl
[21] http://www.nature.com/news/2011/110420/full/472261a.html

Table 2.2. Potential job profiles of **InsecTRAIN** graduates

In academic/public sector	*In industry*
• Post-doctoral researcher in academic lab: including depts. Molecular Biology, Chemical Ecology, Entomology, Analytical Chemistry	• Researcher in Biotechnology Research Departments of vegetable and fruit breeding companies worldwide (including depts. Phytopathology, Molecular Biology, Biochemistry, Analytics
• Position in national institutes e.g. NAK Tuinbouw • Management position in academic institute	• Entomology research in industry • Data management and bioinformatics positions
• Entomological research position • Policy maker	• Position in national and international funding agencies • Position in patent office
• Regulatory affairs specialist	• Position at FAO/WHO
• University / HBO lecturer • Science communicator	• Position in multinational agro companies and SME • Field trials expert • Crop protection entrepreneur • Science communicator • Product manager • Technical application specialist

2.2 Contribution to structuring doctoral/early-stage research training at the European level and to strengthening European innovation capacity

InsecTRAIN will develop a framework for structured doctoral training at European level between leading participants from academic and non-academic sectors. Specifically, **InsecTRAIN** will:

- Establish **long-term collaborations between the participating universities and companies** to continue joint training of young scientists, including secondments in industry. The new collaborations can be sponsored by EU/national funded programmes or private sponsoring. Commercial partners will benefit from a secure confidential environment to share ideas and innovations, which can promote development of novel products.
- Develop **strong academic networks** of scientists and research groups at the interface of the growing field of metabolic engineering and biotechnology, which has a strong need for novel tools and technologies. This will be initiated in **InsecTRAIN** through the several secondments of the ESRs and the networking events, and will continue through close working relationships (arising from **InsecTRAIN** networking) between ESRs and staff.
- Establish a **sustainable structured training programme, seminar series and conferences** between the academic partners. The **InsecTRAIN** workshops will be continued beyond the project completion.

InsecTRAIN will have a significant impact on structuring the initial research training capacity of the 15 ESRs. The partners will form a network that will ensure sustainable inter-disciplinary training of ESRs both through structured training programmes, exchange programmes, mutual recognition of training and specific R&D projects. This network will be of great importance to the future position of European research on crop protection and pest management with direct implications to industrial production of compounds and non-synthetic pesticides, which will also be of great benefit to European industrial competitiveness.

2.2.1 Strengthening European Innovation Capacity

A significant impact on academic-private collaboration that strengthens EU innovation capacity will come in several forms:

- The **unique combination** of expertise in plant molecular biology with expertise in insect genetics, olfaction and behaviour on the one hand and industrial competence in biotechnology, bioinformatics, plant breeding and insect rearing on the other hand will create a unique opportunity for innovative industrial applications that will continue beyond the duration of the **InsecTRAIN** project.
- **Knowledge exchange and development of collaborations** between academic and non-academic partners both at the ESR level (collaboration between the ESRs and meetings across sectors at networking courses/events) and staff level (coordination of courses and knowledge sharing for the ESRs' research projects). Moreover, secondments will have a crucial role in the exchange of knowledge between partners.
- Providing **in-depth knowledge of soft-skills**, i.e. management, IP and business development through transferable skills courses on entrepreneurship and innovation.

Recently, in recognition of the development of insecticide resistance, environmental concerns and increasingly stringent legislation, the focus on insect pest control has shifted dramatically from insecticide use to alternative control strategies. Alternative pest management strategies can be designed through a multi-level knowledge of the principal life-history traits of pest insects, which is the goal of **InsecTRAIN**. Specifically, **InsecTRAIN consists of researchers** who have:

1. identified host plant volatiles that are attractive or repellent for specific pest insects[22],
2. identified genes involved in the biosynthetic pathway of these volatiles[23],

[22] FernandEnza et al. 2007. *Entomol. Exp. Appl.125: 157-164*; Keesey et al. 2015. *J. Chem. Ecol. 41: 121-128*.
[23] Cumplido-Laso et al. *2012 J. Exp. Bot. 63: 4275-4290*; Koepke et al. 2010. *Phytochemistry 71: 909-917*

3. selected plants differing in emission of volatiles affecting pest insects[24] and beneficial insects[25],
4. identified behavioural plastic traits of herbivorous insects[26]
5. extensive knowledge on the behaviour, biology, variation and genetics of the pest insects[27], and
6. extensive knowledge and use of insects for biological control and pollinators in IPM programmes[28].

With this highly qualified team of researchers and industrial partners, the **InsecTRAIN** consortium will train a new generation of researchers to translate scientific advances into innovations that can contribute to efficient, user-friendly and sustainable insect pest management.

The enhanced cross-sectoral collaboration through inter-disciplinary research in the fields of cell physiology, engineering and experimental approaches will, furthermore, be crucial **in strengthening EU innovation capacity in terms of**:

- education of future leading scientists in Europe within key emerging fields;
- education of future business leaders with a strong academic background;
- fostering mutual trust between research institutions and industry;
- attracting, retaining and motivating high skilled scientists interested in entrepreneurial aspects and new career opportunities;
- increasing Europe's global competitiveness through the development and commercialisation of newly engineered frameworks in key sectors of EU's economy – biotechnology, crop protection and pest management.

In line with the principal strategic objective of **InsecTRAIN**, the private partners will get access to inter-disciplinary skilled scientists, who will be of utmost importance for the development of new technologies and products that will help ensure **their competitive advantage**.

The knowledge and solutions that will be developed in **InsecTRAIN project will positively impact industry** in the following ways:

- **InsecTRAIN will develop three toolboxes,** which will greatly enhance the development of innovative measures for control of major pest insects. The four pest insect species that are the focus in **InsecTRAIN** will form the basic platform that can be used by other companies and entrepreneurs to streamline the necessary steps that need to be taken for other insect – crop interactions to achieve dissemination of new products into the field.
- The involvement of highly successful companies in supervision and the external board will ensure that students will be exposed to and need to show their plans, developments and progress to supervisors specifically interested in the applicability of these findings.

Innovations generated in **InsecTRAIN** will play a crucial role in the transition from current synthetic processes to bio-based processes.

2.2.2 Contribution of the non-academic sector to the doctoral / research training

The **InsecTRAIN** training programme has been designed to ensure that the **non-academic sector will directly contribute** to the doctoral training of each ESR. Specifically:

- 15 ESRs will be recruited and all of them will be seconded to non-academic and industrial partners for a total of 6-9 months (see Gantt chart in section 4), which will ensure validation and applicability of research results.
- The above-mentioned four non-academic/industrial partners will organise and/or actively participate in network events for the ESRs to discuss industrial drivers and challenges and to receive specific training in innovation and entrepreneurship activities. In addition, all ESRS will be trained by a professional company (Hoekstra Mediatraining) in presenting and communicating research results (see Tables 1.2b and 1.2c for more details).
- At network meetings the non-academic sector will among others contribute to views on commercialisation and patent development.

2.3 Quality of the proposed measures to exploit and disseminate the results

Why wanted: **InsecTRAIN** offers key contributions to European innovation in academia and industry as follows:

i) Contribution to harmonised doctoral trainings

- **Mutual recognition of qualifications and degrees**: All academic partners in **InsecTRAIN** use the ECT system for their structured PhD programmes (see Table 1.2b) and mutually recognise the ECT points awarded at the partner institutions to ensure transferability of ESRs.
- **Adoption of best practices in PhD training and supervision**: Our main face-to-face networking vehicle is via the secondments and summer schools, which will also serve as the exchange of best practice and dissemination of information among partners, and between senior and junior researchers. Moreover, members of the Graduate Schools at the partner universities will be invited to meet with the Management Board in the attempt to establish

[24] Bleeker et al. 2012. *Proc Natl Acad Sci USA. 109: 20124-9*
[25] Ament et al. 2010. *Plant J. 1:124-34.*
[26] Austel et al. 2015. *Chem. Senses 40: 109-124*; Thöming et al. 2013. *Ecology 94: 1744-1752*. Proffit et al. 2015. *Ecol. Lett. 18: 365-374*.
[27] Beyaert & Hilker 2014. *Biol Rev 89: 68-81*; Reinecke & Hilker 2014. *Annu. Plant Rev. 47: 115-154*; Groot et al. 2016. *Annu Rev. Entomol.61: 99-117.*
[28] Messelink et al. 2014. *Biocontrol. DOI 10.1007/s10526-014-9579-6*

permanent joint postgraduate courses.

InsecTRAIN will thus contribute to the EU's efforts to promote harmonised and intersectoral doctoral training.

ii) Contribution to strong international and interdisciplinary network

- **Offering summer schools.** The **InsecTRAIN** summer schools, also open to other European PhD students, are set up such that all six training elements will be taught, so that not only the ESRs of this programme will get a highly integrative, multidisciplinary training, but also other European students interested in the field of insect pest management. Therefore, the impact and benefit of this programme will reach students throughout Europe and support networking among the PhD students.
- **Interactions at international meetings**. The young researchers and supervisors will attend international meetings in their appropriate specialities, and disseminate the work of the network to the scientific community. Targeted conferences are not only the regular scientific ones, but also industry related events and events related to the Horizon2020 programme.
- **Development of interdisciplinary network**. Not only the ESRs will benefit from the **InsecTRAIN** network directly, but also the European Union, as this network aims to become a long-lasting interactive collaboration between all the labs involved. Each Beneficiary and Partner, although being well-known expert in one or more of the disciplines involved in **InsecTRAIN**, will profit from the knowledge that the others will contribute. For example, Enza is expert in plant breeding and developing pest-resistant crops, but has little knowledge on insect pests, their behaviour, variation, physiology and learning abilities. Through **InsecTRAIN**, intimate collaborations between the Beneficiaries from different disciplines are realised that are necessary to ensure scientific advances in the field of plant breeding, crop protection and insect chemical ecology, and to translate these advances to innovative pest management strategies. The basis for this synergy is Open Science and Open Innovation, as also promoted in the course 7 "*Commercialisation and Intellectual Property"*.
- **Establishment of sustainable and long-lasting training collaborations**: Our consortium aims to create self-funded and sustainable training activities that will transcend the duration of the **InsecTRAIN** project through joint publications, joint exploitation and launching joint future research projects.

iii) From science to application: In addition to the development of the three toolboxes, the research results of **InsecTRAIN** will be actively disseminated to industry, i.e. policy makers, stakeholders and end-users through the two workshops that the ESRs will organise (at the end of summer school 2 and 3). As the **InsecTRAIN** training contains two courses in disseminating results (course 6 and 7) and our consortium consists of world leading industrial Beneficiaries and partners (Enza, Biobest, Koppert), ESRs will be thoroughly exposed and encouraged to communicate and disseminate their research results to stakeholders and end-users. In addition, with the assistance of the plant breeding industry, the identification and characterisation of interesting transcripts related to insect pest resistance will be transferred to DNA markers that can be directly used in existing breeding programmes. In this way, generated knowledge can immediately be transferred to the users while simultaneously protection in the form of IP can be realised, as successfully done already by the host labs.

2.3.1 Dissemination of the research results

The overall scientific dissemination of our work will be in the traditional form of **presentations** at national and international meetings (2-3 per ESR, 30-40 total), and **publications** in peer-reviewed journals (a total of 45-60 publications, or 3-4 per ESR following requirements of each PhD rewarding university (see Table 1.2a), which will be written mainly by the ESRs. **InsecTRAIN** will finish with an **end symposium** to disseminate our results to growers, policy makers, potential end users and the general public. Our publications will provide the proximate index of the quality of our work, and stimulate the interest of our scientific peers. Many of our members have excellent publication records in the upper echelon of biological science journals (see Table 1.3). Since **InsecTRAIN** is a unique consortium of plant biologists and insect chemical ecologists, **InsecTRAIN** aims to publish research results in refereed high impact journals, such as Nature, Current Biology, PLoS Biology, PNAS, Biology letters, Applied Ecology, Ecology Letters, Proceedings of the Royal Society-B. Following our standard practice, after acceptance, all network publications will be posted both on the **InsecTRAIN** webpage as well as on our Institute web pages. All data will be stored in public databases, such as Dryad and Genbank, as has become common practice for all ecological and molecular related publications. A Data Management Plan will specify this further (see 3.2.8). To ensure full access to all research results, we will also make all network publications available, as specified in 2.4.1 and 3.2.7.

Our network will likely generate some negative results, such as unsuccessful field trials. In order to inform future research and pest control endeavours of which approaches are less likely to be successful, negative data will be uploaded to archival websites in biology such as bioRXiv.org and registration of studies at Open Science Framework: opensciencefframework.org, where relevant. These data will be linked to our website and social media.

2.3.2 Exploitation of results and intellectual property

The **InsecTRAIN** programme is designed to have significant impact at a commercial level, through the practical

outputs throughout the research programme and the strong link between academic and industrial partners (see Table 2.3). Details of exploitation of the results will be agreed upon in the Consortium Agreement (CA), but will follow the general rules of the programme (see section 3.2.6 for all details). All disseminations of results will be pre-scanned by industrial partners for potential protection and/or exploitation possibilities.

Exploitation will be done via the EPSO (European Plant Science Organisation) Technology Platform or via the excellent existing relationships of the **InsecTRAIN** partners with relevant companies formed, with commercial outputs from previous research (see reports of Enza, Baseclear, Biobest and Koppert). In addition, exploitation will also rely on the European Technology Platform (ETP) 'Plants for the Future', which is a stakeholder forum for the plant sector and consists of members from industry, farmer organisations, academia and other stakeholder groups. Where there is no obvious route to commercialisation, we will promote open access to our data and resources to provide maximum benefit to the public in general and farmers in particular.

Table 2.3. Expected results generated by the **InsecTRAIN** network

Expected key results for future commericalisation by our private sector Beneficiaries	
1. **For future commercialisation**, a) establish a software tool that will predict and map metabolic pathways to genome sequences, b) derive a method to quickly genotype and/or identify molecular markers in higher eukaryotes, c) demonstrate the value of NGS technology in the field of plant breeding and crop protection. 2. **New ecological tomato, cole and strawberry cultivars** that are repellent to pests and attractive to beneficial natural enemies and pollinators. 3. **Molecular markers for accelerated incorporation of insect resistance**: identification and characterisation of interesting genes related to pest-resistance will be transferred to DNA (molecular) markers that can be directly used in existing breeding programs. The industry predominantly uses molecular markers for directed breeding.	4. **Skilled personnel**: trained young people with a high-value profile for both universities but also industry e.g. breeding. 5. **Increased value of seeds**: creation of novel varieties with insect resistance to increase the value of seeds. 6. **Increase the competitive value**: industrial innovation will lead to an enhanced competitive position for European companies in a global market 7. **Transfer of knowledge**: understanding the mechanisms behind insect behaviour and the mechanisms underlying resistance in plants is valuable for effective use in the stacking of various resistance layers and for Integrated Pest Management 8. Scientific dissemination of results in 45-60 peer-reviewed papers and broadcasted in 30-40 conference talks 9. **Exploitation** of results: protecting generated knowledge in IP.

2.4 Quality of the proposed measures to communicate the activities to different target audiences

2.4.1 Communication and public engagement strategy of the project

How to benefit? **InsecTRAIN** works in the field of **food security and safety** (SDG#15 and 2), connecting biodiversity and ecosystem services with Life Science approaches, which are sensitive topics to policy makers and the general public. We aim to communicate results from our consortium to a wide audience, which is also the reason that the ESRs in **InsecTRAIN** will be trained in course 8 how to **handle press and media**. Press releases from our member institutions, newspaper articles, and radio and TV appearances are one way in which we have, and will continue to interact with the public via the various media channels available.

We will create a **publicly accessible InsecTRAIN website, Facebook page, Twitter account and LinkedIn profile**. Our ESRs will be expected to contribute ideas and help design these pages and accounts. The public website will include links to the web pages of all contributing laboratories and SMEs of the network, and use the social media (depending on the developments in this field), which reports the essence and progress of **InsecTRAIN** and targeting interest groups and health professionals. Topics will be explained in laymen's terms and include, crop damage, insects and their life-cycles, with focus on agricultural pests and disease transmitting insects, chemical ecology, integrated pest management and interviews with members of our network (both PIs and ESRs)

Each ESR will be responsible to present and update the specific projects he/she is involved in. As many projects involve more than one ESR, the joined work on the website will not only strengthen the corporate identity within **InsecTRAIN**, but will also force each ESR to continuously track the project progress and to react to newly emerged challenges. All members of **InsecTRAIN** will continue to give *ad hoc* presentation to the public when appropriate. We will also create a **YouTube channel** on which we will post our results via video created by our ESRs. In addition, each member of the network will be involved in **outreach activities** within their country of residence, such as "The night of art and science" in Groningen, "The long night of sciences" and "Girl´s Day" in Jena and Berlin, children's lectures at NEMO in Amsterdam, "the CU Open Weekend for the Public", the "Weekend of the Science" at WUR and the Open Alnarp Day. In the ESR-driven symposia at the end of each of the three summer schools, all ESRs will present their projects (first symposium), their progress (second and third symposium), and their final findings (concluding conference) in informative and attractive presentations that are geared towards a broad audience. These symposia will be announced broadly and press and EU representatives will be invited as well. Our concluding international conference taking place in Amsterdam will be the high-point of our outreach activities. This end symposium will be targeted to our main professional stakeholders, being the scientific community, as well as end users (see below), life-science companies working in the field of pest-management and policy makers. We will invite the press and EU representatives, and full stories will be posted on our website.

InsecTRAIN consists of end users and all members have **strong links with end users** and end user communities,

and will keep these communities updated on progress (e.g.: www.greenportnhn.nl/english). In the ESR-driven symposia at the end of each of the three summer schools, all ESRs will present their projects in informative and attractive presentations that are geared towards a broad audience, including end users like **farmers, farmers' organisations and horticultural companies**. These symposia will be announced broadly and press and EU representatives will be invited as well. At our concluding international conference, the **InsecTRAIN** research conclusions of the most promising findings for commercialisation will be presented and ideas will be exchanged to set the perspective of future research development of novel pest management strategies.

But following-up of the ESRs will not stop at the end of the programme. To ensure life-long professional connections between the **InsecTRAIN** members, we will create a LinkedIn professional group that will enable academic and non-academic partners to advertise up-coming job opportunities to our former ESRs and to develop new collaborations. We also aim to continue our **InsecTRAIN** website and YouTube channel to continue interactions with all junior and senior members of **InsecTRAIN** and with the general public.

3 Quality and Efficiency of the Implementation

3.1 Coherence and effectiveness of the work plan

3.1.1 Work Packages description

Table 3.1a Description of Work Packages

WP no. 1	**M7-M43**	***Lead Beneficiary:* ENZA**	***Title*: Develop a toolbox to identify genes conferring pest resistance in plants**
Objectives **1**) To analyse the biological variation of host plant (tomato, cole, and strawberry) volatiles; **2)** Identify the plant volatiles that are perceived by four important pest species, to use these host plant volatiles in sustainable pest management strategies; **3**) Provide a list of candidate genes and (draft) metabolic pathways related to the biosynthesis of the host plant attractants/repellents, which can be used to select and/or develop crop plants resistant to pest insects.			
Description Insects usually identify and localise their hosts by following host-specific key odours. The chemical identity and quantity of the volatile compounds varies with the plant species, organ and age. The bouquet of volatile compounds, rather than any single volatile, determines the degree of attractiveness to herbivores. To determine which host plant volatiles emitted from the plants are used by the pest insects, plant volatiles will be collected and identified by GC-mass spectrometry (GC-MS) , which in WP2 will be tested physiologically and behaviourally to discover the key components and blends that elicit attraction. Plant candidate genes involved in the metabolic pathways of these host plant volatiles will be identified by transcriptomic and bioinformatic analyses. To functionally analyse and determine possible pleiotropic effects, identified candidate genes involved in the biosynthesis of plant volatiles will be either overexpressed by agroinfiltration or suppressed by RNA interference. **Tasks** **1**. Chemical ecological analysis: Volatile collections, extractions and identifications of host plant volatiles; **2**. Genetic analysis: RNA-seq and (reduced) genome sequencing; **3**. Bioinformatics: genome assembly and annotation; transcriptome analysis and expression profiling; mapping of metabolic networks; **4.** Integration of phenotypic data and genomics/transcriptomics/metabolomics for metadata analysis; **5.** Functional analyses by genetic modifications: Overexpression by agroinfiltration, downregulation by RNA interference. **6**. **6**) Determine how to develop IPM strategies (with WP4).			
Deliverables **See table 3.1b**			

WP no. 2	**M7-M43**	***Lead beneficiary*: SLU**	***Title*: Develop a chemical-ecological toolbox to determine variable behavioural and sensory responses of pest insects to plant cues**
Objectives To determine in the four pest insects: **1)** genetic and behavioural variation, allowing host plant shifts and adaptation; **2**) innate preference and behavioural plasticity; **3**) olfactory signal detection and integration; **4**) variations in olfactory gene expressions.			
Description Genetic variation between insect populations and phenotypic plasticity has been shown to affect behavioural responses to volatile plant cues in insects. To understand processes that underlie adaptations to host plant shifts and insect resistance, we need to investigate how insects cope with variation of sensory cues in the environment. This is crucial for understanding the establishment of pest species in crop systems, especially invasive species, and can have a profound effect on infochemical-based pest management strategies. Perception of host plant volatiles will be assessed through GC-EAD. Attraction to host plant volatiles sources will be identified in the windtunnel, while oviposition behaviour will be assessed in specifically designed cage experiments. Synthetic blends of electrophysiological active compounds will be made and tested in these behavioural assays. The identity of and variation in the olfactory receptors involved will be determined by transcriptomic and bioinformatic analyses. Genetic variation between populations will be distinguished from behavioural plasticity though selection experiments and genetic analysis (QTL: quantitative trait locus analysis and GWAS: genome wide association studies). **Tasks** **1)** Chemical ecological analysis: GC-EAD-recordings will be performed to identify which plant volatiles are detected by the insects, and their effect will be determined in behavioural bioassays; **2)** Behavioural analysis to determine innate responses, and plasticity and learning in the pest insects in relation to host plant volatiles; **3)** Genetic analysis: QTL analysis and GWAS studies to identify genomic loci underlying variation in attraction to host plant volatiles, RNA-seq and (reduced) genome sequencing on insect olfaction; **4)** Bioinformatic analysis: transcriptome analysis and expression profiling; integration of phenotypic data and genomics/ transcriptomics for metadata analysis, to identify nsect candidate genes and variation in insect olfaction and attraction; **5**) Functional analysis by genetic modifications: RNA interference and CRISPR-Cas9 to functionally analyse the candidate olfactory genes and assess pleiotropic effects in the pest insects; **6**) Determine how to develop IPM strategies (with WP4).			
Deliverables **See table 3.1b**			

WP no. 3	**M7-M43**	***Lead Beneficiary*: Biobest**	***Title*: Develop a dissemination toolbox towards field testing and implementation**
Objective To determine attraction, repellence and/or retention of beneficial insects to specific plant volatiles in laboratory trials and (semi)field experiments, with the aim to identify which host plant volatiles that are potential candidates to be used in pest management strategies against the pest insects, are compatible with, or may even increase the efficacy of these beneficial insects.			
Description Plant volatiles do not only play a role in direct plant resistance, by triggering behavioural responses in insect herbivores, but also affect herbivore natural enemies and pollinators that are guided by plant volatiles. These arthropod groups may differ widely in their			

behavioural responses to a given plant volatile profile. Given that arthropod predators and parasitoids play a crucial role in biological pest control, while pollinators are often key to pollination and thus to crop production, it is essential to determine the responses of beneficial arthropods to the different plant accessions emitting specific plant volatile profiles. Attraction, repellence and/or retention will be determined for beneficial insects, i.e. the main predators and parasitoids of the pest insects and the main pollinator of the three crops. To test attraction, repellence and retention, laboratory trials will include olfactometer studies in which plants and plant volatile extracts will be tested to quantify responses to the emitted plant volatiles. Based on the laboratory trials, promising accession-arthropod combinations will be selected for tests in semi-field trials, in which plant patches will be created consisting of a single accession and entirely of undamaged plants, or of a mix of herbivore damaged and undamaged plants. Visitation by pollinators will be assessed based on direct observations, colour marks, and bite marks. Distribution of pest natural enemies will be assessed through the use of sentinel traps and direct observations.
Tasks 1) Host plant volatile collections and analyses (together with ESRs in WP1 and wWP2); **2**) Behavioural analyses in the laboratory with the key beneficial insects to assess which host plant volatiles are attractive and repellent for the beneficial insects; **3)** Behavioural analyses in (semi)field experiments with the most attractive and repellent host plant varieties/accessions (for pest insects) to determine the behavioural response of the beneficial insects on these plants in a realistic field situation.

Deliverables See table 3.1b

WP no. 4	**M25-M43**	***Lead Beneficiary*: CU**	***Title*: Dissemination and Outreach**

Objective To develop sustainable pest management strategies in the three crops against the four pest insect species that are the focus of InsecTRAIN. By communicating the outcomes of WP1-3 to end-users, this WP aims to refine and improve marketability of pest management approaches developed by the project, and to provide valuable exposure of ESRs to the reality of commercial farming and grower's requirements

Description To prevent pest colonisation on crops, and improve pest suppression by arthropod natural enemies, a better understanding of insect-plant interaction mechanisms is required and field tests are necessary to determine the impact of changes of host plant volatile profiles in an ecological setting and realistic field situation. Outcomes from the InsecTRAIN project that are of relevance to commercial agriculture will be communicated to farmers through the established marketing approaches developed by Enza, Biobest and Koppert, through articles in the industry and farming press and through websites and social media. We will also hold workshop meetings with innovative growers and contacts from policy makers and the food chain industry to determine how best to incorporate new knowledge from InsecTRAIN into their farming systems to effectively protect crops from pests. This dialogue with stakeholders will allow co-production and co-design with end users. We will conduct development trials with pioneer growers to evaluate new treatments under commercial conditions.
Tasks 1) (Semi)field tests to develop realistic and sustainable pest management strategies against the pest insects that are the focus of InsecTRAIN. These field tests will be conducted at the commercial sites of Biobest, Koppert, Enza and CU, as well as field sites of farmers that are already working with these companies; **2**) Organise workshop meetings with innovative growers and other stakeholders (M19, M31); **3**) Communicate (potentially) useful results through the InsecTRAIN website and social media; **4)** Organisation of End Symposium

Deliverables See table 3.1b

WP no. 5	**M1- M48**	***Lead Beneficiary*: UvA**	***Title*: Training**

Objective To provide recruited fellows with high-quality and balanced training that enriches them with all necessary skills to pursue a successful career in academia and/or industry

Description This WP will organise all aspects surrounding the training program. All InsecTRAIN participants will be involved in providing training and/or supervision to the appointed fellows. ESRs will actively take part in the project management activities, using the expertise, available facilities and experience of the WP1 staff at UvA.
Tasks 1) Recruit and appoint eligible ESRs; **2**) Ensure local supervisor-fellow meetings; **3**) Provide quarterly InsecTRAIN co-supervisor-fellow (digital) meetings; **4**) Acquire research-specific and transferable skills; **5**) Arrange and monitor secondments at the Participating Organisations; **6)** Network-wide Summer School organisation; **7)** Involve ESRs in writing and editing the Risk Management Plan, progress reports for the European Commission and the External Advisory Board; **8)** Assist ESRs in the organisation of the symposia; **9)** Assist ESRs in publishing results through the InsecTRAIN website, social media channels, presentations at their institutions and at conferences.

Deliverables See table 3.1b

WP no. 6	**M1- M48**	***Lead Beneficiary*: UvA**	***Title*: Management**

Objectives 1) To ensure effective and appropriate coordination and management of the InsecTRAIN network; **2)** To safeguard planning, in particular the overall training, technical, administrative, financial and legal management of the network and project activities.

Description WP6 activities include all activities necessary to successfully manage and run the consortium.
Tasks 1) Coordinate the overall research, training and dissemination activities, **2)** Manage the quality control, monitor the work plan and handle risks and contingencies, **3)** Coordinate the administrative, legal and financial aspects of the project, **4)** Manage the InsecTRAIN internal communication and meetings, **5)** Communicate with and report to the Research Executive Agency, **6)** Set up of the Data Management Plan and maintaining it during the project lifetime

Deliverables See table 3.1b

3.1.2 List of major deliverables

Table 3.1b Deliverables List

Scientific Deliverables						
No.	Deliverable Title	WP no.	Lead Ben.	Type	Dissemination Level	Due Date
1.1	List of potential attractive, repellent and neutral plant volatiles	1	ENZA	R	PU	M20
1.2	List of candidate genes involved in the biosynthetic pathway of the attractive and repellent host plant volatiles	1	ENZA	R	PU	M30
1.3	Draft of toolbox to identify metabolic pathways genes in plants related to the formation of the new attractants or repellents	1	Baseclear	R	PU	M40
2.1	List of host plant volatiles that are detected by the pest insects	2	SLU	R	PU	M15

2.2	List of olfactory receptors involved in the detection of host plant volatiles	2	SLU	R	PU	M25
2.3	List of host plant volatiles that are attractive, repellent and neutral to the pest insects	2	SLU	R	PU	M30
2.4	List of genomic loci involved in variation in host plant attraction in the pest insects	2	UvA	R	PU	M35
2.5	List of pest species that show high behavioural plasticity	2	SLU	R	PU	M40
2.6	List of pest insect traits and environmental factors that strongly affect behavioural responses to host plants	2	SLU	R	PU	M40
3.1	Matrix of beneficial insect responses (attraction, repellence, neutral) to host plant varieties/accessions	3	Biobest	R	PU	M20
3.2	Matrix of beneficial insect responses (attraction, repellence, neutral) to host plant volatiles	3	Biobest	R	PU	M35
3.3	List of potentially useful pest management strategies against the pest insects of insecTRAIN that does not interfere with beneficial insects	3	Biobest	R	PU	M40
Training, Management, Recruitment and Dissemination Deliverables						
No.	Deliverable Title	WP No.	Lead Ben.	Type	Dissemination Level	Due Date
4.1	Initial Personal Career Development Plans	4	CU	R	CO	M9
4.2	Report on one-day workshops with innovative growers and end-users in Europe	4	CU	PDE	PU	M45
4.3	End symposium Report	4	CU	PDE	PU	M45
5.1	Website	5	UvA	adm	PU	M3
5.2	Summer schools Report	5	UvA	R	PU	M33
5.3	Progress report	5	UvA	adm	PU	M13
6.1	Researcher Declarations on Conformity	6	UvA	adm	CO	M3
6.2	Recruitment	6	UvA	adm	PU	M6
6.3	Risk Management Plan	6	UvA	R	CO	M6
6.4	External Advisory Board Report	6	UvA	R	PU	M45
6.5	Data Management Plan	6	UvA	R	PU	M6

3.1.3 List of major milestones

Table 3.1c Milestones List

Nr	Title	Related WPs	Lead Ben.	Due Date	Means of Verification
1	Kick-off meeting	6	UvA	M1	Meeting notes and participation list
	Website up and running	5	UvA	M3	Website
2	All fellows recruited	6	UvA	M6	15 ESRs hired
	Summer school 1	5	UvA	M7	Participation lists and D4.2
3	Host plant varieties/accessions identified that differ in host odour profiles	1	Enza	M9	Chemical analysis (GC-MS)
4	Extracted host plant volatiles detected by pest insects	2	SLU	M15	Electrophysiology (GC-EAD)
	Summer school 2	5	UvA	M19	Participation lists and D4.2
5	Detected host plant volatiles chemically analysed	1-2-3	SLU	M20	Chemical analysis (GC-MS)
	First one-day workshop with innovative growers in Europe	3	CU	M30	Meeting notes and participation list
6	Genomic loci and candidate plant genes for detected host plant volatiles identified	1	Baseclear	M35	Genetic analysis complete and loci validated
7	Functional analysis of plant candidate genes	1	WUR	M40	Overexpression by agroinfiltration and RNA interference successful
8	Olfactory receptors in pest insects identified	2	FUB	M25	Genetic and transcriptomic analysis complete
9	Variation in olfactory receptors in pest insects assessed through bioinformatics and transcriptomics	2	SLU	M30	Genetic variation and relative expression levels determined
	Summer school 3	5	UvA	M31	Participation lists and D4.2
	Two one-day workshops with innovative growers in Europe	4	CU	M30, M43	Meeting notes and participation list
10	Genomic loci and candidate genes for insect variation in attraction to host plant odours identified	2	UvA	M35	Genetic analysis complete and loci validated
11	Effects of defined host plant odours and odour profiles on selected beneficial insects determined in lab assays	3	Biobest	M25	Lab assays complete and data validated
12	Effects of defined host plant odours and odour profiles on selected beneficial insects determined in semi-field assays	3	Biobest	M35	Field assays complete and data validated
13	Protocols for potential pest management strategies developed	4	CU	M43	Field experiments at different sites completed and validated
	End symposium InsecTRAIN	4	CU	M43	Participation lists and D5.2

3.1.4 Fellow's individual projects

Table 3.1d Individual Research Projects

Fellow: *ESR1*	**Host institution**: Enza	**PhD enrolment**: Y	**Start date:** *Month 7*	**Duration** *36 months*	**Deliverables** 1.1-2, 2.3, 2.4, 4.1-3, 5.1-3
Identification of tomato metabolic pathways in tomato conferring resistance against *Tuta absoluta* – WP1					
Objectives 1. Collect volatile metabolites on a collection of wild and cultivated tomato accessions; **2.** To correlate phenotypic responses to the presence of volatile metabolites in tomato; **3.** Identify the underlying biosynthetic pathways of pest-related plant volatiles in tomato; **4.** Determine the genetic diversity of olfactory receptors in *T. absoluta*					
Expected Results 1: Identification of 20 different tomato accessions that are more or less attractant/repellent for *T. absoluta,* of which the plant volatiles have been identified **2:** In a systems biology approach, correlation analyses between the phenotypic responses and the metabolite databases will identify key odours involved in attraction/repellence, which will be evaluated by ESR7 in choice assays with pure compounds and tested for response on the insect antennae (in secondments at SLU and UvA). **3**: Identification of the underlying biosynthetic genes present in (wild) tomato trichomes through quantitative trait locus (QTL) analysis, using already available or newly to be generated populations by Enza, that will be analysed for metabolites (UvA) and genotyped (Enza) to fine-map the loci of interest. Expression of candidate genes will be studied using existing trichome mRNAseq databases and validated using qPCR. The effect of knocking out genes involved in the biosynthetic pathway will be investigated using a targeted EMS approach at Enza and gene silencing by RNA interference. The genotyped F2 population will be used to develop molecular markers that will be used directly to breed for plants with resistance against *T. absoluta*.					
Planned secondment(s) 1: at SLU (Andersson), M19-21 (3 months): To study the natural variation in *Tuta absoluta* odour recognition and learn techniques involving olfactory reception in insects. **2**: at UvA, M28-30 (3 months): untargeted metabolite analyses using GC-Tof-MS (Schuurink) and insect choice assays in wind tunnel (Groot).					

Fellow: *ESR2*	**Host institution:** UvA	**PhD enrolment:** Y	**Start date**: *Month 7*	**Duration**: *36 months*	**Deliverables:** 1.1-2, 2.3, 2.4, 4.1-3, 5.1-3
How do certain wild tomatoes provide resistance to whiteflies? – WP1					
Objectives 1. Identify the genes underlying a previously identified QTL in tomato critical for whitefly antibiosis; **2.** Characterise the corresponding metabolites from tomato; **3.** Implement and validate the resistance mechanism in tomato.					
Expected Results 1. Previously we identified, by screening an introgression library (ILs) of a wild tomato and a cultivated tomato, one IL that still has the whitefly antibiosis feature of the wild tomato. The identified QTL involved in whitefly resistance in this IL will be fine-mapped in a backcrossed population (F2 available), genotyped and phenotyped; **2.** Subsequently RNAseq of several backcrossed lines will be performed to pinpoint potential eQTLS underlying the resistance trait; **3.** Since whiteflies are phloem feeders, and we hypothesise that the mechanism resides in the phloem, ESR2 will isolate phloem (with which UvA has ample experience) from several phenotyped ILs. **4.** The phloem will be used for targeted metabolite analysis that correlates with resistance using bioassay-guided fractionation. **5.** Molecular markers will be developed that can be used for the implementation of the trait in commercial tomato using advanced breeding techniques. ESR2 will collaborate with ESR6 in secondments.					
Planned secondment(s) 1. At Enza (Bleeker), M12-14 (3 months), to genotype and phenotype several backcrossings, learning to use new molecular marker techniques. **2**. At CU (Picket), M24-26 (3 months), for targeted metabolite analysis.					

Fellow: *ESR3*	**Host institution** WUR	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 1.1-2, 2.1, 2,3, 3.1, 4.1-3, 5.1-3
The genetic basis of biosynthesis of the volatile metabolome of *Brassica rapa* attracting the Diamondback moth, *Plutella xylostella:* – WP1					
Objectives: **1**: Screen core collections of *B. rapa* for degree of attractiveness to *P. xylostella* using windtunnel and olfactometer assays. **2.** Identification of volatile metabolite profiles of most and least attractive accessions using dynamic headspace volatile entrainment; **3**: Select plant mapping populations to identify QTLs for volatile production. **4**. Identify causal genes in *B. rapa* for emission of attractive compounds.					
Expected Results: **1**: Volatile metabolite profiles of test plant population. **2.** Formulated volatile blends that mimic range of attractiveness of intact *Brassica*-plants to *P. xylostella*. **3**: Metabolite variation during plant development and depending on growth conditions within most and least attractive accessions. **4**: Selected mapping populations and generated metabolite profiles and genetic markers in *B. rapa*. **5**: Identification of QTLs in *B. rapa* for emission of plant volatiles that attract the pest insect. **6**: Validation of candidate genes involved in the plant volatile biosynthesis and their expression profiles through gene transformation to *Arabidopsis thaliana* and concomitant bioassays on *P. xylostella* as under Obj. 1**; 7**: Minimal volatile blend to be deployed in baited traps in a trap-and-kill approach (ESR 3, 5, 8, 9, 10, 15 will work closely together)					
Planned secondment(s): **1:** at UvA (Groot), M10-11 (2 months): To perform GC-EAD on *P. xylostella* antennal preparations to select *Brassica rapa* volatiles that elicit olfactory activity. **2**: at Baseclear (Duijsings), M19-20 (2 months): To learn metabolic pathway analyses using bioinformatic analyses of reseq and expression data. **3**: at FUB (Hilker), M27-28 (2 months): To learn how to study insect physiological and behavioural variation in relation to host plant odour.					

Fellow: *ESR4*	**Host institution** TUM	**PhD enrolment** Y	**Start date** Month 7	**Duration** 36 months	**Deliverables** 1.1-3, 4.1-3, 5.1-3
Identification of strawberry metabolites conferring resistance against *Drosophila suzukii* – WP1					
Objectives: **1.** To identify the volatile composition of differentially attractive strawberry plants (e.g. *Fragaria vesca, F. nilgerensis* and *F. x ananassa* genotypes) and developmental stages by GC-MS analysis. This will use a large strawberry germplasm collection, available via Hansabred (the "Professor Staudt Collection" with more than 460 accessions of wild species and more than 175 cultivars). **2.** To identify the genes of the metabolic pathways which produce the attractants or repellents by RNAseq of the varieties of contrasting attraction. **3.** to manipulate the metabolic pathway to validate the gene function by RNAi (agroinfiltration). **4.** To analyse the emission of volatiles of the transgenic plants by GC-MS.					

Expected Results: **1.** Identification of diversity of attractant and repellent volatiles isolated from *Fragaria* genotypes by GC-MS. **2.** Quantification of these volatiles in different *Fragaria* genotypes. **3.** Selection of a number of varieties of contrasting levels. **4.** Identification of candidate genes in the metabolic pathways that produce the attractants or repellents by RNAseq of the varieties of contrasting levels and by bioinformatic analysis on these strawberry varieties. **4.** List of putative genes involved in the formation of attractant and repellent volatiles. **5.** Validation of the gene function by RNAi (agroinfiltration) to downregulate candidate genes and to manipulate the metabolic pathway. **6.** Identified volatiles of the transgenic plants.

Planned secondment(s): 1. at MPG (Knaden), M10-11 (2 months): To learn how to isolate plant volatiles for GC-EAD analysis. **2**. at Baseclear (Duijsings), M24-26 (3 months): To learn untargeted metabolomics, to prepare for tasks like comparative genomics, analysis of large transcriptome and metabolome datasets and for integration of complex data into systems biology models. **3**. at Biobest, M35-36 (2 months): To determine effects of metabolic manipulations on insect behavior in (semi)field experiments.

Fellow: *ESR5*	**Host institution** Baseclear	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 1.3, 2.4, 4.1-3, 5.1-3

To develop a toolbox to identify genes conferring pest resistance in plants – WP1

Objectives: **1.**To assign enzyme activities to annotated genes in *Brassica* and *Plutella xylostella* genomes; **2.** To identify complete metabolic pathways in *Brassica* based on the identified enzymes as a source of volatile compounds; **3.** To use genomic and expression data to predict phenotypes in both crop and pest insect.

Expected Results: **1**. Generation of genomics and transcriptomics data of already identified genetic variants within *Brassica rapa* that are most attractive to *Plutella xylostella*. **2**: Generation of improved annotation by of the already existing genome, combining new and existing genomic and transcriptomic data of *B. rapa*. **3**. Determination of host plant odour variation, and combination with mRNA expression profiles for selected *B. rapa* variants in database. **4**: Integrated metabolite/volatiles plus WGS & transcriptomics (meta)database, mapping of metabolic networks. **6**: General metabolic network analysis toolbox based on comparative metabolic analyses between cole, tomato and strawberry. **7**: Generation and analysis of WGS and transcriptomics data of different *Plutella xylostella* populations. **8**: Bioinformatics analysis of pest insect WGS and transcriptomics, creating metabolic networks of insect variation in host plant volatiles and insect attraction.

Planned secondment(s): 1. at WUR (Bonnema), M10-12 (3 months): Selection of genetic *B. rapa* variants, based on differential attraction of *Plutella xylostella* phenotypes, plus generation of genomics & transcriptomics data of *Brassica*. **2**: at TUM (Schwab), M22-24 (3 months): compare metabolic network analysis in strawberry with that in cole crops. **3**: at UvA (Groot), M31-33 (3 months): Generation and analysis of WGS and transcriptomics data of pest insect *P. xylostella*

Fellow: *ESR6*	**Host institution** CU	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 1.1, 2.3, 3-4, 4.1-3, 5.1-3

Understanding olfactory perception in whiteflies for underpinning novel practical and viable management strategies – WP2

Objectives: **1**: To determine whether whiteflies can detect the difference between resistant and susceptible host plants (tomato varieties) and recognise the presence of conspecifics using laboratory behaviour assays (olfactometry, wind tunnel). **2**: To identify relevant volatile chemical signals from healthy and infested host plants and by con-/heterospecifics using advanced hyphenated chromatographic and spectroscopic techniques (GC-MS, LC-MS). **3**: To identify the specific olfactory recognition proteins (OBPs, ORs) utilised by whiteflies in olfactory perception of volatile signals from resistant/susceptible tomato varieties and con/heterospecifics. **4**: To match cloned, overexpressed and purified OBPs and ORs with ligands using a range of ligand binding assays (eg. subtractive GC, fluorescence displacement).

Expected Results: **1**. Data on the impact of host tomato varieties on whitefly behaviour, using a selection of tomato varieties available from UvA. **2**. Volatile collections and chemical analysis from selected host tomato plants and conspecifics. **3**. Behavioural analysis in the laboratory with whiteflies to assess which host tomato volatiles and conspecific volatiles are attractive and repellent. **4**. Identification of specific olfactory recognition protein (OBP, OR) genes in whiteflies with a putative role in olfactory perception of host tomato and conspecific volatiles, using verified insect olfactory genes as templates for homology-based searches in whitefly transcriptomes. **5**. Functional characterisation of whitefly olfactory genes and determination of the molecular receptive range of whiteflies. Results in this project will provide fundamental knowledge of whitefly olfaction and underpin the rational design of new infochemical tools for novel whitefly management.

Planned secondment(s): 1: UvA (Schuurink), M8-10 (3 months): behavioural analysis with whiteflies in an established 'flight arena' for whiteflies**. 2.** UvA (Schuurink), M24-26 (3 months): analysis of host plant volatiles from susceptible and resistant tomato varieties. **3**: Baseclear (Duijsings), M31-33 (3 months): Transcriptomic analysis of olfactory receptors in different whitefly biotypes

Fellow: *ESR7*	**Host institution** SLU	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 1.1, 2.3, 2.5-6, 4.1-3, 5.1-3

Identification of tomato volatiles responsible for difference in relative attractiveness and oviposition deterrents for *Tuta absoluta* – WP2

Objectives: **1**. Determine the level of resistance of different tomato accessions to oviposition of *T. absoluta.* **2**. Identify the difference in tomato volatiles between the more and less resistant plants. **3**. Assess the level and extent of variation in oviposition preference in *T. absoluta* populations, in combination with sex pheromone volatiles, experience and learning.

Expected Results: **1**: Identification of 20 different wild tomato accessions involved in oviposition deterrents for *T. absoluta* females (at Enza) in collaboration with ESR1. **2:** Identification of oviposition deterring volatiles extracted from the least preferred tomato plants, using GC-EAD and GC-MS (at SLU). **3**: Bioassays (at SLU and UvA) to determine level and extent of variation in oviposition preference and male attraction to with sex pheromone jn combination with deterring volatiles in a wind tunnel. **4**. (semi)Field experiments to determine level and extent of variation in oviposition preference under field conditions (at Enza). **5**. Determination of effects of oviposition repellents for *T. absoluta* on beneficial insects (at Biobest).

Planned secondment(s): 1. at Enza (Bleeker), M8-9, 29-30 (4 months): To determine which wild plant species are least preferred by *Tuta absoluta* for oviposition. **2**. at UvA (Groot), M20-21 (2 months): Wind tunnel experiments with and without sex pheromone to compare responses in two controlled wind tunnel environments (SLU versus UvA). **3**. at Biobest (Wäckers), M34-36 (3 months): to determine effects of oviposition stimulants/repellents for *T. absoluta* on beneficial insects.

Fellow: *ESR8*	Host institution UvA	PhD enrolment Y	Start date *Month 7*	Duration *36 months*	Deliverables 2.4, 4.1-3, 5.1-3
Genetic analysis of variation in *Plutella xylostella* strains in relation to their attraction to host plants – WP2					
Objectives: To determine the genetic variation in host plant attraction between different populations of *P. xylostella* in relation to host plant odour variation in already identified Brassicaceae plants as well as unrelated plants, such as pea, based on the host range expansion of *P. xylostella* found in Kenya in 1999.					
Expected Results: **1**. Differentiation between genetic and phenotypic variation through selection experiments with different *P. xylostella* populations. The selection will be based on variation in host plant choice. **2**: Identification of the genomic locations and candidate genes in host plant attraction in different populations of *P. xylostella*. This identification will be done through Quantitative trait locus (QTL) analysis with the different insect strains and different selection lines (if there is response to selection, which is expected, based on previous results) by backcrossing the strains/lines, and phenotyping (oviposition preference in females) and genotyping (using sequenced-based markers). **3**. Functional analysis using CRISPR-Cas9 with identified candidate genes.					
Planned secondment(s): 1: at MPG (Heckel), M16-18 (3 months): Genomic and transcriptomic analysis of *P. xylostella* cole and pea strains with already generated data. **2**: at Baseclear (Duijsings), M28-30 (3 months): Genomic and transcriptomic analysis of selected *P. xylostella* population and newly generated data. **3**: at SLU (Anderson), M33-34 (2 months): To compare perception and attraction variation of *P. xylostella.*					

Fellow: *ESR9*	Host institution FUB	PhD enrolment Y	Start date Month 7	Duration 36 months	Deliverables 2.2-3, 4.1-3, 5.1-3
Chemosensory plasticity of *Plutella xylostella* in response to olfactory cues (specifically isothiocyanates): Impact of the moth´s strain and odour experience					
Objectives: To determine the dependence of expression of chemosensory genes and attraction to host plants on the moth´s strain and the moth´s experience of host plant volatiles, especially isothiocyanates					
Characteristic volatiles emitted by the host plants of *P. xylostella* are isothiocyanates (ITCs), which are released along with ubiquitous general green leaf volatiles (GLVs) and are known to be attractive to the moth. **Expected Results**: **1.** Determination of physiological responses to ITCs in dependence of prior odour experiences in collaboration with ESR 10 (EAG, SSR). **2.** Identification of genes encoding olfactory receptors and odorant-binding proteins specifically sensitive to ITCs by competitive binding assays. **3.** Determination of expression levels of these ITC-sensitive genes in dependence of prior experience of ITCs during various developmental stages of the moth; experience-dependent expression levels of chemosensory genes have been shown in e.g. *Drosophila melanogaster* or *Spodoptera exigua.* **3**. Determination of expression levels of ITC-sensitive OR genes in dependence of prior experience of GLVs and chemically characterised natural host plant odours (i.e. blends of ITCs, GLVs and terpenoids); assessment of (possible) interference of ITC perception and perception of other volatiles; **4.** CRISPR-Cas9 on candidate olfactory receptors for host plant volatiles to functionally characterise olfactory genes and to assess pleiotropic effects of ORs on other (reproductive) behaviours. Laboratory and field tests will determine attraction of the differently treated moths to host plants and trap crops like *Barbarea vulgaris* which is attractive to moths, but lethal to hatching larvae because of its toxic leaf saponins.					
Planned secondment(s): 1. at SLU (Anderson), months 10-12 (3 months): to conduct EAG and SRR studies of differently experienced moths; **2**. at WUR (van Loon; Bonnema), months 22-24 (3 months): to conduct (semi)field experiments with differently experienced moths and to determine their responses to brassicaceous host plants with different ITC-emissions; **3.** at Enza (Bleeker), months 31-32 (2 months): to learn how to conduct genetic analyses on highly attractive and less attractive brassicaceaous host plants of *P. xylostella.*					

Fellow: *ESR10*	Host institution SLU	PhD enrolment Y	Start date *Month 7*	Duration *36 months*	Deliverables 2.5-6, 4.1-3, 5.1-3
Plasticity in reproductive behaviours between *Plutella xylostella* strains and after experience – WP2					
Objectives: To determine the level and extent of behavioural plasticity in reproductive behaviours in different *Plutella* strains and in relation to variation of olfactory cues					
Expected Results: **1.** Assess variation in host plant choice behaviour by monitoring oviposition patterns between *Plutella* strains (host strains as well as Bt-resistant and susceptible strains) and by determining effects on these decisions of intra- and trans-generational host plant experience. Experiments will be performed in cage bioassays, presenting mated females with two or several host plants. **2:** For males, using the same insect strains, investigating positive or negative experience-based interactions between host plant volatiles and sex pheromone in windtunnel assays (using authentic plant odour extractions and later the minimal blend by ESR3). **3**: Electroantennogram (EAG) recordings and single-cell recordings (SSR) to determine physiological variation in perception of host plant and sex pheromone volatiles between different moth strains. **Expected Results 1-3**: Variation in the behavioural plasticity in the response to host plant cues in female oviposition, in the combination of host plant volatiles and sex pheromone on male attraction between different *Plutella* strains; and in the interaction (attraction/repellence) and sensory response to these two types of odours. **4**: Using the CRISPR-Cas9 moths from ESR9 and other moths with silenced ORs to investigate mechanism of odour blend information transfer guiding behavioural plasticity.					
Planned secondment(s): 1: at UvA (Groot), M13-15 (3 months) to learn genetic methods to study underlying gene expression patterns of observed behavioural and sensory physiological changes. **2**: at Enza (Bleeker), M25-26 (2 months) to learn how this company conducts genetic analysis on cole plants. **3**. at WUR (van Loon/Bonnema), M31-33 (3 months) to conduct (semi)field experiments with different *Brassica* accessions to assess variation in attraction in field settings.					

Fellow: *ESR11*	Host institution MPG	PhD enrolment Y	Start date *Month 7*	Duration *36 months*	Deliverables 2.2-3, 4.1-3, 5.1-3
Identification of *Drosophila suzukii* attractants in differentially attractive strawberry strains –WP2					
Objectives: 1. To quantify strain-specific attraction of strawberry plants to *D. suzukii.* **2**. To identify those plant volatiles that cause differential attraction in mated female *D. suzukii*. **3**. To test the identified odourants in field trials for their potential in IPM.					
Expected Results: **1**. *D. suzukii* is known to prefer some strawberry strains over others. Identification of strawberry volatiles that can be detected by the olfactory sensilla of *Drosophila suzukii* via GC-EAD. **2**. Identification of physiologically active volatiles that could cause					

differential attraction of *D. suzukii* to the different strawberry strains. **3**. Identification of *D. suzukii* attractants by testing plant strain-specific odourants in several behavioural assays, including trap assays, wind tunnels, and oviposition assays. **4**. Estimating the suitability of identified attractants for IPM by performing field studies. Field studies will be conducted together with Biobest, who are experts in translating results from lab experiments into field eperiments (in collaboration with ESR12 and ESR14).

Planned secondment(s): 1. at TUM (Schwab), months 16-18 (3 months): To learn how to analyse plant volatile metabolic pathways. **2**. at RUG (Billeter), months 25-27 (3 months) to learn oviposition assays and check for synergistic effects of *D. suzukii* pheromones (identified by RUG) with strawberry volatiles. **3**. at Biobest (Waeckers), months 32-34 (3 months) to test identified attractants in field trials.

Fellow: *ESR12*	**Host institution** RUG	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 2.2-3, 4.1-3, 5.1-3

Oviposition deterrent pheromones to disrupt *Drosophila suzukii* egg-laying on strawberries – WP2

Objectives: 1. To evaluate communal oviposition behaviour of *D. suzukii* on strawberries. **2.** To identify oviposition deterrent pheromones in *D. suzukii*. **3.** To evaluate *D. suzukii* oviposition in response to *D. melanogaster* oviposition pheromones. **4.** To identify chemosensory genes influencing communal oviposition in *D. melanogaster* as candidate genes for *D. suzukii* oviposition. **5**. To evaluate the response of *D. suzukii* candidate chemosensory receptors to oviposition pheromones. **6**. To test identified oviposition deterrents in field trial for potential IPM use.

Expected Results: **1**: Description of *D. suzukii* oviposition avoidance on strawberries already infected by conspecifics. This avoidance might vary depending on the volume and nutritional quality of the strawberry. **2**: Identification of deterrent cuticular hydrocarbons (CHCs) deposited by *D. suzukii* females during oviposition site choice. Achieved by chemical analysis of the surface of infected strawberries by GC-MS. **3**: Identified CHCs and aggregation pheromones from *D. melanogaster* applied on strawberries to block oviposition by *D. suzukii*. *D. melanogaster* is a communal egg-layer and uses identified pheromones to attract conspecifics to lay eggs on common sites. Since *D. suzukii* is sexually repelled by *D. melanogaster* pheromones, these may act as oviposition deterrents. **4**. Identification of taste and/or odourant receptors that respond to oviposition signals in *D. melanogaster* through a GWAS linking variation in oviposition response to aggregation pheromones to single gene variants using the *Drosophila* Genome Reference Panel (DGRP) strains. Given the high level of genetic homology, bioinformatics will identify homologues that become candidates for *D. suzukii*. **5.** Identification of chemosensory receptors and neurons in *D. suzukii* that respond to oviposition deterrent pheromones by anatomical localisation of candidate odourant or taste receptors in specific sensillae using in-situ hybridisation, followed by SSR in response to the identified oviposition deterrent pheromones. **6.** Estimating the suitability of identified deterrent for IPM by performing field studies (in collaboration with ESR11 and ESR14).

Planned secondment(s): 1. at SLU (Dekker), month 16-18 (3 months): To identify CH and other chemicals deposited on the surface of strawberry by *D. suzukii* females by GC-MS **2**. at Baseclear (Duijsings), month 22-23 (2 months): to analyse GWAS study in *D. melanogaster* and search for candidate genes in the genome of *D. suzukii*. **3**. At MPG (Knaden), month 31-33 (3 months): To perform SSR.

Fellow: *ESR13*	**Host institution** Biobest	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 3.1-3, 4.1-3, 5.1-3

Determine attraction/repellence of tomato plant volatiles to beneficial insects – WP3

Objectives: 1. Screen attraction/repellence of 20 host plant accessions (see project ESR1) that are candidates to be used in potential pest management strategies to key beneficial insects in tomato, i.e. the pollinator *Bombus terrestris* and the natural enemy of *Tuta absoluta*, *Macrolophus pygmaeus*. **2**. To determine the nutritional suitability of promising accessions to the main tomato pollinator and the main zoophytophagous predator. **3.** Study behavioural responses of this pollinator and pest natural enemy in laboratory and semi-field to plant volatiles and volatile profiles, which have been identified in the host plant accessions and were shown to be attractive/repellent to *T. absoluta* (see project ESR7).

Expected Results: **1**: A matrix of plant accessions/varieties and associated plant volatiles of tomato and their attractivity/repellency and nutritional suitability to a) pollinators (*Bombus terrestris*) b) pest natural enemies (*Macrolophus pygmaeus*)). **2**: Based on the laboratory trials and resulting matrix, selection of promising accessions to be tested with pollinators, pests and pest natural enemies in free-choice semi-field conditions. **3**: Impact on pollination service delivery in full field crop patches. **4**: Assessment of interactions between pest and pest natural enemies and the resulting pest control service delivery in full field crop patches. This ESR will collaborate with ESRs 1, 2, 6, 7 and industrial partners to bridge the gap between academic studies in the lab and field trial stage evaluation to gauge the commercial prospects of new approaches to crop protection from insect pests.

Planned secondment(s): 1: at Enza (Bleeker), M10-11 (2 months): To obtain knowledge and experience in genetic-chemical analysis of host plant volatiles at this company. **2**: At SLU (Anderson) M19-20 (2 months); To interact with ESR7 determining which plant accessions are least preferred by *Tuta absoluta* for oviposition **3**. At Enza (Bleeker), M31-34 (4 months); Field bioassays with *Macrolophus* to test olfactory responses to promising plant accessions.

Fellow: *ESR14*	**Host institution** CU	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 3.1-3, 4.1-3, 5.1-3

Determining behavioural effects of strawberry accessions on beneficial insects for improved pest management – WP3

Objectives: 1. To test how the foraging behaviour and performance of *Trichopria drosophilae,* the main natural enemy (predator) of *Drosophila suzukii*, is influenced by different strawberry accessions when attacked by *D. suzukii*. **2.** To determine which herbivore-induced plant volatiles from selected accessions are attractive or repellent to *T. drosophilae*. **3.** To compare observed field performance with that expected from lab and semi-field studies.

Expected Results: **1.** Physiological analyses through EAG recordings on *T. drosophilae* antennae strawberry volatiles from accessions that are with differentially attractive for *D. suzukii* ; **2.** Behavioural analyses in the laboratory with *T. drosophilae* to assess which host plant volatiles are attractive and repellent for *T. drosophilae*; **3.** Based on the laboratory trials and resulting matrix, selection of promising accessions to be tested in free-choice semi-field conditions with pollinators, pests and pest natural enemies to promising accessions versus control plants. **4.** Behavioural analyses in (semi)field experiments with the most attractive and repellent host plant varieties/accessions (for pest insects) to determine the behavioural response of the beneficial insects on these plants in a realistic field situation. **5.** Assessment of interactions between *D. suzukii* and its natural enemy and the resulting pest control service delivery in full field crop patches. This ESR will collaborate with ESRs 4, 11, 12 and industrial partners to bridge the gap between academic studies in the lab and field trial stage evaluation

to gauge the commercial prospects of new approaches to crop protection from insect pests.
Planned secondment(s): 1. at Biobest (Wäckers), month 25-27 (3 months) to conduct (semi)field experiments at R&D locations of Biobest for field and greenhouse evaluation of biocontrol agent performance on different strawberry lines that are resistant to *Drosophila* infestation. **2**. at Biobest (Wäckers), months 37-40 (4 months) to test the effects of identified oviposition deterrents in combination with attractants from ESR11 on *T. drosophilae* in field trials.

Fellow: *ESR15*	**Host institution** CU	**PhD enrolment** Y	**Start date** *Month 7*	**Duration** *36 months*	**Deliverables** 3.1-3, 4.1-3, 5.1-3
Determination of attraction/repellence of *Brassica* plant volatiles on beneficial insects – WP3					
Objectives: **1.** To evaluate, in olfactometer bioassays, effects of herbivore-induced plant volatiles of selected *Brassica rapa* accessions on the behavior of a parasitoid wasp, *Diadegma insulare*, which is a key natural enemy of *Plutella xylostella;* **2**. To conduct parasitoid foraging bioassays with selected *Brassica* accessions in the lab; **3.** To compare observed field performance with that expected from simulation (lab and semi-field) studies.					
Expected results: **1**. Behavioural analyses in the laboratory with the key natural enemy species *D. insulare* to determine which host plant volatiles are attractive and repellent for this beneficial insect. **2**. Behavioural analyses in (semi)field experiments with the most attractive and repellent host plant varieties/accessions (for pest insects) to measure the behavioural response of the beneficial insects to these plants in a realistic field situation. **3.** Evaluation of positive or negative effects of host plant volatiles on key natural enemy species *D. insulare* in the lab and in the field. This ESR will collaborate closely with ESRs 3, 5, 8, 9 and 10, as well as with industrial partners to bridge the gap between academic studies in the lab and field trial stage evaluation to gauge the commercial prospects of new approaches to crop protection from insect pests.					
Planned secondment(s): 1. at Biobest (Wäckers), month 16-18 (3 months): to learn about novel biocontrol interventions and how to optimise their performance **2**: at Enza (Bleeker), M25-26 (2 months) to learn how this company conducts genetic analysis on cole plants. **3**: at WUR (Bonnema), M34-36 (3 months): To interact with ESR3 on assessing the effects of *Brassica* plant variation on beneficial insects in outdoor field experiments.					

3.2 Appropriateness of the management structures and procedures

3.2.1 Network organisation and management structure

Prof. Dr. Astrid T. Groot at the University of Amsterdam (UvA) will coordinate the project and be supported by administrative departments of the UvA. The coordinator is the single link between the Beneficiaries and the European Commission and has the overall responsibility for the network and financial activities. The coordinator will be supported by a dedicated project manager provided by UvA. The project manager is responsible for all administrative, legal and financial issues in the project, and will provide back-up support for the Supervisory Board and will organise all meetings within the project. The UvA has **extensive experience in coordinating European Projects**, including several Marie Curie ITNs and provides professional support to serve coordinators of large projects with management, administration, advice and exchange of best-practices. UvA as coordinating Beneficiary is awarded the 'HR Excellence in Research Logo' by the European Commission[29], signifying that UvA Human Resource policies and management comply with the 'European Charter for Researchers and Code of Conduct for the Recruitment of Researchers'.

Specifically, Prof. Groot has successfully supervised >20 master students and 10 PhD students, and has coordinated and been part of several international projects, including the *Ostrinia* consortium that led to the identification of the first pheromone biosynthesis gene in moths, the *Spodoptera frugiperda* genome consortium and the *Heliothis virescens* genome consortium. Prof. Groot is adjunct associate professor at North Carolina State University (USA), group leader at MPG (10%) and full professor at UvA (90%).

The UvA will control and redistribute the budgets for training/research and management/overhead. The consortium will reserve part of these budgets in a central place to provide for payments to external training and secondment providers, the organisation of the summer schools, buy in services for website building and maintenance, and compensating for the extra task of coordination. However, the major part of the budgets for training/research (~75%) and management/overhead (~60%) will be transferred to the Beneficiaries to ensure excellent performance of the capital-intensive research in the consortium's laboratories.

3.2.2 Supervisory board

The highest decision-making body of **InsecTRAIN** will be the Supervisory Board (SB), which will consist of all Beneficiaries and Partner Organisations with one representative each, thus including academia and industry. The decision-making and voting process will be arranged in a Consortium Agreement, following the DESCA model. However, the project aims to base its decisions on consensus. To become familiar with board tasks, such as monitoring scientific progress, monitoring training and decision making, five board positions will be reserved for ESRs. These positions will rotate among all ESRs once a year, so that each ESR is part of the board for one year. The coordinator will chair the meetings of the Board, which will take place at least once a year, coinciding with the annual network meetings.

[29] http://ec.europa.eu/euraxess/index.cfm/rights/index

The SB oversees and decides on major project issues, and ensures an appropriate balance between research-specific and transferable skills training. Through the Project Coordinator and the Project Manager, the SB will manage and coordinate the establishment of the Personal Career Development Plan (PCDP) of the fellows and will monitor the progress of every recruited fellow in the consortium. The SB will use the half-yearly periodic ESR reports to evaluate the training progress, using the PCDPs as guides. Personal interviews will be conducted at least once each year at the annual meeting and more in case progress of the fellow is hampered. The SB will ensure that fellows obtain sufficient intersectoral skills to be employable in academia as well as the private sector, and advises to adjust activities of the individual fellows to achieve the desired skill level (see Figure 2).

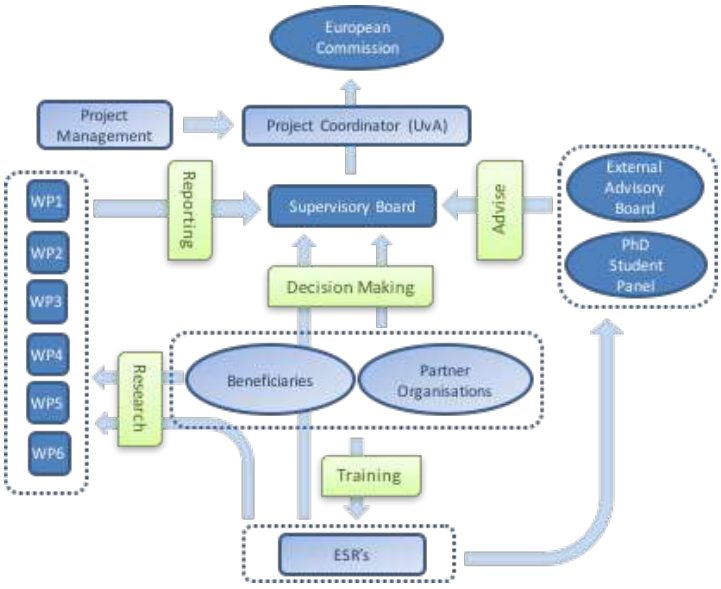


Figure 2 Organisation structure of InsecTRAIN

The External Advisory Board: The external advisory board will be composed of three well-recognised and internationally highly valued researchers who cover the different areas of research represented in **InsecTRAIN** (Dr. Zeyaur Khan, principal scientist (and co-developer of the Push-Pull system) at icipe, Dr. Ted Turlings, Professor at the University of Neuchatel and Dr. Klaus Olbricht, director of Hansabred; Letters of commitment attached). They will attend the annual meetings, discuss the scientific progress and evaluate the training quality of the individual fellows and the ETN as a whole. They will provide unbiased advice on network activities and suggest improvements. Their advice will be sent to the EU along with the annual report.

The Scientist-in-Charge (PI): The PI of an individual ESR project will be responsible for the direct supervision of the appointed ESR in his/her group. The PI will, together with the fellow and SB, establish a Personal Career Development Plan (PCDP) that fits best the fellow's needs, and provide the right environment for the implementation of the PCDP. Also, the PI will make sure that any measures proposed by the SB concerning training needs of the appointed fellows are put in place. Each ESR will be co-supervised by two other PIs. ESR and major PI will meet each other at least twice a month, while ESR, major and Co-PIs will have a joint (Skype) meeting at least every 3 months.

PhD Student Panel: The ESRs in **InsecTRAIN** will elect a speaker and vice-speaker who will communicate common student affairs, questions, problems, novel ideas (scientific and organisational ones) within the Network and with the coordinator. Speaker and vice-speaker of the PhD students will organise an internal PhD student meeting (without supervisors) at least once a year, during summer schools, in order to promote and intensify exchange and networking among the international PhD students.

Conflict Resolution: The primary mechanism for decision-making within the project will be by consensus (defined as a lack of sustained opposition to a decision). However, where consensus cannot be reached, it is essential that procedures should be available to prevent disagreements from escalating into conflicts. The Consortium Agreement (CA) will include rules for convening a meeting, definition of a quorum and voting. In this regard, the foreseen conflict resolution mechanism aims to a) minimise the impact of any disagreement and to localise its effect and b) to ensure the speediest possible resolution of disagreements. Conflicts between Beneficiaries/partner organisations shall, in the first instance, be mediated by the Coordinator and ultimately by decisions of the SB. Conflicts between a Beneficiary/partner organisation and the Coordinator shall be managed in the same way as disputes between Beneficiaries, except that the SB shall elect a chairperson to temporarily replace the Coordinator in that role. The CA will provide a procedure to handle this.

3.2.3 Recruitment strategy

As the success of our programme depends to a great extent on the quality of the students that we will be able to recruit, the **InsecTRAIN** network will recruit in a similar way as the highly successful International Max Planck Research School (IMPRS) recruitment procedure, where each applicant student will give a short presentation on his/her master project and each beneficiary will give a short presentation on each project as well. Extended discussions afterwards will give the students and recruiters the opportunity to interact with each other.

To start, the partners will prepare a joint public advertisement, describing the required profiles as well as the research projects. Different platforms and tools will be used to announce the open positions internationally: (i) Euraxess website (The Coordinator University of Amsterdam holds the logo for HR Excellence in Research); (ii)

Naturejobs website; (iii) partner institutes' websites; (iv) emails to personal contacts and other institutes; (v) **InsecTRAIN** flyers to distribute to international institutes; (vi) **InsecTRAIN** website; (vii) EMBO Life Science Mobility Portal. Short-listed candidates of independent international graduate programmes (e.g. EMBL, IMPRS, CRG) with fitting interests and background will also be contacted.

Selection will be centralised and the network coordinator will make sure that it is in line with the European Charter for Researchers and the EC Grant Agreement. Applicants will submit a cover letter, CV and 2 reference letters, and will indicate a top three of all available **InsecTRAIN** projects. The scientific project manager will create a common **InsecTRAIN** database containing all the eligible applications. The **InsecTRAIN** Beneficiaries will be able to choose the most qualified and motivated applicants for the specific projects and organise a web-based meeting for the presentations of both students and beneficiaries. Afterwards, web-based one-on-one interviews will be held, such that each student will have an interview with beneficiaries of two to three preferred projects, to ensure 2-3 independent assessments per student.

All beneficiaries aim to recruit the best candidates. Selection will be exclusively based on excellence. A strict equal-opportunities policy, irrespective of gender, physical disability, religion or belief, political opinion, economic condition or nationality will be applied, without taking precedence over quality and competence. To ensure equal treatment, the selection panel will have an adequate gender balance with a percentage of female scientists superior to the actual gender balance of the PI's in the consortium (see 3.2.7 for further details). Given equal scientific qualification, ESRs from less favoured regions will be given preference. Given the current political situation in and around Europe, through LERU (League of European Research Universities), the coordinating partner UvA has an active role in the Science4Refugees initiative as defined by the European Commission to help refugee scientists and researchers find suitable jobs that both improve their own situation and put their skills and experience to good use in Europe's research system. Also, UvA is a founding partner of the Dutch University Refugee Fund (UAF) in the Netherlands, that assists refugees in finding proper jobs and education in their new home countries. For **InsecTRAIN**, UvA will actively use these ties to promote the possibilities for suitable refugee scientists to apply for an ESR position across the entire project. The use of EURAXESS will assist in doing so

The selection panel will positively consider mobility experiences in another country/region or in another research setting (public or private), shifts of researchers between disciplines or sectors, as well as returns after a career break. The consortium will guarantee adequate employment conditions of the ESR, including for disabled researchers in line with the 'European Charter for Researchers and Code of Conduct for the Recruitment of Researchers' (see 3.2.1). These conditions include for example full social security coverage in compliance with the national legislation, access to research training, continuous personal development, specific guiding for PhD students and data management support.

3.2.4 Progress monitoring and evaluation of individual projects

Each PI will be responsible for writing a progress report twice a year, which will be distributed (confidentially) among the members of the network. This progress report can be used as input to PCDP adjustment if necessary. The annual reports provided by each PI will be compiled by the coordinator for the annual ITN report that will be submitted to the EU. Furthermore, each ESR will present the result of his/her project at the Management and ESR progress meeting at the beginning of each summer school and to discuss progress with the network members; each PI and ESR will receive feedback from the supervisory board, both on the scientific process, and through Partner Organisations also on their career perspective and impact issues like IPR and commercialisation opportunities.

3.2.5 Risk management at consortium level

Within the context of a Risk Management Plan (RMP), the SB will identify and categorise all potential strategic risks to the successful delivery of the project. For each risk area, mechanisms for risk mitigation are identified and, in the case of risks, which are rated as highly likely to occur or as having a high impact on the successful delivery, contingency action is proposed. The RMP distinguishes between project-wide and specific (project, work package training) risks. Regular monitoring and updating of these two classes of risk are the responsibility of the SB and the PI's respectively. The SB shall be responsible for ensuring that a) Risk mitigation actions are included in project plans at the appropriate level and are monitored as part of the regular project management process; b) Risks are routinely monitored and the register maintained at project and work package levels and c) Contingency plans for any high likelihood/high impact risks are current. The Risk Register created within the RMP will be available to all Consortium members on the project web site.

Specific risks are identified for each ESR project and given in Table 3.2a. A major risk on the consortium level is the possibility that the ESRs will not progress enough on the scientific level, to be able to obtain their PhD. For this reason, all ESRs have more than one supervisor, and the SB will review twice a year the progress against the Career Development Plan. Project-wide risks (e.g. ESRs dropping out, illness) are not listed in Table 3.2a as they are common to all ITN projects. These will be monitored and handled appropriately, if necessary.

Table 3.2a Implementation Risks

Risk No.	Description of Risk	WP No.	Proposed mitigation measures
R1	Delay in recruitment	6	Start new round of advertisements, include extensive network of partners.
R2	Workshop/course fails to deliver	4	Coordinator (UvA) has a long list of alternative suppliers of similar courses for transferable skills. Partnership will organise scientific/technical alternatives.
R3	Lead Beneficiary no longer capable of coordinating the network	6	Beneficiary 3 is closely involved in the network and capable of taking over responsibilities. The PI from Beneficiary 3 has a co-appointment at UvA, so, if appropriate, project management can remain in the same place
R4	Partner organisation dropping out	6	For transferable skills, UvA has long experience with various partners that can act as alternative, for scientific/technical skills, the network of partners can provide an alternative.
R5	Beneficiary dropping out	all	ESR either to be appointed with another Beneficiary, or bring in an alternative.
R6	Decision making/conflict resolution could escalate in between project/annual meetings	6	Project will acquire a professional teleconferencing tool to organise regular telcons. Agenda and minutes will be prepared by the project manager.
R7	Not enough natural variation in volatile production	1/2	Unlikely, for tomato, cole and strawberry there is an enormous variation in volatile production.
R8	Not sufficient material for identification of the volatile	1/2	More plant varieties will be analysed to find a variety which produces higher levels or alternatively more plant material will be extracted.
R9	Identified compounds are not commercially available	1/2	Compounds will be synthesised in collaboration with chemistry departments.
R10	Biosynthetic pathways are very complicated	1	Collectively we have ample experience to elucidate the pathways.
R11	Not enough server capacity	1	Baseclear has access to alternative server and cloud-based capacity through its collaboration within Generade.
R12	No attractive or repellent host plant odours	2	Test efficacy of already identified host plant attractants and repellents.
R13	Insufficient response of pest insects to host plant odours in bioassays	2	Due to the numerous plant volatiles that are usually identified as potential attractants or repellents by GC-coupled electrophysiology, the risk is low. Testing compounds in several different bioassays will increase the success rate.
R14	No genetic variation in host plant attraction by pest insects	2	Genetic variation has already been identified for the moth *Plutella xylostella* and the whitefly *Bemisia tabaci*. If the other 2 pest species do not show genetic variation, the focus will be on the level and extent of behavioural plasticity in these species.
R15	No candidate genes in the identified QTL loci in the pest insects	2	The most likely gene located in the identified QTL will be disrupted through CRISPR-Cas9 to determine its effect on host plant attraction in the pest insect. If there are no (obvious) genes in this region at all, identified olfactory receptors in the pest insect will be functionally analysed through CRISPR-Cas9.
R16	The tested insects do not rely on experience	2	Learning and plasticity has been shown in many insects already, making this an unlikely risk.
R17	Host plants potentially interesting for pest insects interfere with beneficial insect attraction	3	Other host plants need to be evaluated that are potentially useful in pest management strategies AND do not interfere with beneficial insects.
R18	Host plant volatiles potentially interesting for pest insects interfere with beneficial insect attraction	3	Other host plant volatiles need to be evaluated that are potentially useful in pest management strategies AND do not interfere with beneficial insects.
R19	Potential pest management interventions innefficient .	5	Try and combine a range of measures, based on the results from the individual projects.
R20	New developed approaches in InsecTRAIN are not commericalised	5	As InsecTRAIN consists of commercial partners, who are potential end users and highly interested in developing alternative pest management strategies, any potential approach is likely to be commercialised. If the consortium is not interested, other potential end users will be approached.
R21	Growers find new approaches difficult to adopt	5	As growers no longer have effective pesticides against these pest insects, they are increasingly interested in trying novel approaches.

3.2.6 Intellectual Property Rights (IPR)

InsecTRAIN has secured the services of Yellow Research as partner organisation in the project, who will offer a dedicated training on IPR issues to the ESRs, but will also, through their position in the SB, actively monitor the potential for exploiting and commercialise results coming from the ESR projects. This will secure an active position and a positive stance throughout the project towards exploitation opportunities. It also ensures a 'learning by doing' training opportunity for the ESRs.

The consortium agreement will comply with the **standard rules for IPR** as set out in the Grant Agreement as well as the agreed principles in the Desca working group for consortium agreements. The Intellectual Property Rights (IPR) of foreground information to be generated in the project will be owned by the organisation(s) of the investigators(s) who made the relevant discoveries. Commercially interesting findings, as identified by the partners and the project supervisors, may be offered for being patented by (1) the legal organisation(s) of the investigator(s); (2) (industrial) partners in the project, or (3) third parties within the EU. Information potentially relevant for patent applications will only be released into the public domain after permission to do so has been obtained from the

Supervisory Board. For the use of pre-existing know-how necessary for the execution of the project, or for the use of knowledge resulting from the project, the partnership will follow the guidelines agreed upon in the consortium agreement as a framework for the further development and exploitation of the results of the InsecTRAIN project.

In cases where the supervisory board anticipates that particular **findings are exploitable**, the information will remain confidential for, at most, a further 6 months. During this period, the partners themselves, with help of the Supervisory Board if requested, will provide effective protection of knowledge that is potentially of interest for industrial or commercial application. Accordingly, the partners will search for parties interested in filing patent applications and, eventually, in commercialising the knowledge generated by the programme. Agreements between the partners will be made concerning the possible benefits of the exploitation of these findings, and concerning (first) rights to obtain licenses for any IP generated within, or as a direct result of, InsecTRAIN.

3.2.7 Gender aspects

We acknowledge the fact that our newly trained ESRs should be aware of gender and other issues that could provoke inequality while professionally performing in science or elsewhere. We therefore specifically introduced a bias-training as part of the overall project management course. All host organisations will especially encourage women to apply for an ESR position, offering "equal pay for equal work" and aid to conciliate private and professional life, as flexible work arrangements with guaranteed maternity leave. In cases two candidates have equal qualities and backgrounds, preference will be given to the female scientists. The SB, containing four senior female scientists, one as the coordinator, will ensure that in all interviews at least one female PI will be present.

Our network aims to balance the factors driving the decrease of female proportions in science. Special emphasis will be paid to the following two factors: (i) differences in male and female profiling and self-expression which may result in different acknowledgement of achievements and (ii) differences in male and female self confidence, way of communication, and involvement in networks which may result in different success especially in highly competitive situations.

To address these factors, we will involve specialists on women's affairs in recruitment and mentoring programs to prepare young female scientists for a successful (scientific) career. We will offer proper child-care opportunities where required.

All partners have pre-existing policies that support flexible working patterns, access for disabled staff and forbid any form of harassment or discrimination. We will nominate an equality representative to the supervisory board who will monitor gender distribution of project supervisors and recruited researchers and report to the board on this topic. This person will also be a first point of contact for any network member that is concerned about potential cases of discrimination. These processes and principles are aligned with the Responsible Research and Innovation strategy and goals of the European Research Area.

3.2.8 Data management plan

The project will, in accordance with the EU policies on proper and responsible data management set up a Data Management Plan (DMP), following the FAIR principles (Findable, Accessible, Interoperable and reusable). The coordinating partner UvA has a clear and well outlined policy on this topic, see for instance http://rdm.uva.nl/en. The DMP will contain information on:

- the handling of research data during and after the end of the project;
- what data will be collected, processed and/or generated;
- which methodology and standards will be applied;
- whether data will be shared/made open access and;
- how data will be curated and preserved (including after the end of the project).

The DMP will take into account the specific legal agreements coming from the Grant Agreement and the Consortium Agreement. All interest, both academic and commercial will be addressed and arranged. Data standards, exploitation, curation and preservation are all topics that will be addressed in the DMP.

3.3 Appropriateness of the infrastructure of the participating organisations

Table 3.3 Infrastructure of the participating organisations

Beneficiary/ partner	ESR	Equipment present
1. UvA – Groot/ Schuurink	ESRs 1, 2, 3, 5, 6, 7, 8, 10, 15	Fully equipped molecular lab, walk-in climate chambers and green house, wind tunnel, various olfactometer bioassay set-ups, GC-FID and GC-EAD, GC-TOF-MS, GC-Q-TOF-MS, and LC-MS/MS, real-time PCR
2. MPG - Knaden/ Hanssen/ Heckel	ESRs 4, 8, 11, 12	Climate controlled rooms dedicated to insect behavioural assays, wind tunnels, CC-FID, GC-EAD, GC-SSR, laser confocal microscope, optical imaging setup, molecular biology, laboratory licensed for use of transgenic insects.
3. Enza - Bleeker	ESRs 1, 2, 7, 9, 10, 13, 15	Ample nursery, growth chamber and greenhouse facilities, including containment areas, large crop gene-bank collections, crop genome sequences and analysis tools and facilities and staff for high throughput disease testing and data analysis. State-of the-art molecular labs for genotyping, qPRC etc, tissue culture labs and a biochemistry lab with a wide range of modern equipment.

Beneficiary/ partner	ESR	Equipment present
4. SLU - Anderson/Dekker	ESRs 1, 7, 8, 9, 10, 11, 12, 13	Behaviour setups (olfactometers, wind tunnels, egg laying assays), peripheral and intracellular electrophysiological recording, optical imaging, molecular biology lab with basic genomic studies.
5. RUG - Billeter	ESRs 11, 12	Climate controlled rooms dedicated to insect behavioural assays, GC-FID, olfactometer, automated video-tracking of behaviour, equipment and reagents for pheromone bioassays, laser confocal microscope, molecular biology, laboratory licensed for use of transgenic insects and microorganisms.
6. Baseclear - Duijsings/ Pirovano	ESRs 3, 4, 5, 6, 8, 12	HiSeq2500, MiSeq, access to PacBio RSII, PAcBio Sequel, ABI7500 real time PCR, QuantStudiio 5 real time PCR, Oxford Nanopore MinION, GridION, PromethION, in-house servers for bioinformatics analyses, cloud-based solutions for data analysis.
7. TUM - Schwab	ESRs 4, 5, 11, 13, 14	Analytical, biochemical and molecular biology lab, modern analytical instruments (3 HPLC-DAD-MSn, GC-MS and GC-TOF), access to 400/600 MHz NMR, real-time PCR, gel electrophoreses apparatus, incubation chambers, greenhouse.
8. CU –Pickett/ vd Goes vNaters	ESRs 2, 6, 14, 15	Controlled environment rooms for dynamic headspace collection, insect behaviour assays and insect electrophysiology, synthetic chemistry laboratory for the production of non-commercially available infochemicals, experimental field sites
9. Biobest – Wäckers/Pozo	ESRs 4, 7, 11, 13, 14, 15	The Biobest Group, through its subsidiaries, has production sites, sales and technical support staff strategically located across the globe. The R&D headquarters in Belgium features multiple laboratories and climate controlled rooms and a 3000 m2 greenhouse divided in 12 compartments.
10. FUB - Hilker	ESRs 3, 9	Climate chamber for insects, greenhouse, molecular lab, EAG setup, various olfactometer bioassay set-ups; GC-MS for odour analysis
11. WUR – Bonnema/ van Loon	ESRs 3, 5, 9, 10, 15	Molecular and biochemical labs, phytopathology lab, transformation and tissue culture propagation labs, climate rooms, greenhouse facilities and various field sites. Facilities for insect behavioural studies and setups for electrophysiology, controlled environment rooms for dynamic headspace volatile collection and GC-MS equipment for volatile identification.

3.4 Competences, experience, complementarity of participating organisations and their commitment

3.4.1 Consortium composition and exploitation of participating organisations' complementarities

As indicated in section 1.2 and 1.3, the **InsecTRAIN** consortium consists of a team of exceptionally strong researchers in the fields of plant biology and insect chemical ecology. The members of the consortium represent world leading competence in key areas, ranging from genetic, genomic and molecular analysis of plant characteristics and mechanisms behind olfactory-guided behaviour in pest and beneficial insects, to commercialisation and incorporation of pheromones and kairomones in integrated insect pest management solutions. The Beneficiaries and Partners complement each other, as specified in Table 3.4.

Table 3.4 Complementary skills of all Beneficiaries and partner organisations

Beneficiary/Partner	Basic skills	Complementary skills
1a Groot (UvA) 1b Schuurink (UvA)	Insect chemical ecology, genetics Plant volatile chemistry & genetics	Quantitative genetics in Lepidoptera Genetics, metabolomics and transcriptomics host plants
2. Knaden/ Hansson/Heckel (MPG)	Chemical ecology, neurology, insect genetics	Neuro-ethology & bioassays, *Drosophila,* quantitive genetics
3. Bleeker (Enza)	Plant breeding and genetics	QTL analysis in vegetable crops
4. Anderson/Dekker (SLU)	Chemical ecology, neurology	Modulation & learning in insects
5. Billeter (RUG)	Molecular biology, genetics	Molecular toolbox *D. melanogaster*, transgenics
6. Duijsings/Pirovano (Baseclear)	Genome assembly, annotation	Genome & transcriptome analysis and comparison, web-based interfaces
7. Schwab (TUM)	Plant breeding and metabolomics	Biochemistry, plant genetics, metabolomics in strawberry
8. Pickett/ vd Goes vNaters (CU)	Chemical ecology	Field ecology and translation to pest management
9. Wäckers/ Pozo (Biobest)	Biological control & pollinators	Insect ecology, specifically on predators, parasitoids and pollinators
10. Hilker (FUB)	Chemical ecology	Plant-insect interactions
11. Bonnema (WUR) van Loon (WUR)	Plant breeding and genetics Insect-plant interactions	QTL analysis in Brassica's, Brassica genetic variation Insect electrophysiology and behavior; chemical ecology
Vitae	Career development	Transversal skills and competences, project management
Yellow Research	IPR and Commercialisation	Transversal skills and competences, IPR/Exploitation opportunities assesment
Koppert	Field ecology, Pest management	Translating research results to commercial products

3.4.2 Commitment of beneficiaries and partner organisations to the programme

As indicated in section 5, supervisors from all Beneficiaries and Partner Organisations have committed considerable (10-20%) time to invest in the project. This investment is coming from own resources. We also refer to the letters of commitment added to the end of this proposal.

4. GANTT Chart

ESR	Benef_inst	Lead person	focus	Month		7	8	9	10	11	12	13	14	15	16	17	18		19	20	21	22	23
1	Enza	Petra Bleeker	Tomato (Tuta)	recruitment (month 1-6)	Summer School 1	h	h	h	h	h	h	h	h	h	h	h	h	Summer School 2	SLU	SLU	SLU	h	h
2	UvA (sils)	Rob Schuurink	Tomato (Bemisia)			h	h	h	h	h	EZ	EZ	EZ	h	h	h	h		h	h	h	h	h
3	WUR	Guusje Bonnema	Cabbage (Plutella)			h	h	h	UvA	UvA	h	h	h	h	h	h	h		BC	BC	h	h	h
4	TUM	Willy Schwab	Strawberry (Drosophila)			h	h	h	MPG	MPG	h	h	h	h	h	h	h		h	h	h	h	h
5	BaseClear	Danny Duijsings	Cabbage & Plutella			h	h	h	WUR	WUR	WUR	h	h	h	h	h	h		h	h	h	TUM	TUM
6	CU	John Picket	Whitefly (Tomato)			h	UvA	UvA	UvA	h	h	h	h	h	h	h	h		h	h	h	h	h
7	SLU	Teun Dekker	Tuta (Tomato)			h	EZ	EZ	h	h	h	h	h	h	h	h	h		h	UvA	UvA	h	h
8	UvA (ibed)	Astrid Groot	Plutella (Cabbage)			h	h	h	h	h	h	h	h	h	MPG	MPG	MPG		h	h	h	h	h
9	FUB	Monika Hilker	Plutella (Cabbage)			h	h	h	SLU	SLU	h	h	h	h	h	h	h		h	h	h	WUR	WUR
10	SLU	Peter Andersson/ Teun Dekker	Plutella (Cabbage)			h	h	h	h	h	h	UvA	UvA	UvA	h	h	h		h	h	h	h	h
11	MPG	Markus Knaden	Drosophila (Strawberry)			h	h	h	h	h	h	h	h	h	TUM	TUM	TUM		h	h	h	h	h
12	RUG	J-C Billeter	Drosophila (Strawberry)			h	h	h	h	h	h	h	h	h	SLU	SLU	SLU		h	h	h	BC	BC
13	Biobest	Felix Wäckers	Beneficials on Tomato			h	h	h	EZ	EZ	h	h	h	h	h	h	h		SLU	SLU	h	h	h
14	CU	Wynand van der Goes van Naters	Beneficials on Strawberry			h	h	h	h	h	h	h	h	h	h	h	h		h	h	h	h	h
15	CU	John Picket	Beneficials on Cabbage			h	h	h	h	h	h	h	h	h	Biob	Biob	Biob		h	h	h	h	h

ESR	Benef_inst	Lead person	focus	24	25	26	27	28	29	30	Summer School 3	31	32	33	34	35	36	37	38	39	40	41	42	End Symposium
1	Enza	Petra Bleeker	Tomato (Tuta)	h	h	h	h	UvA	UvA	UvA		h	h	h	h	h	h	BC	BC	BC	h	h	h	
2	UvA (sils)	Rob Schuurink	Tomato (Bemisia)	CU	CU	CU	h	h	h	h		h	h	h	h	h	h	h	h	h	h	h	h	
3	WUR	Guusje Bonnema	Cabbage (Plutella)	h	h	h	FUB	FUB	h	h		h	h	h	h	h	h	h	h	h	h	h	h	
4	TUM	Willy Schwab	Strawberry (Drosophila)	BC	BC	BC	h	h	h	h		h	h	h	Biob	Biob	Biob	h	h	h	h	h	h	
5	BaseClear	Danny Duijsings	Cabbage & Plutella	h	h	h	h	h	h	h		h	h	h	h	h	h	h	h	h	h	h	h	
6	CU	John Picket	Whitefly (Tomato)	h	h	h	h	UvA	UvA	UvA		BC	BC	BC	h	h	h	h	h	h	h	h	h	
7	SLU	Teun Dekker	Tuta (Tomato)	h	h	h	h	h	EZ	EZ		h	h	h	Biob	Biob	Biob	h	h	h	h	h	h	
8	UvA (ibed)	Astrid Groot	Plutella (Cabbage)	h	h	h	h	BC	BC	BC		h	h	FUB	FUB	h	h	h	h	h	h	h	h	
9	FUB	Monika Hilker	Plutella (Cabbage)	WUR	h	h	h	h	h	h		EZ	EZ	h	h	h	h	h	h	h	h	h	h	
10	SLU	Peter Andersson/ Teun Dekker	Plutella (Cabbage)	h	EZ	EZ	h	h	h	h		WUR	WUR	WUR	h	h	h	h	h	h	h	h	h	
11	MPG	Markus Knaden	Drosophila (Strawberry)	h	RUG	RUG	RUG	h	h	h		Biob	Biob	Biob	h	h	h	h	h	h	h	h	h	
12	RUG	J-C Billeter	Drosophila (Strawberry)	h	h	h	h	h	h	h		MPG	MPG	MPG	h	h	h	h	h	h	h	h	h	
13	Biobest	Felix Wäckers	Beneficials on Tomato	h	h	h	h	h	h	h		EZ	EZ	EZ	EZ	h	h	h	h	h	h	h	h	
14	CU	Wynand van der Goes van Naters	Beneficials on Strawberry	h	Biob	Biob	Biob	h	h	h		h	h	h	h	h	h	Biob	Biob	Biob	Biob	h	h	
15	CU	John Picket	Beneficials on Cabbage	h	EZ	EZ	h	h	h	h		h	h	h	WUR	WUR	WUR	h	h	h	h	h	h	

5. Participating Organisations

Beneficiary 1	UNIVERSITEIT VAN AMSTERDAM
General Description	The Institute for Biodiversity and Ecosystem Dynamics (IBED) at UvA aims to better understand the dynamics of ecosystems from genes to climate change, using a truly multidisciplinary approach. IBED's strength lies in integrated studies of biodiversity, ecosystems and the environment using methods typical of the disciplines of biology, chemistry and physical geography. The Swammerdam Institute for Life Sciences (SILS) at UvA main research objective is to understand the functioning of living organisms, from the most basic aspects up to complex physiological function(s). Biological processes are studied at the level of molecules, cells, cellular networks and organisms. SILS' strength is its multidisciplinary and systems biology approach to questions in life sciences using state of the art technologies. UvA has been rewarded the HR Excellence Logo from the European Commission, signifying recognition of the UvA's HR policy and compliance with the 'European Charter for Researchers and Code of Conduct for the Recruitment of Researchers'
Role and Commitment of ke persons (incl.supervisors)	Prof. Dr. Astrid T. Groot – Coordination (10%), supervision (Scientific: 15%) Dr. Robert Schuurink – Associate Professor, supervision (Scientific 10%) Project Manager - (50%)
Key Research Facilities, Infrastructure and Equipment	The Groot and Schuurink labs are fully equipped for chemical ecological and molecular biological analyses, walk-in climate chambers, state of the art green-houses, various olfactometers and a state-of-the-art windtunnel. There is also a dedicated GC-EAD system. The molecular lab is fully equipped for all genetic and transcriptomic analyses, including a real-time PCR machine. For metabolite analysis there is a GC-TOF-MS, a GC-Q-TOF-MS, and a LC-MS/MS. The lab also maintains various insect rearings.
Status of Research Premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	The faculty of Science at the UvA has a longstanding experience in the EC Marie Curie training and mobility programme, This experience includes coordination of several large ITN projects. Groot has supervised national and international master students at North Carolina State University, at MPG and at the UvA, with a total of >20 master students, 10 PhD students and 8 postdocs, with currently 4 PhD students, 3 Postdocs and 2 technicians. Under Schuurink's supervision 9 PhD students have graduated and there are currently 4 PhD students in his group, 4 Postdocs and 2 technicians.
Current involvement in Research and Training Programmes	Groot's main research question is how sexual attraction is involved in the initial divergence of populations, and thus the first step in speciation. She has a long expertise on studying the evolution of moth sexual communication at the molecular and mechanistic level, especially on genetic and chemical analysis. Schuurink addresses how plants are capable of defending themselves against herbivorous arthopods. For a more holistic view of the interaction, not only the metabolites and genes in the plants are studied, but also the molecules that insects use to manipulate the defenses of the plant and their interactors in the plant. Groot and Schuurink coordinate and teach in various BSc and MSc courses. Groot is part of the *Spodoptera frugiperda* genome consortium and the *Heliothis virescens* genome consortium. Schuurink is part of the ERA-CAPS program with HIPS and is host to the MC fellow of ISOSPIT.
Relevant Publications and/or research/innovatio n products	• Groot AT, Dekker T, Heckel DG. 2016. The genetic basis of pheromone evolution in moths. *Annu Rev Entomol* 61: 99-117. • Koutroumpa F, Groot AT, Dekker T, Heckel DG. 2016. Genetic mapping of male preference in the European corn borer identifies candidate genes affecting neurogenesis. *Proc Natl Acad Sci USA*, 113(42):E6401-E6408 • Lassance JM, Groot AT, Liénard MA, Binu A, Borgwardt C, Andersson F, Hedenström E, Heckel DG, Löfstedt C. 2010. Allelic variation in a fatty-acyl reductase gene causes divergence in moth sex pheromones. Nature, 466, 486-489. • Bleeker, P.M., Mirabella, R., Diergaarde, P.J., VanDoorn, A., Tissier, A., Kant, M.R., Prins, M., de Vos, M., Haring, M.A., and Schuurink, R.C. (2012). Improved herbivore resistance in cultivated tomato with the sesquiterpene biosynthetic pathway from a wild relative. *Proc Natl Acad Sci USA* 109:20124-20129. • Emission of volatile organic compounds from petunia flowers is facilitated by an ABC transporter. Adebesin F, Widhalm JR, Boachon B, Lefèvre F, Pierman B, Lynch JH, Alam I, Junqueira B, Benke R, Ray S, Porter JA, Yanagisawa M, Wetzstein HY, Morgan JA, Boutry M, Schuurink RC, Dudareva N. Science. 2017 Jun 30;356(6345):1386-1388

Beneficiary 2	Max Planck Institute for Chemical Ecology
General Description	Department for Evolutionary Neuroethology The focus of research in the department is to study odour-directed behaviour and its underlying neurobiological substrate in insects from a functional and evolutionary perspective.
Role and Commitment of key persons (including supervisors)	Prof. Bill Hansson – supervision (Scientific: 10%) Dr. Markus Knaden - supervision (Scientific: 20%)
Key Research Facilities, Infrastructure and Equipment	Climate controlled rooms dedicated to insect behavioural assays, wind tunnels, gas chromatograph coupled with flame ionization detector (GC-FID) and single sensillum recording setup (SSR), laser confocal microscope, optical imaging setup, molecular biology, laboratory licensed for use of transgenic insects.
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	Hansson is director of the department and the co-founder of the highly successful Insect Chemical Ecology (ICE) course series that began at the Swedish Agricultural University at Alnarp (SLU Alnarp) in 2003 and now rotates annually between Penn State, SLU Alnarp, and the Max Planck Institute for Chemical Ecology in Jena, Germany. Hansson has supervised 31 PhD students of which 21 have defended their thesis. He currently hosts 10 postdoctoral fellows. Knaden has organized and taught at the ICE and at the spring school for chemical ecology at NCBS/Bangalore. 5 PhD students have already defended their thesis under supervision of Knaden.
Current involvement in Research and Training Programmes	Hansson is scientific coordinator of the ITN FLiACT (FP7-People-2011-ITN) Hansson and Knaden together currently train 14 PhD students, and 6 Post-docs. Knaden is group leader of the insect behaviour group within the department. He currently supervises three postdocs, 4 PhD students and 5 undergraduate students.
Relevant Publications and/or research/innovation products	• Keesey, I.W., Koerte, S., Khallaf, M.A., Retzke, T., Guillou, A., Grosse-Wilde, E., Buchon, N., Knaden, M., Hansson, B.S. (2017). Pathogenic bacteria enhance dispersal through alteration of *Drosophila* social communication. Nature Comm, 8: 265. DOI:10.1038/s41467-017-00334-9. • Dweck, H.K.M., Ebrahim, S.A.M.E., Khallaf, M.A., Koenig, C., Farhan, A., Stieber, R., Weissflog, J., Svatos, A., Grosse-Wilde, E., Knaden, M., Hansson, B.S. (2016). Olfactory chaneels associated with the *Drosophila* maxillary palp mediate short- and long-range attraction. eLife, 5:e14925. DOI: 10.7554/eLife.14925. • Haverkamp, A., Bing, J., Badeke, E., Hansson, B.S., Knaden, M. (2016). Innate olfactory preferences for flowers matching proboscis length ensure optimal energy gain in a hawkmoth. Nature Comm, 7: 11644, DOI:10.1038/ncomms11644 • Ebrahim, S.A.M., Dweck, H.K.M., Stökl, J., Hofferberth, J.E., Trona, F., Weniger, K., Rybak, J., Seki, Y., Stensmyr, M., Sachse, S., Hansson, B.S., Knaden, M. (2015). *Drosophila* avoids parasitoids by sensing their semiochemicals via a dedicated olfactory circuit. PLoS Biology 13(12): e1002318. doi:10.1371/journal. pbio.1002318 • Stensmyr, M. C., Dweck, H., Farhan, A., Ibba, I., Strutz, A., Mukunda, L., Linz, J., Grabe, V., Steck, K., Lavista Llanos, S., Wicher, D., Sachse, S., Knaden, M., Becher, P. G., Seki, Y., Hansson, B. S. (2012). A conserved dedicated olfactory circuit for detecting harmful microbes in Drosophila. Cell, 151(6), 1345-1357.

Beneficiary 3	
General Description	ENZA Zaden (EZ) is one of the world's leading vegetable breeding companies, with a strong research focus, known for its high-quality varieties, which are bred by an international team of plant breeders and researchers in different parts of the world (www.enzazaden.com). EZ has research, breeding and commercial stations all over the world. Around 50% of the employees work in research and development and innovative solutions allow acceleration of EZ's breeding programmes. Knowledge and creativity is combined with modern and highly advanced technologies.
Role and Commitment key persons (inc supervisors)	Dr. Petra Bleeker – Sr. Scientist ENZA Zaden, Assistant Professor (UvA) scientific supervision (20%)
Key Research Facilities, Infrastructure and Equipment	The EZ main research station in the Netherlands houses ample plant nurseries, growth chambers and greenhouse facilities, including containment areas for work with quarantined organisms and genetically modified material. EZ has expertise and facilities for routine crop transformations and high throughput phenotyping. EZ has large (wild) crop germplasm collections, segregating populations and introgression libraries, in-house crop genome sequence data, genomic analysis tools and expertise and facilities and staff for high- throughput disease testing and large-data analyses. Additionally, there are state-of- the-art molecular labs (including standard equipment but also modern genotyping platforms and Next Generation Sequencing equipment), tissue culture labs and a biochemistry lab containing a wide range of modern analytical equipment (including GC- and LC-MS for plant metabolite analyses). The company is staffed with (highly) educated and experienced research staff, many of whom hold a PhD.
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	EZ is a regular host for (international) BSc, MSc and PhD students. Petra Bleeker currently holds a shared position employed by EZ (60%) and as Assistant Professor University of Amsterdam (40%). In both positions she has been involved in the supervision of BSc, MSc and PhD students and in setting up courses for colleagues within the ENZA Academy and within the UvA Master track Green Life Sciences. EZ is familiar with PhD supervision, currently employing a PhD student in a (different) ITN training Network.
Current involvement in Research and Training Programmes	At ENZA Zaden Bleeker is involved in phytopathology-related research projects in Solanaceas, including various insect-resistance programmes with the aim to develop novel, insect resistant, crop varieties. Bleeker is involved in the Enza Academy, providing focused training and development for employees within EZ. EZ is member of the Seed Valley initiative, a foundation that ensures that the many possibilities of the seed sector are brought to the attention of pupils, students and future employees. In collaboration with academics and Seed Valley EZ is involved in the organization of Summer Schools for students and PhD students. EZ is member of the Dutch Experimental Research School for Plant Sciences (EPS). Finally, EZ is currently hosting and supervising a PhD student as beneficiary partner in the ITN-EID project CropStrengthen (grant agreement 642901)
Relevant Publications and/or research/innovation products	• Patent-US2009271890 method for obtaining a plant with a lasting resistance to a pathogen. • Van Damme et al 2008. Arabidopsis DMR6 encodes a putative 2OG-Fe(II) oxygenase that is defense/associated but required for susceptibility to downy mildew. Plant Journal 54, 785-793. • Bleeker P. et al 2012. Improved herbivore resistance in cultivated tomato with the sesquiterpene biosynthetic pathway from a wild relative. PNAS USA 109, 20124-20129. • Bleeker P.M., Ament, K. Diergaarde P.J., Schuurink, R.C., de Both M.T.J. Plant volatiles based on R curcumene. Applicant: KeyGene NV. Priority date: 2009-03-05 Application nr. WO2010EP01599 20100304

Beneficiary 4	SLU
General Description	The department of Plant Protection Biology at the Swedish University of Agricultural Sciences studies behavioural, physiological and genetic aspects of insect ecology and management of insect pests.
Role and Commitment of key persons (including supervisors)	Prof. Peter Anderson – supervision (Scientific: 20%) Associate Prof. Teun Dekker – supervision (Scientific: 20%)
Key Research Facilities, Infrastructure and Equipment	The Chemical Ecology Division in Alnarp has excellent facilities dedicated to chemical ecological research. This includes behavioural setups (windunnels, olfactometers, oviposision assays, etc), peripheral and intracellular electrophysiological recordings, optical imaging, molecular biology, and basic genomic studies. A new Biotron for rearing experimental plants is available.
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	Anderson: Participation in an international research project (InvaVol, 2011-2013) funded by the European Science Foundation consisting of six European partners. Anderson and Dekker have together supervised and co-supervised 25 PhD-students, 16 post-docs and more than 30 MSc/BSc theses, with many post-docs and PhD-students moving on to good research positions. Have taken courses in scientific leadership and in courses for supervision of PhD-students and post-docs. Dekker and Anderson: Participation in a bi-lateral student training and exchange programme between Ethiopia and Sweden (Linnaeus-Palme, 2008-2014).
Current involvement in Research and Training Programmes	The research group of Anderson covers research projects on fundamental and applied aspects of host plant choice and mate location in insects. Prof. Anderson and Dr. Dekker have long experience in combining evolutionary and ecological studies with physiological and molecular experiments to explain mechanisms behind behavioural and neural plasticity. Anderson & Dekker: Participation in a large national research project (Linnaeus project, 2006-2016) for training of PhD-students and post-docs. Prof. Anderson is a member of the Committee for PhD-studies at the LTV-faculty at SLU.
Relevant Publications and/or research/innovation products	• Karpati Z., Tasin M., Cardé R.T., Dekker T. 2013. Early quality assessment lessens pheromone specificity in a moth. Proceedings of the National Academy of Sciences, 110: 7377-7383. • Anderson P. & Anton S. 2014. Experience-based modulation of behavioural responses to sensory cues in insect herbivores. Plant, Cell & Environ. 37: 1826-1835. • Proffit M., Khallaf M. A., Carrasco D., Larsson M. C. & Anderson P. 2015. "Do you remember the first time?" Host plant preference in a moth is modulated by experiences during larval feeding and adult mating. Ecology Letters 18: 365-374. • Hatano E., Saveer A. M., Borero-Echeverry F., Strauch M., Zakir A., Bengtsson M., Ignell R., Anderson P., Becher P. G., Witzgall P. & Dekker T. 2015. A herbivore-induced plant volatile interferes with host plant and mate location in moths through suppressing olfactory signaling pathways. BMC Biology, 13: 75. • Carrasco D., Desurmont G. A., Laplanche D., Proffit M., Gols R., Becher P. G., Larsson M. C., Turlings T. C. J. & Anderson P. 2017. With or without you: effects of the concurrent range expansion of an herbivore and its natural enemy on native species interactions. Global Change Biology, accepted for publication.

Beneficiary 5	rijksuniversiteit groningen
General Description	University of Groningen, Groningen Institute for Evolutionary Life Sciences, Evolutionary Genetics, Development and Behaviour group. Our research focuses on the mechanisms by which genes influence behaviour. We use the reproductive behaviours of Drosophila as a model system. Teaching includes Genes & Behaviour, behavioural biology and directorship of an interdisciplinary Master in Behavioural and Cognitive Neurosciences.
Role and Commitment of key persons (including supervisors)	Prof. Dr. J-C. Billeter: supervision (Scientific: 20%)
Key Research Facilities, Infrastructure and Equipment	Climate controlled rooms dedicated to insect behavioural assays, Gas Chromatograph coupled with Flame Ionization detector (GC-FID), equipment and reagents for pheromone bioassays, laser confocal microscope, molecular biology, laboratory licensed for use of transgenic insects and microorganisms.
Status of research premises	Fully independent and owned by the beneficiary
Current involvement in Research and Training Programmes	Billeter studies the neurogenetics of social behaviours in *Drosophila*. His main research question concerns how individuals integrate social and environmental cues to make reproductive decisions. He uses a range of molecular genetics techniques and cellular physiology to study infochemical cues in behaviour. Billeter has supervised national and international master students in Canada, United Kingdom, and the Netherlands. He currently supervises 5 master students, 5 PhD students, and 2 technicians. Billeter is coordinator of the BSc course "Genes & Behaviour" (65 students), Director of the Interdisciplinary top research master in Behavioural and Cognitive Neurosciences (60 students) and teaches in the BSc course "Behavioural Biology', the Honours College, and the Master's course "Cellular and molecular neurosciences.
Relevant Publications and/or research/innovation products	• Laturney, M. and Billeter, J.-C (2016). Females *Drosophila melanogaster* control post-mating attractiveness by removing male anti-aphrodisiac pheromones. *Nature Communications,* 7:12322 doi: 10.1038/ncomms12322. • Duménil, C., Woud, D., Pinto, F, Alkema, J.T., Roessingh, S. and Billeter, J.-C (2016). Pheromonal cues convey social information about egg-laying sites in *Drosophila melanogaster. Journal of Chemical Ecology*. 42: 259-269. • Gorter, J.A., Jagadeesh, S., Gahr, C., Boonekamp, J.J., Levine, J.D., and Billeter, J.-C (2016). The nutritional and hedonic value of food modulates sexual receptivity in *Drosophila melanogaster* females. *Scientific Reports* 5, 19441; doi: 10.1038/srep19441. • Billeter, J.-C., Jagadeesh, S., Stepek, N., Azanchi, R., and Levine, J.D. (2012). *Drosophila melanogaster* females change mating behaviour and offspring production based on social context. *Proceedings of the Royal Society B*. 279 (1737), 2417-2425. • Billeter, J.-C., Atallah, J., Krupp, J.J., Millar, J. and Levine, J.D. (2009). Specialized cells tag sexual and species identity in Drosophila melanogaster. *Nature* 461 (7266), 987-991.

Beneficiary 6	BASECLEAR FOR 100% DNA RESULTS
General Description	BaseClear is an independent and ISO17025 accredited service laboratory for DNA-based research. The customer base are both academic and commercial companies across Europe, as well as key players in industrial biotech and pharma industries like e.g. DuPont, DSM and Johnson & Johnson. The primary services offered by BaseClear are in the areas of DNA sequencing (both sanger and Next-Generation), Bioinformatics, microbiology, microbiological identification and synthetic biology. BaseClear is a privately owned independent laboratory. We have a particular focus on (meta)genome and -transcriptome sequencing and analysis, specialising in the de Novo assembly of such genomes and their analysis. Additionally we have a number of peer review publications which focus on the novel methods to improve the De Novo assembly of Next-generation sequencing data.
Role and Commitment of key persons (incl.supervisors)	Dr. Walter Pirovano – Coordination (10%) Dr. Daniël Duijsings – supervision (Scientific: 10%) BaseClear staff members / technical specialists: as required.
Key Research Facilities, Infrastructure and Equipment	BaseClear has a fully equipped NGS analysis lab, including Illumina HiSeq and MiSeq sequencing platforms, Oxford Nanopore MinION adn GridION sequencing equipment, and access to PacBio RSII and Sequel equipment. All required support equipment, including fragment analyser, real time PCR, etc are present at BaseClear.
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	BaseClear has participated, and is currently involved in multiple granted projects, at a national as well as an international level (FP7) BaseClear has previously been an SME partner in the ZF-Tools (High-throughput tools for biomedical screens in Zebrafish) project which was funded as part of the European commissions 6th Framework programme.
Current involvement in Research and Training Programmes	BaseClear has participated, and is currently involved in multiple granted projects, at a national as well as an international level (two independent H2020 MSC-ITN projects). BaseClear is currently an active partner in "Generade" (http://generade.nl/) a public-private partnership based in the bioscience park in Leiden, The Netherlands with the aim of bringing together commercial companies and academic institutes to work together on education, research and entrepreneurship in the field of genomics
Relevant Publications and/or research/innovation products	• Gursinsky T, Pirovano W, Gambino G, Friedrich S, Behrens SE, Pantaleo V. Homeologs of the Nicotiana benthamiana Antiviral ARGONAUTE1 Show Different Susceptibilities to microRNA168-Mediated Control.(2015) Plant Physiol. Jul;168(3):938-52. • Boetzer, M., Pirovano., W., SSPACE-LongRead: scaffolding bacterial draft genomes using long read sequence information. (2014) BMC Bioinformatics. Jun 20;15:211 • Boetzer, M., Pirovano., W., Toward almost closed genomes with GapFiller. (2012) Genome Biol. 2012 Jun 25;13(6) • Boetzer, M., Henkel, C.V., Jansen, H.J., Butler, D., Pirovano, W., (2011), • Scaffolding pre-assembled contigs using SSPACE. Bioinformatics. Feb 15;27(4):578-9.

Beneficiary 7	Technische Universität München
General Description	The Technical University of Munich (TUM) is committed to excellence in research and teaching, interdisciplinary education and the active promotion of promising young scientists. The university also forges strong links with companies and scientific institutions across the world. TUM was one of the first universities in Germany to be named a University of Excellence. The TUM group 'Biotechnology of Natural Products' works within the department Food and Nutrition at the Centre of Life and Food Sciences, Land Use and Environment in Weihenstephan, Freising. The campus hosts groups working in plant genetics, plant metabolism, nutrition, food chemistry, food technology, crop protection, ecology and agricultural systems. 'Biotechnology of Natural Products' has concentrated on investigating plant physiology using chemical-analytical, biochemical and molecular biological methods.
Role and Commitment of key persons (incl. supervisors)	Prof. Dr. Wilfried Schwab – supervision (20%) Dr. Thomas Hoffmann (10%)
Key Research Facilities, Infrastructure and Equipment	The TUM group is well equipped with modern analytical instruments such as liquid chromatography-mass spectrometry (3 LC-MSn) as well as gaschromatography-mass spectrometry (GC-MS; GC-TOF) and has access to 400/600 MHz nuclear magnetic resonance spectroscopy (NMR) at the campuses Weihenstephan and Garching. In addition, the following instruments are available for the project: thermocyclers, qPCR, microplate reader, fluorescence microscopes, gel electrophoreses apparatus, diverse incubation chambers, freezers, centrifuges, and an autoclave. Greenhouse facilities are located on or within 2 km of the TUM campus (Weihenstephan) in Freising.
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	Schwab has supervised national and international bachelor, diploma and master students at the University of Würzburg, Germany and TUM, for more than 15 years with a total of more than 50 master students, 28 PhD students, 10 postdocs, 5 DAAD and 3 ERASMUS students. He has also served in more than 80 graduate student committees was a member of the consortium that sequenced the strawberry (*Fragaria vesca*) genome.
Current involvement in Research and Training Programmes	Current activities focus on the biosynthesis and metabolism of natural products in a number of crop plants. The group has a long expertise on studying the chemical structure, the enzymology and genetics of plant volatiles. Schwab currently supervises 10 PhD students, 3 postdocs and 4 MSc students. He is also external supervisor of 4 PhD students. Schwab teaches the Master course 'Biomolecular Food Technology', the BSc courses 'Metabolic engineering and biotransformation of natural products' and 'Biochemical analyses". He is member of the GoodBerry consortium that is studying the effects of the genome and environment on strawberry fruit quality and FavorDeNonDe group which is analyzing the allergen content in fruit crops. Besides, he is the founding father of the start-up project 4GENE which will develop, produce and market natural, biotechnologically engineered flavour precursors.
Relevant Publications and/or research/innovation products	• Härtl, K, … W. Schwab, Early metabolic and transcriptional variations in fruit of natural white-fruited *Fragaria vesca* genotypes. Scientific Reports 7 (2017), 45113 • Song C, … W. Schwab, Glucosylation of 4-hydroxy-2,5-dimethyl-3(2H)-furanone, the key strawberry flavor compound in strawberry fruit. Plant Physiology 171(1) (2016), 139-151. • Schiller D, … W. Schwab, A dual positional specific lipoxygenase functions in the generation of flavor compounds during climacteric ripening of apple. Hortcultural Research 2 (2015), 15003. • Bönisch F, … W. Schwab, A UDP-glucose:monoterpenol glucosyltransferase adds to the chemical diversity of the grapevine metabolome (Vitis vinifera L). Plant Physiology 165 (2014), 561-581. • Shulaev V, … Schwab W, … Folta KM, The genome of woodland strawberry (*Fragaria vesca*). Nature Genetics 43 (2011) 109-116. • Schwab W, Davidovich-Rikanati R, Lewinsohn E, Biosynthesis of plant-derived flavor compounds. Plant Journal 54 (2008), 712-732.

Beneficiary 8	CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD
General Description	Founded in 1883, Cardiff University is established as one of Britain's leading research universities, producing high quality, innovative research that directly translates to deliver benefits locally and worldwide. The University is part of the prestigious Russell Group of 24 leading research-intensive UK universities and wins on average £100 million per annum in research grants and investments. Research staff are world-class and include Nobel Laureates, Fellows of the Royal Society and members of other prestigious societies. The University was ranked 5th across the UK universities for its research quality and 2nd on the impact of its research in the 2014 'Research Excellence Framework' assessment by the UK government.
Role/commitment of key persons	Prof. John Pickett CBE FRS Foreign Member, NAS – ESR supervisor, 10% FTE (expertise in chemical ecology and crop protection); Dr Wynand van der Goes van Naters – Lecturer, ESR supervisor, 10% FTE (expertise in insect sensory systems, neurobiology of behaviour).
Key Research Facilities, Infrastructure and Equipment	Cardiff University has seven *Drosophila* research groups, which share insect research facilities and infrastructure. Further key facilities in the School of Biosciences are the technology hubs; these include a plant growth hub with a full spectrum of growth facilities (two large heated glasshouses with GM approved areas, 13 additional smaller glasshouses, a large outdoor cultivation area, growth rooms and Fitotron/Sanyo cabinets, tissue culture facilities), a small-molecule technology hub (sampling, sample preparation and analysis with GC-MS, Thermal desorption GC-TOF MS, HPLC), a genomics hub (with an Agilent TapeStation for sample integrity analysis, Illumina NextSeq for NGS sequencing, NeoPrep for library preparation), a large capacity server cluster, a well equipped imaging hub. The lab is equipped for molecular biology, electrophysiology and imaging of insect behaviour. The School of Chemistry houses state-of-the-art platforms/facilities for the isolation and identification of small lipophilic molecule (SLM) infochemicals (including dynamic headspace collection, analytical chemistry facilities, NMR spectroscopy) and synthetic chemistry labs for production of non-commercially available infochemicals.
Status of research premises	Independent research premises- Yes
Previous Involvement in Research and Training Programmes	Cardiff University has considerable experience with the MSCA Programme and has extensive expertise in managing these awards. Since 2010 CU has coordinated 42 EU projects, totalling €28.5. The University obtained funding for 172 FP7 projects, (ca. €74M EU Contribution). Of these, 53 were Marie Curie projects, (ca. €14.5M EU Contribution), including 12 Initial Training Networks (ITN), and 3 Industry-Academia Partnerships and Pathway (IAPP). Furthermore at a national level, Cardiff is heavily involved in the co-ordination and delivery of national Doctoral Training Centres and is part of the South West Doctoral training programme. Pickett: Supervised > 30 successful PhDs to completion. External examiner for over 25 PhDs. Participated in EU-ADOPT project involving the UK and partners in 3 African countries. Van der Goes van Naters: Supervised 2 PhDs, 1 current SWBio-DTP PhD student on Spotted-Wing Drosophila. External examiner/internal assessor for PhD students, Assessment Co-ordinator Integrated MSc module Advanced Research Methods.
Current involvement in Research and Training Programmes	Under Horizon 2020, Cardiff has already secured participation in 11 ETNs and is fully committed to growing its activities in the area of researcher training. Cardiff is also currently involved in eight UK national doctoral training centres, leading two of them. Cardiff School of Biosciences is currently a beneficiary in ITN's "Pandora" (Horizon 2020, no. 671881), "PolarNet" (Horizon 2020, no. 675407) and "TargetCare" (Horizon 2020, no. 642414).
Relevant Publications and/or research/innovation products	Pickett JA & Khan ZR (2016) Plant volatile-mediated signalling and its application in agriculture: successes and challenges. New Phytol 212: 856–870. Push-pull cropping: chemical ecology-based IPM (see J Chem Ecol 42: 689-697). Khan et al (2015) Exploiting phytochemicals for developing sustainable crop protection strategies to withstand climate change: example from Africa. Adv Plant Biopest 3: 35-46. Bruce TJA & Pickett JA (2011) Perception of plant volatile blends by herbivorous insects – Finding the right mix. Phytochemistry 72: 1605–1611. Ray A, Van der Goes van Naters W & Carlson JR (2014) Molecular determinants of odorant receptor function in insects. J Biosci 39(4): 555-563. Van der Goes van Naters W and Carlson JR (2006) Insects as chemosensors of humans and crops. Nature 444: 302-307.

Beneficiary 9	
General Description	Biobest is specialized in developing innovative solutions for effective natural crop pollination and biological pest/disease management. The R&D department employs 28 researchers, including 8 senior researchers with a PhD in entomology or crop protection. Senior researchers have ample experience in training both graduate and postgraduate students. The Biobest Group, through its subsidiaries, has production sites, sales and technical support staff strategically located across the globe for effective worldwide service. As the first company ever to commercially supply bumblebees in 1987, Biobest offers more bumblebee species to deal with pollination needs in various parts of the world than any other supplier, for every pollination need, including our patent Flying Doctors® hive. Natural pollination goes hand in hand with biological control of pests and diseases. Use our biological solutions: they make for a strong first line of defense in Integrated Pest Management. Let's work together for People, Planet and Profit.
Role and Commitment of key persons (incl.supervisors)	Felix Wäckers – Supervision, training, secondments (15%)
Key Research Facilities, Infrastructure and Equipment	The Biobest Group, through its subsidiaries, has production sites, sales and technical support staff strategically located across the globe for effective worldwide service. The R&D headquarters in Belgium features multiple laboratories and climate controlled rooms. A 3000 m2 greenhouse divided in 12 compartments is also part of the R&D facility.
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	Biobest frequently hosts multiple graduate and postgraduate students, offering the opportunity to work together with our academically trained researchers, as well as with technical field staff. The R&D department employs 28 researchers, including 8 senior researchers with a PhD in entomology or crop protection. Senior researchers have ample experience in training both graduate and postgraduate students. Biobest is actively involved in a broad range of national and international research consortia
Current involvement in Research and Training Programmes	Collaboration with academic groups is an integral part of the R&D philosophy. For this reason, Biobest is actively involved in a broad range of national and international research consortia, such as the EU FP7 IAPP project COLBICS, and frequently hosts multiple graduate and postgraduate students, offering the opportunity to work together with our academically trained researchers, as well as with technical field staff.
Relevant Publications and/or research/innovation products	• Lenaerts, M., Pozo, M. I., Wäckers, F., Van den Ende, W.,Jacquemyn, H., and Lievens, B., Impact of microbial communities on floral nectarchemistry: potential implications for biological control of pest insects,Basic andApplied Ecology (2015), http://dx.doi.org/10.1016/j.baae.2015.10.001 • Ramsden, M., Menéndez, R., Leather, S. & Wackers, F Optimizing field margins for biocontrol services: the relative role of aphid abundance, annual floral resources, and overwinter habitat in enhancing aphid natural enemies 1/01/2015 In : Agriculture, Ecosystems and Environment. 199, p. 94-104 11 p. • Improving pest control and pollination services in cider apple orchards by means of multi-functional flowering strips. / Campbell, Alistair; Sutton, Peter; Wilby, Andy; Wackers, Felix. Environmental Management on Farmland: Environmental Management on Farmland. ed. / Nigel Boatman; Mike Green; Jon Marshall; Kees Musters; Will Peach; Steve Peel; Gavin Siriwardena; Barbara Smith. Warwick : ASSOCIATION OF APPLIED BIOLOGISTS, 2013. p. 283-290 (Aspects of Applied Biology; Vol. 118). • Faria, C. A.; Romeis, Jörg; Wäckers, Felix L. 2015. Reduced defence induction in Bt cotton benefits non-target pests. Proceedings of the National Academy of Sciences of the United States of America (in press) Together with the R&D team at Biobest we launched a number of key innovations, including: • the "Flying Doctors®" system, • "Nutrimite", the first commercially available food supplement for predatory mites. • "Dyna-mite", a group of rapidly reproducing generalist predatory mites with high combined efficacy against thrips, whitefly and spider mites

Beneficiary 10	Freie Universität Berlin
General Description	Freie Universität Berlin, Institute of Biology, Applied Zoology/Ecology: Our research focuses on chemical and molecular ecology of plant – insect interactions; teaching includes basic ecology courses/lectures as well as chemical & molecular ecology of plant - insect interactions
Role and Commitment of key persons (including supervisors)	Prof. Dr. Monika Hilker – supervision (20%)
Key Research Facilities, Infrastructure and Equipment	Climate chamber for beetles, greenhouse, molecular lab, set-up for insect electroantennography (EAG), gaschromatography-mass spectrometry for volatile analysis, various olfactometer bioassay setups
Status of research premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	Projects funded by the German Research Foundation / DFG: - PhD Graduate School "Functional Insect Science" - Priority Programme on Plant Protection - Numerous (> 20) bilateral projects Professor Hilker has supervised 96 Diploma (Master) students, 30 PhD students, 17 post docs. Five of the former students/post docs are now professors/lecturers in the field of Chemical Ecology (three in Germany, one in Argentina, one in New Zealand).
Current involvement in Research and Training Programmes	Hilker's research focuses on the ecology of plant - insect interactions, especially plant – insect egg interactions. Hilker uses several chemical and molecular techniques, electrophysiology and behavioural assays. Hilker is head of the "Biology Diploma Studies Committee" and member of the "Committee for Promotion of Young Researchers" at the Freie Universitaet Berlin. Current projects funded by German Research Foundation= DFG: - PhD Graduate School "Biocommunication" - Collaborative Research Centre (= CRC = SFB 973) "Priming and Memory of Plant Responses to Stress"; head of CRC Current projects funded by FU Berlin: - Dahlem Research School for PhD students - Dahlem Centre of Plant Sciences (Member Executive Committee)
Relevant Publications and/or research/innovation products	• Austel, N., Eilers, E.J, Meiners, T. & Hilker, M. (2016). Elm leaves "warned" by insect egg deposition reduce survival of hatching larvae by a shift in their quantitative leaf metabolite pattern. Plant, Cell & Environment 39: 366-376 • Beyaert, I. & Hilker, M. (2014). Plant odour plumes as mediators of plant-insect interactions. Biological Reviews 89: 68-81. • Geiselhardt, S., Otte, T. & Hilker, M. (2012). Looking for a similar partner: host plants shape mating preferences of herbivorous insects by altering their contact pheromones. Ecology Letters 15: 971-977. • Hilker, M. & Fatouros, N.E. (2015) Plant responses to insect egg deposition. Annual Reviews of Entomology 60: 493-515. • Hilker, M. & Fatouros, N.E. (2016). Resisting the onset of herbivory: plants perceive and respond to insect eggs. Current Opinion in Plant Biology 32: 9-16.

Beneficiary 11	WAGENINGEN UNIVERSITY & RESEARCH
General Description	The Plant Science Group of Wageningen University consists of 18 chair groups and five business units, that share a common research domain: healthy food and living environment. In DISRUPT, Wageningen UR Plant Breeding (PBR) and the Laboratory of Entomology (ENT) are involved. Wageningen UR Plant Breeding is performing research aimed at unravelling the genetics behind those traits that determine how crops can be developed with a high yield and a supreme quality in very different environments with a reduced input in water, fertilizers and crop protection chemicals. Varieties with such traits will form the basis for a sustainable agriculture. PBR furthermore educates students and trains the employees in breeding companies to be able to breed in the most effective ways. The Laboratory of Entomology studies insect-plant interactions at the level of individuals, populations and communities at multiple trophic levels. To understand the mechanisms underlying interactions between individuals, we investigate transcriptional processes and metabolite synthesis for both the insects and their host plants.
Role and Commit-ment c key per-sons (incl.supervisor	Dr.ir. A.B. Bonnema-supervision (scientific 10%) Prof. J.J.A. van Loon - supervision (scientific 10%)
Key Research Facilities, Infrastructure and Equipment	Plant Breeding is unique as the only group within Wageningen actively involved in developing plant material of crops for research. For DISRUPT this includes large collections of *B. rapa* and *B. oleracea*. Facilities at Wageningen UR Plant Breeding are excellent. They consist of molecular labs, biochemical labs, phytopathology lab, transformation and tissue culture propagation labs, climate rooms, greenhouse facilities of Unifarm, and various field sites (clay, sand). We are expanding our bioinformatics infrastructure, including databases and servers. Additional facilities at Entomology are facilities for insect behavioural studies (windtunnels, Y-tube olfactometers) and setups for electrophysiology (EAG and singe sensillum recording), controlled environment rooms for dynamic headspace volatile collection and GC-MS equipment for volatile identification.
Status of re-search premises	Fully independent and owned by the beneficiary
Previous Involvement in Research and Training Programmes	Plant Breeding has good contacts with all major vegetable and potato breeding companies. Within EU-funded programmes Plant Breeding coordinates or participates (often with other Wageningen groups) in several EU projects, including EU-Sol (Solanaceae genomics), ISAFRUIT and FRUITBREEDOMICS (markers for quality traits in apple), PGR Secure (allele mining in crop wild relatives, with CGN), and JATROPT (biobased). Dr. Bonnema has supervised 11 PhD students. Prof. van Loon has supervised 21 PhD students. Entomology was involved in the EU-programmes SUSPROT and EUROVOL in which 10 PhD students were trained.
Current involvement in Research and Training Programmes	The group of Dr Bonnema has a large training network with the Chinese Academy of Agricultural Sciences, in which they conduct joint research, educate PhDs, and give training courses to employees and graduate students. Plant Breeding organizes the 2 yearly Plant Breeding course for staff of Plant Breeding companies at the MSc level. Guusje Bonnema currently supervises 4 PhD students. Entomology permanently hosts EU-Marie Curie fellows. Prof. van Loon is currently supervising 12 PhD-students and is WP-leader in FP7 (AMIGA) and H2020 (COSMOS) R&D consortia.
Relevant Publications and/or research/innov ation products	• Feng Cheng, Yang Cui, Micheal R. Freeling, Theo Borm, Guusje Bonnema*, Jian Wu*, Xiaowu Wang* (2016). Sub-genome parallel selection is associated with morphotype diversification and convergent crop domestication in *Brassica rapa* and *Brassica oleracea* . Nature Genetics doi:10.1038/ng.3634. *: corresponding authors. • Ram Kumar Basnet, Dunia Pino Del Carpio, Dong Xiao, Johan Bucher, Mina Jin, Kerry Boyle, Pierre Fobert, Richard G. F. Visser, Chris Maliepaard, Guusje Bonnema (2015) A systems genetics approach identifies gene regulatory networks associated with fatty acid composition in *Brassica rapa* seed. Plant Physiology (doi: http://dx.doi.org/10.1104/pp.15.00853) • Dunia Pino Del Carpio, Ram Kumar Basnet, Danny Arends, Ke Lin , Ric CH DeVos, Dorota Muth, Jan Kodde, Kim Boutilier, Johan Bucher, Xiaowu Wang, Ritsert Jansen, Guusje Bonnema (2014). Regulatory Network of Secondary Metabolism in Brassica rapa: Insight Into The Glucosinolate Pathway. PLoS ONE 9(9): e107123. doi:10.1371/journal.pone.0107123 • Stam J.M., Kroes A., Li Y., Gols R., Van Loon J.J.A., Poelman E.H. & Dicke M. (2014) Plant interactions with multiple insect herbivores: from community to genes. Annual Review of Plant Biology 65: 689-713. • Pashalidou, F.G., Frago, E., Griese, E., Poelman, E.H., Van Loon, J.J.A, Dicke, M. & Fatouros, N.E. (2015). Early herbivore alert matters: plant-mediated effects of egg deposition on higher trophic levels benefit plant fitness. Ecology Letters, 18, 927-936.

Partner Organizations:

Partner Organisation: Koppert BV	KOPPERT BIOLOGICAL SYSTEMS
General description	Koppert Biological Systems is the international market leader in biological crop protection and natural pollination. Koppert has a result-oriented research and development department, and a world-wide network of contacts with scientific institutes, distributors and users.
Key Persons and Expertise	Dr. Tom Groot, Entomologist, Manager R&D Entomology; Dr. Markus Knapp, Acarologist, Knowledge Manager R&D Entomology
Key Research Facilities, Infrastructure and Equipment	Laboratory and greenhouse facilities to conduct research in biological control; PCR laboratory; facilities to (mass) rear pests and beneficial arthropods.
Previous and Current Involvement in Research and Training Programmes	Koppert is involved in BINGO-ITN. One early stage researcher is hosted at the R&D department. Koppert is host to a large number of students (from high school to PhD level) every year. A regular course is hold to train advisors and farm staff in the principles and application of biocontrol. Koppert has been involved in a large number of collaborative research projects with universities and research institutes in different countries.
Relevant Publications and/or Research / Innovation Product	Many new biocontrol agents in the last 50 years, among them the first predatory mite commercially produced for biological control in greenhouses, *Phytoseiulus persimilis,* and the first predatory mite that can be used in biocontrol of whiteflies, *Amblyseius swirskii* (see: e.g. Calvo FJ, **Knapp M**, van Houten YM, Hoogerbrugge H, Belda JE (2015) *Amblyseius swirskii*: What made this predatory mite such a successful biocontrol agent? Exp Appl Acarol 65: 419-433). Koppert holds several patents on innovations made at the R&D department.

Partner Organisation: Yellow Research	Yellow Research
General Description	YR is a Dutch consultancy & training company geared to advising universities with regard to the third money flow and how to transfer knowledge from academia to industry. An important part of the work we do focusses on research grants strategies. This work brings us in contact with top universities across Europe. Besides preparing researchers to successfully write high-risk/high-gain projects, we are also involved in the discussions with representatives of university management in the development of strategies to focus research staff on excellent research as well as strategies with regard to tenure tracks. Yellow Research is owned by: Lotte Jaspers, Jet van Dijk, Mette Skraastad and Aya van den Kroonenberg.
Supervisors and Expertise	As a company we focus on developing our expertise and business portfolio. In this capacity we work from time to time with secondees. Mette Skraastad, co-owner and partner in Yellow Research has a track record as scientific supervisor when working at Leiden University. Lotte Jaspers has supervision expertise overseeing 3 PhD working as intellectual property scouts at the University of Amsterdam. Aya van den Kroonenberg has experience with supervision of 3 MSc students and 2 PhD students during her Post doctoral stay at Harvard University. Moreover, she has extensive managerial experience leading a team of more than 10 EU specialists during her employment at PNO consultant.
Key Research Facilities and Infrastructure	Yellow Research has its own training and office facilities in Amsterdam, with infrastructure suitable for training and desk-top research.
Previous Involvement in Research and Training Programmes	We support institutes with regard to their strategies as well as individual researchers in obtaining individual and collaborative grants, with focus on FP6 and FP7 programmes. In addition, we provide legal advice with regard to intellectual property right & ethical issues . We have been involved in this respect in over 150 FP7 projects.
Current involvement in Research and Training Programmes	MC-ITN Upstream and Cooperation project AP@home. Further we are subcontractor with regard to several MC ITN projects for training of PhD students
Publications– relevant to the training we provide	- FP7 Consortium Agreement Models, Lotte Jaspers, IPR Helpdesk No 32 March April 2007 - FP7 Decision making in FP6 consortia, Richard Tomlin, Lotte Jaspers, IPR Helpdesk No 26 March-April 2006 - Yellow Research Training Manuals: Writing Individual Grants, From PhD to ERC, Understanding Horizon 2020 etc

Partner Organisation: VITAE/CRAC	
General description	The Careers Research & Advisory Centre (CRAC) is a limited company, established in 1964 and registered as a charity, which owns and manages Vitae. CRAC provides research, expertise and innovation to those who support career development of people of all ages. Based in Cambridge, UK, our largest business activity is Vitae, an international programme which aims to improve the personal, professional and career development of researchers. Vitae delivers leading-edge development of doctoral researchers and research staff in higher education institutions and research institutes, internationally.
Key Persons and Expertise	Alison Mitchell, Director of Development, acts as an international consultant and leader of high profile projects for Vitae including Vitae's Researcher Development Framework (RDF), the Every Researchers Counts equality and diversity programme, professional development of early career researchers, research staff and early career academics, including on leadership and international mobility. Before joining CRAC she held a number of roles in universities, including responsibility for postgraduate research and recruitment.
Key Research facili-ties, infra-structure and Equipment	CRAC/Vitae has very extensive resources and expertise, through its own staff and a network of associate trainers who support the delivery of high quality Vitae training internationally. CRAC has led the development of transferable skills and career development training for researchers in the UK since 1968. The CRAC/Vitae team based in Cambridge oversees our UK and international work.
Previous and Current Involvement in Research and Training Programmes	Since 1968, CRAC/Vitae has run 'GRADschools' programmes which are intensive experiential learning programmes for researchers to improve their employability skills and career options. The Effective Researcher programme, is run by over 30 universities in the UK. The Vitae Researcher Development Framework underpins training and career development for world-class researchers, and has been validated with the European Science Foundation in six countries (and has been adopted by 90% of research-intensive institutions in the UK). Leading on a number of research and knowledge-based projects to evidence the impact of professional and career development. Identifying career structures and good practice programmes in supporting international researchers as part of the ImpactE project. Leading work to develop European researcher career development tools funded through the EURAXESS network (PIPERS project). EURAXESS mobility project exploring intercultural relationships in the postgraduate environment and developing training resources. Associate partner in the 'Epitraits' ITN, including delivering project management training and use of the Vitae Researcher Development Framework Planner.
Relevant Publications and/or research/innova tion product	1) The Enterprising Researcher, February 2014 2) 'What do researchers want to do? The career intentions of doctoral researchers', survey report, CRAC, 2012 3) ESF-funded feasibility study calls for a single European Researcher Development Framework, September 2013

6: Ethics Issues

As far as we can foresee,the project does not entail any ethical issues. The animal involvement is strictly limited to the study of behaviour of regular (pest) insects that are not in any way endangered. If necessary and where appropriate, partners will apply for permits to use these insects in lab environments, following local reguations with which all partners have extensive experience.

7: Letters of Commitment

Gembloux Agro-Bio Tech
Université de Liège

Entomologie fonctionnelle et évolutive

Gembloux, December 5th 2017

Letter of Commitment

I have been informed about the **InsecTRAIN** proposal to be submitted in the framework of Marie Curie Initial Training Network (MC-ITN) focusing on the selection of crops having volatile profiles effective in suppressing agricultural pests. Since this topic fits with the strategy of Gembloux Agro-Bio Tech (Liege University) as well as with my own research themes, I accept to supervise one PhD candidate. He/she will have to comply with the PhD education program of the University of Liege. A thesis advisory commitee will be established including members of the MC-ITN consortium and additional faculty members.

Prof. François Verheggen

Université de Liège – Gembloux Agro-Bio Tech – Entomologie fonctionnelle et évolutive
Passage des Déportés, 2 – B-5030 Gembloux
Tél. +32(0)81 62 26 62 – Fax : +32(0)81 62 23 12 – fverheggen@ulg.ac.be

www.gembloux.ulg.ac.be

FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA
Biologisch-Pharmazeutische Fakultät
Dekanat

Universität Jena · Biologisch-Pharmazeutische Fakultät · 07737 Jena

Max Planck Institute for Chemical Ecology
Dr. Markus Knaden
Hans Knoell Str. 8
07745 Jena
Germany

Prof. Dr. Stefan Lorkowski
Prodekan

Bachstraße 18k
07743 Jena

Telefon: 0 36 41 9-490 17
Telefax: 0 36 41 9-490 02
E-Mail: promobio@uni-jena.de

BearbeiterIn: Bianka Amann

Jena, 18.12.2017

Letter of Commitment

The Faculty of Biology and Pharmacy of the Friedrich Schiller University, Jena, has been informed about the Grant Proposal to establish a European Training Network named InsecTRAIN and herewith confirms that, if the selected Early Stage Researcher complies with the demands of the Faculty, we will accepted her/him as a PhD student under the supervision of Prof. Bill S. Hansson. A thesis advisory committee will then be established including further members of our Faculty.

Sincerely,

Prof. Dr. Stefan Lorkowski
Vice Dean of the Faculty of Biology and Pharmacy

Koppert B.V.
Veilingweg 14
P.O. Box 155
2650 AD Berkel en Rodenrijs
the Netherlands
Tel. +31 (0)10 5140444
Fax +31 (0)10 5115203
IBAN NL42 RABO 0307 4020 96
info@koppert.nl
www.koppert.com

KOPPERT BIOLOGICAL SYSTEMS

Berkel en Rodenrijs, 06-12-2017

To whom it may concern,

With this letter I am pleased to confirm that Koppert Biological Systems will participate as a partner organisation in the Marie Curie European Training Network entitled 'InsecTRAIN'.

The proposal focuses on a theme that is new and highly relevant in the fields of Biodiversity, Ecology, and Pest management research, and Dr. Tom Groot and Dr. Markus Knapp are fully committed to supporting the young researchers in this project by providing the training and secondments as described in the proposal.

As a partner organisation we will participate in the Supervisory Board meetings and evaluate the research and training quality of the ETN and that of the individual fellows.

We looking forward to our collaboration and wish you all the best in the proposal evaluation,

With kind regards,

Dr. Tom Groot
Manager R&D Entomology

19 November 2017

To whom it may concern

Letter of commitment

Marie Curie Initial Training Network: INSECTIVE

CRAC manages Vitae, the organization dedicated to realizing the potential of researchers, and is pleased to commit to this application for funding in the following ways:

1. Vitae will provide a 2-day training programme in Project Management in Research to facilitate Fellows' management of their research and successful progression through their doctoral studies to completion.
2. Vitae will also be a member of the Supervisory Board, providing external feedback on the professional development and progression of the Fellows.
3. Vitae will provide a placement opportunity for Fellows.

CRAC through Vitae has long experience of working on researcher career programmes on a European basis, for example as external advisors, professional development support and training providers for: EpiTRAITS Marie Curie project supporting transnational researcher development; British Council EURAXESS mobility projects; POCARIM project, funded by FP7, Mapping careers, mobility and impact in the social sciences; EU funded projects, for example, leading EURAXIND project to provide researchers' resources for trans sectoral movement, Doctors in Enterprise project under the Lifelong Learning funding scheme, which developed training modules for doctoral researchers interested in moving into local enterprises; Exploring intercultural relationships in the postgraduate environment and developing training resources; Conducting a pilot of the Vitae Researcher Development Framework across six countries for European Science Foundation

On behalf of CRAC and Vitae, I confirm our strong interest and commitment to contribute our expertise to the success of the research training program as described in the proposal.

Yours sincerely

Alison Mitchell

Director of Development

1

Yellow Research

LETTER OF COMMITMENT

Amsterdam December 13, 2017

Dear Dr Groot,

Yellow Research is excited about the opportunity to participate in your MSCA-ETN proposal 'InsectTRAIN' because the proposed work has the potential to boost the set-up of a new supra-disciplinary field in which we work on a daily basis not as scientists but as professional consultants.
Yellow Research commits and certifies its services to the project regarding the following tasks:

- Providing key expertise in career development plans for PhDs through courses, seminars, lectures and workshops as described in the application and where necessary participate in the Supervisory Board.
- We are interested in actively participating in the training /mentoring of young fellows with regard to elaborating their research portfolio;
- Beside career development training we are in particular interested to train a young group of scientists in aspects of intellectual property and commercialisation strategies from academia to industry;
- Contributing to the quality of the Training Programme by suggesting additional guest speakers from the non-academic sector and lecturers throughout the duration of the Programme.

Yours sincerely,

Lotte Jaspers,

Director Yellow Research and

Founding Partner of Yellow Research BV

UNIVERSITÉ DE NEUCHÂTEL

Institut de biologie

Rue Emile-Argand 11
CH-2000 Neuchâtel

Puerto Escondido, Mexico, Jan. 8, 2018

Dr. Astrid T. Groot
MacGillavry Fellow
Professor Chemical communication
Inst. for Biodiversity and Ecosystems Dynamics (IBED)
University of Amsterdam
Science Park 904
1098 XH Amsterdam

Ted Turlings
professor
ted.turlings@unine.ch
Tél : +41 32 718 31 58

Dear Astrid,

Thank you for informing me about your highly interesting Marie Curie ETN proposal, *InsecTRAIN*. The topic of Sustainable Pest Management, the approach that you and your partnership have chosen, as well as the unique opportunities you offer for training young researchers in a broad palette of skill and competences all are very relevant to me and I am pleased to accept your invitation to act as member of the External Advisory Board.

Please consider this letter as a commitment to the requested obligations that are connected to this membership. All the best with the preparation and evaluation of the proposal,

With kind regards,

Ted Turlings

Professor in Chemical Ecology

FACULTÉ DES SCIENCES

Institut de biologie

Secrétariat
Rue Emile-Argand 11
CH-2000Neuchâtel
Tél : +41 (0)32 718 30 00
Fax : +41 (0)32 718 30 01
secretariat.biologie@unine.ch

www.unine.ch/biol

Hansabred GmbH & Co. KG, Radeburger Landstr. 12, D-01108 Dresden

Prof. Dr. Astrid T Groot
MacGillavry fellow
Professor evolutionary chemical ecology
Institute for Biodiversity and Ecosystem Dynamics
Science Park 904
1098 XH Amsterdam

Dear Astrid Grot,
Thank you for inviting me to be involved as external advisor to the Marie Curie ETN program **InsecTRAIN.**

I feel that I have valuable expertise on the field of different aspects of *Fragaria* germplasm due the fact that we are hosting the largest wild species collection of this genus maintained in Europe. I assume that our activities in practical cultivar breeding and our current and recent cooperation with national research stations with regard to infochemicals as a part of resistance strategies in plants could be helpful for the activities too.
As a private lecturer at the Humboldt University Berlin I am familiar with mentorship for different kinds of graduation (bachelor, master, PhD).

I am pleased to accept your invitation to act as member of the External Advisory Board and look forward to the realization of the concept.

PD Dr. rer. hort. habil. Klaus Olbricht

Dresden, Germany, 8.01.2018

Hansabred GmbH & Co. KG
Radeburger Landstr. 12
01108 Dresden, Germany
Geschäftsführer: Stefan Kraege

Tel.: +49-351-3275-392
Fax: +49-351-4656-2534
Mobil: +49-174-3300-761
www.hansabred.org

Amtsgericht Dresden HRA 7202
USt.-IdNr.: DE 262609780
Steuer-Nr. 346/5871/1093

Komplementärin:
Hansabred Verwaltungs GmbH
Amtsgericht Dresden HRB 26898
Geschäftsführer: Stefan Kraege

Bankverbindung:
Vereinigte Volksbank eG.
BLZ: 412 626 21
Kto-Nr: 352 805 3200

International Centre of Insect Physiology and Ecology
P. O. Box 30772-00100 Nairobi, Kenya
Tel: +254 20 8632000; Fax: +254 20 8632001
icipe@icipe.org — www.icipe.org

09 January 2018

Dr. Astrid T. Groot
MacGillavry Fellow
Professor of Chemical communication
Inst. for Biodiversity and Ecosystems Dynamics (IBED) University of Amsterdam
Science Park 904
1098 XH Amsterdam

Dear Dr. Groot:

Thank you for informing me about your highly interesting Marie Curie ITN proposal entitled InsecTRAIN.

The topic of Sustainable Pest Management, the approach that you and your partners have chosen, as well as the unique opportunities you offer for training young researchers in a broad palette of skills and competences all are very relevant to me and I am pleased to accept your invitation to act as member of the External Advisory Board.

Please consider this letter as a commitment to the requested obligations that are connected to this membership. All the best with the preparation and evaluation of the proposal,

With kind regards,

Sincerely yours,

Z. R. Khan

Zeyaur R. Khan
Principal Scientist

An FAO Reference Centre

OIE Collaborating Centre for Bee Health in Africa

A Stockholm Convention Regional Centre

END PAGE

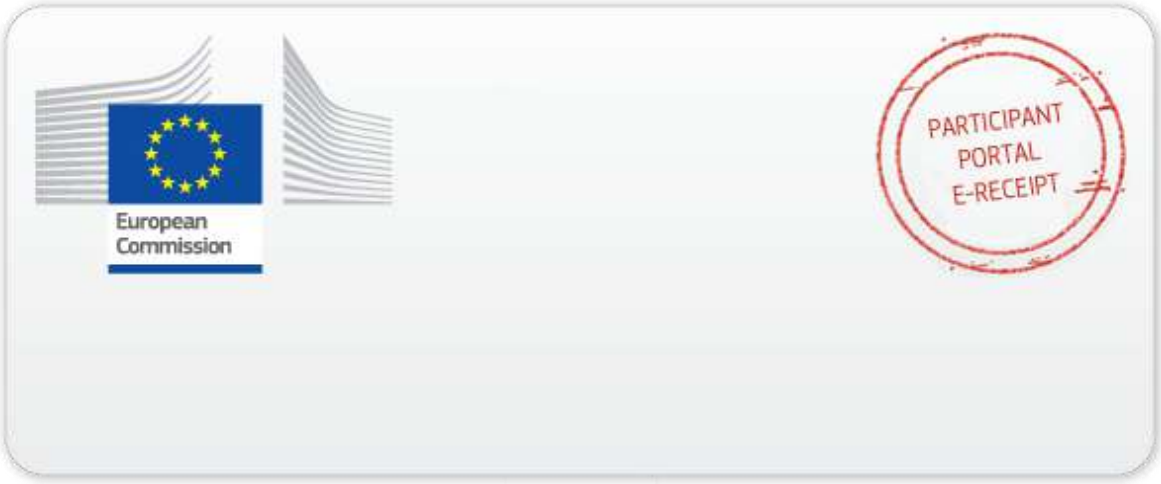
MARIE SKŁODOWSKA-CURIE ACTIONS

Innovative Training Networks (ITN)
Call: H2020-MSCA-ITN-2018

PART B

"InsecTRAIN"

This proposal is to be evaluated as:
ETN



This electronic receipt is a digitally signed version of the document submitted by your organisation. Both the content of the document and a set of metadata have been digitally sealed.

This digital signature mechanism, using a public-private key pair mechanism, uniquely binds this eReceipt to the modules of the Participant Portal of the European Commission, to the transaction for which it was generated and ensures its full integrity. Therefore a complete digitally signed trail of the transaction is available both for your organisation and for the issuer of the eReceipt.

Any attempt to modify the content will lead to a break of the integrity of the electronic signature, which can be verified at any time by clicking on the eReceipt validation symbol.

More info about eReceipts can be found in the FAQ page of the Participant Portal. (http://ec.europa.eu/research/participants/portal/page/faq)