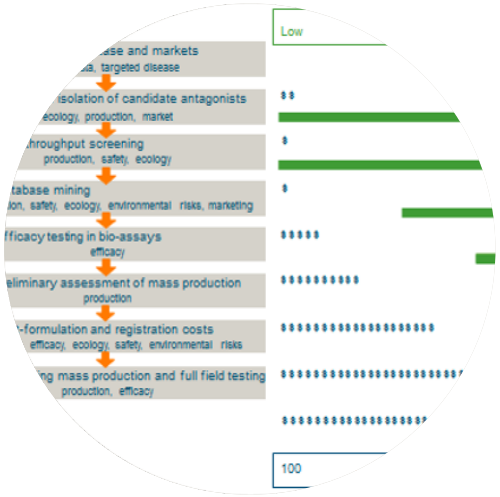
Public-private collaboration in the development of alternative crop protection products: Opportunities and challenges

Nachhaltigkeitstagung Agroscope

23. Januar 2020, Jürgen Köhl



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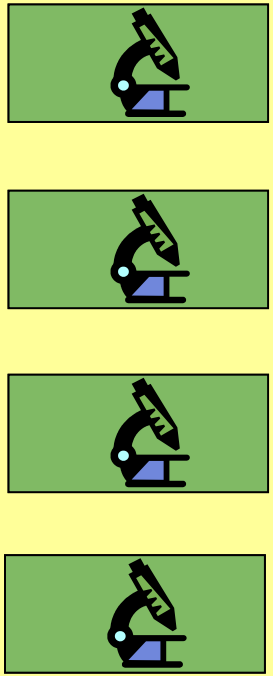
Collaboration of industry and research institutes

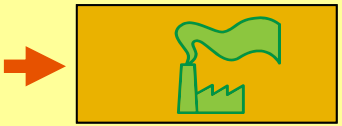


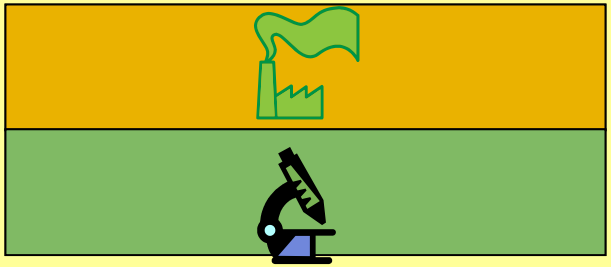
‘BCA shopping’

high public

Investments,

few products





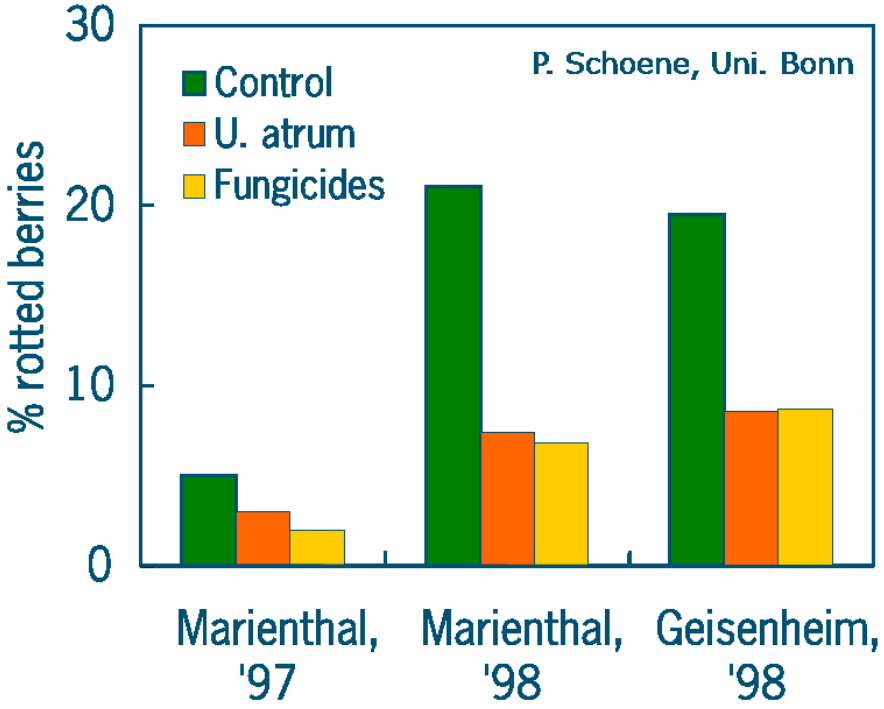
‘Tailor-made BCA’s’

market driven

cost effective

fast

Biocontrol of *Botrytis* with *Ulocladium atrum* 385



Significant results in

- Grapevine
- Strawberry
- Tomato
- Onion
- Carrots
- Cyclamen
- Potted roses
- Hydrangea
- Pelargonium

15 years of science

>30 scientific publications

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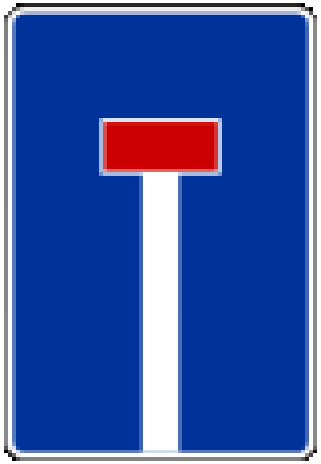
Biocontrol of *Botrytis* with *Ulocladium atrum* 385

Spore production

Preparation of spore suspension



Industrial scaling up of production:

"At a particular effective rate of spores per ha the large spore size does not allow an economically viable production of the antagonist"

Peter Lüth, managing director of the former company Prophyta

Development of BCAs

Isolation of candidate antagonists

Efficacy testing in bio-assays

Field testing

Contacting industries

Development of BCAs

- Market size ?
- Advantage above other products ?
- Is any knowledge patented ?
- Fungicide compatibility ?
- Production costs per hectare ?
- Toxicological risks ?
- Does it work ?
- Shelf life ?
- Mode of action ?
- Genetic stability ?
- …. ?

➔ Consider many relevant questions

➔ Use expertise of different disciplines

➔ Use stepwise approach

➔ Consider commercial questions early

➔ Give the cheap answers first

➔ Avoid expensive field testing with wrong candidates

Köhl, J. , Postma, J., Nicot, P., Ruocco, M., Blum, B. , 2011
Biological Control 57, 1-12

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Development of BCAs

Step 1. Targeted crop, disease and markets

Step 2. Origin and isolation of candidates

Step 3. High-throughput screening

Step 4. Database mining

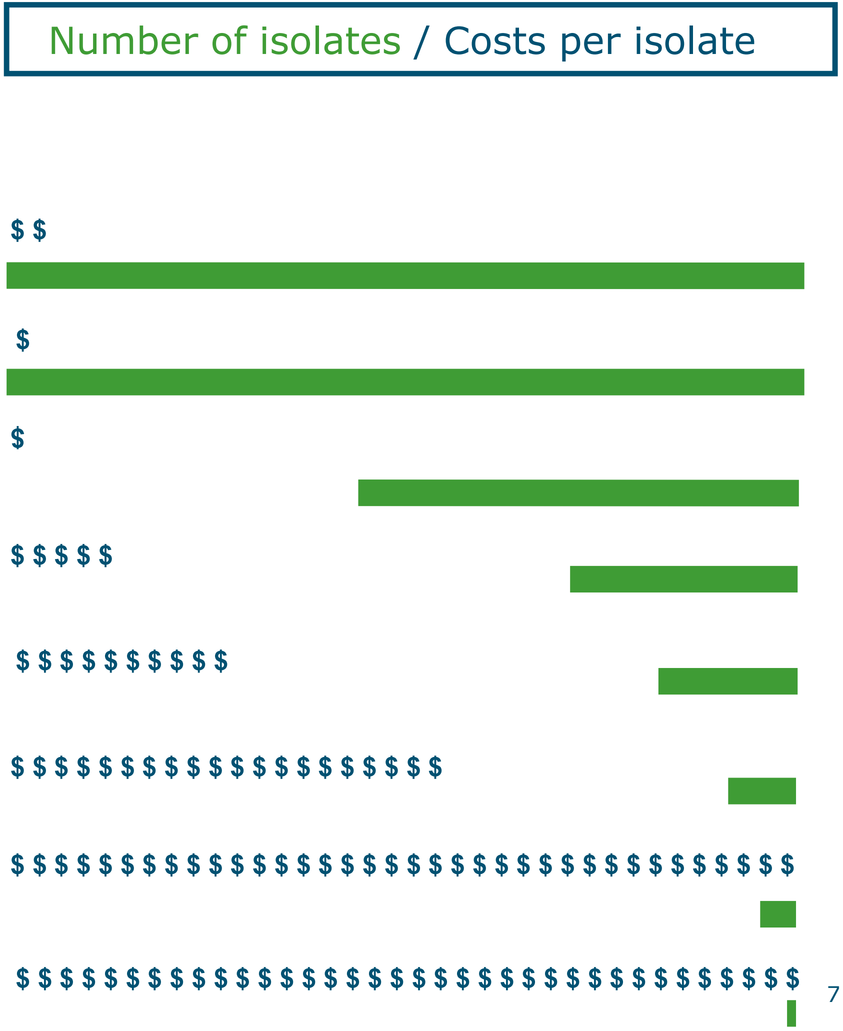
Step 5. Efficacy testing in bioassays

Step 6. Preliminary mass production

Step 7. Formulation and registration costs

Step 8. Mass production and field trials

Step 9. Integration in cropping systems



Apple scab – Antagonist selection

Step 1. Targeted crop, disease and markets

Step 2. Origin and isolation of candidates

Step 3. High-throughput screening

Step 4. Database mining

Step 5. Efficacy testing in bioassays

Step 6. Preliminary mass production

Step 7. Formulation and registration costs

Step 8. Mass production and field trials

Step 9. Integration in cropping systems

Bavendorf, Golden Delicious, summer season 2013

Treatment	Number of applications	Scab incidence (efficacy)	
		on leaves	on fruits
Untreated control	-	17.6 a	70.8 a
Dodine, after infection	10	1.1 b (94)	0.6 b (99)
H39, after infection, $2x10^6$ ml^{-1}	10	0.7 b (96)	3.5 b (95)
H39, after infection, $6x10^6$ ml^{-1}	10	0.3 b (98)	4.6 b (94)

- *Cladosporium cladosporioides* H39 highly effective during summer season if sprayed after infection

Bavendorf, Golden Delicious, primary season 2013

untreated control

H39

Cladosporium cladosporioides H39

Eur J Plant Pathol (2009) 123:401–414
DOI 10.1007/s10658-008-9377-z

Selection and orchard testing of antagonists suppressing conidial production by the apple scab pathogen *Venturia inaequalis*

Jürgen J. Köhl · Wilma W. M. L. Molhoek · Belia B. H. Groenenboom-de Haas · Helen H. M. Goossen-van de Geijn

Product development by industry

- ✓ Production
- ✓ Formulation
- ➔ Authorization process as plant protection product

Toward an Integrated Use of Biological Control by *Cladosporium cladosporioides* H39 in Apple Scab (*Venturia inaequalis*) Management

Jürgen Köhl, Wageningen UR–Plant Research International, 6700 AB Wageningen, The Netherlands; **Christian Sch** Kompetenzzentrum Obstbau-Bodensee, 88213 Ravensburg-Bavendorf, Germany; **Imre J. Holb,** University of Debrecen, Centre Sciences and Engineering, Faculty of Agronomy, H-4015 Debrecen, Hungary, and Plant Protection Institute, Hungarian Acad 1525 Budapest, Hungary; **Sylwester Masny,** Research Institute of Horticulture, Konstytucji 3 Maja 1 **Wilma Molhoek,** Wageningen UR–Plant Research International, The Netherlands.

Abstract

Köhl, J., Scheer, C., Holb, I. J., Masny, S., and Molhoek, W. M. L. 2015. Toward an integrated use of biologi *ioides* H39 in apple scab (*Venturia inaequalis*) management. Plant Dis. 99:535-543.

Aussicht auf Biologische Bekämpfung von Apfelschorf

In der Natur finden sich vielfältige Gegenspieler zu unseren Pflanzenschädlingen. Für den biologischen Pflanzenschutz gilt es, geeignete Gegenspieler aufzuspüren und sie streng nach ihren Eigenschaften zu

ellen Produktion bereits einschätzen. E wichtiges Kriterium für die Zulassu biologischer Pflanzenschutzmittel

(12) **United States Patent**
Kohl

(10) **Patent No.: US 8,404,254 B2**
(45) **Date of Patent: Mar. 26, 2013**

(54) **MICRO-ORGANISMS CONTROLLING PLANT PATHOGENS**

(75) Inventor: **Jurgen Anton Kohl**, Kleve (DE)

(73) Assignee: **Stichting Dienst Landbouwkundig Onderzoek**, Wageningen (NL)

OTHER PUBLICATIONS

Luongo et al, "Potential of Fungal antagonists for biocontrol of *Fusarium* spp. in wheat and maize through competition in crop debris" Biocontrol Science and Technology, vol. 15, No. 3, May 2005, pp. 229-242.
Tatagiba et al, "Biological control of *Botrytis cinerea* in residues and flowers of rose (rose hybrida)", Phytoparasitica, vol. 26, No. 1, 1998,

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BIOCOMES project

- 13 Industrial partners
- 14 Research institutes and universities
- Development of 11 new BCAs and 2 new production technologies
- December 2013 – November 2017
- www.biocomes.eu
- Wageningen UR: Project-
- coordination & communication

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BIOCOMES: Project structure

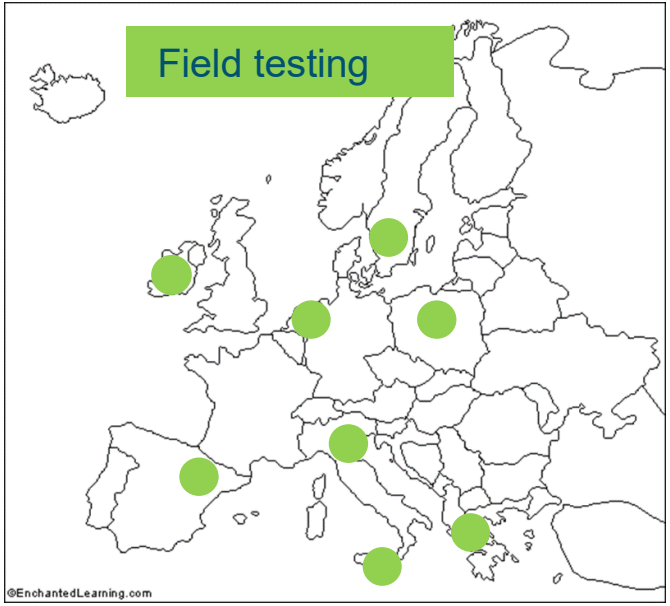
Teams per biocontrol product

1 Biocontrol industry partner

+ Partners with specific expertises needed

Common infrastructure

- Field testing
- Molecular identification
- Registration issues
- Economic evaluation
- Environmental sustainability
- Communication



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BIOCOMES
New biological control products for sustainable farming and forestry

BIOCOMES: some major results

- Tomato leaf miner – *Tuta absoluta*
  - ⇨ entomopathogenic virus
  - ⇨ registration of 'Tutavir'

- Genetic improvement of entomopathogenic nematodes
  - ⇨ Application

- Powdery mildew of wheat – *Blumeria graminis* f.sp. *tritici*
  - ⇨ Selection of new antagonists
  - ⇨ Spore production in follow-up project

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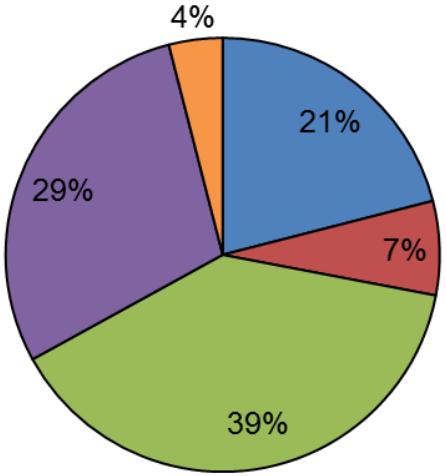
Bernard Blum Award ABIM 2019

Biocontrol of powdery mildew in wheat

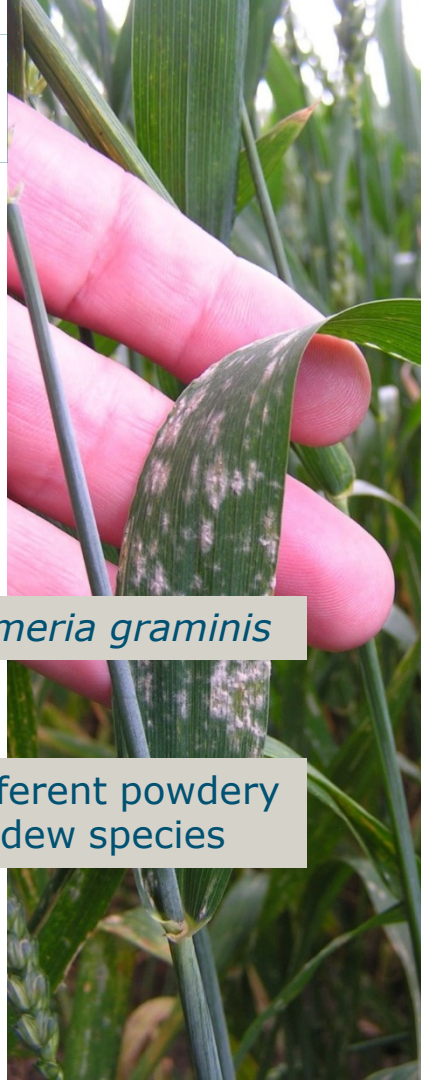
>1200 fungal isolates from Germany, Sweden and The Netherlands



- wheat
- other cereals
- grasses
- herbal plants
- trees

Blumeria graminis

Different powdery mildew species



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BIOCOMES
New biological control products for sustainable farming and forestry

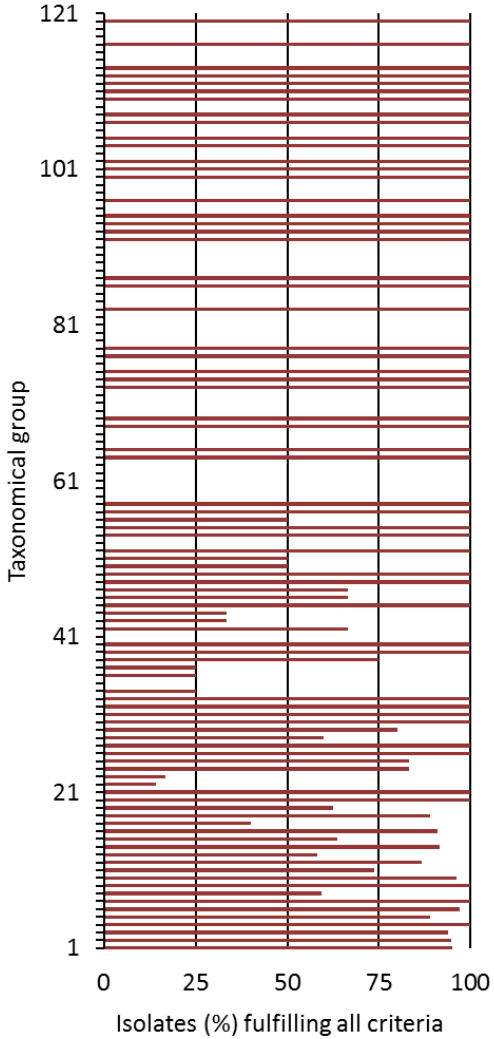
Pre-screening

- Safety: No growth at 36°C
- Cold tolerance: Germination & growth at 5°C
- Survival of UV-B
- Drought tolerance: Germination & growth at -7MPa

✓86 out of 121 taxonomical groups

✓84.9% of isolates (732 / 862)

✓Stronger selection was used for most abundant taxonomical groups



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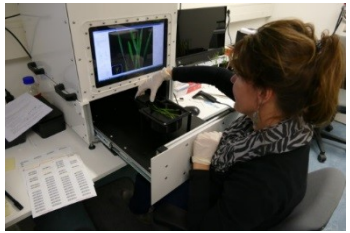
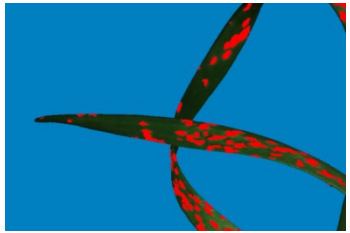
Efficacy Screening - Bioassays on Wheat

- Wheat cv. Julius grown in pots
- Spray inoculation with spores of candidate antagonists
- Dry inoculation with conidia of *Blumeria graminis* f.sp. *triciti*
- Incubation at 15°and high humidity
- Assessment of leaf coverage with powdery mildew pustules and numbers of produced Bgt conidia
- Best 10 antagonists out of 185 isolates selected

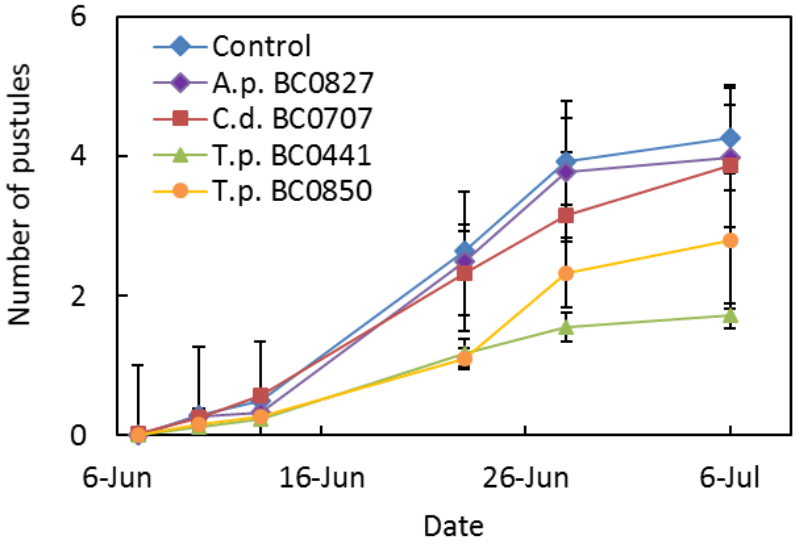




Powdery mildew- Field

Tilletiopsis pallescens reduced

- Number of pustules
- Leaf coverage with pustules
- Speed of development of epidemic



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BIOCOMES
New biological control products for sustainable farming and forestry

Agro Plantarum

Biological control of powdery mildew

- Powdery mildew pustules are colonized by various fungi
- 4 antagonists out of >1200 tested isolates effective in field trials
- Selection of promising antagonists in only 3 years
- Next steps:
  - Mode of action
  - Production
  - Formulation
  - Field testing and integration into cropping systems

BAYER

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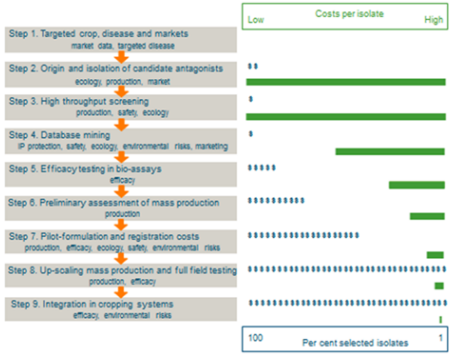
Agro
Plantarum
e-nema®

BIOCOMES
New biological control products
for sustainable farming and forestry

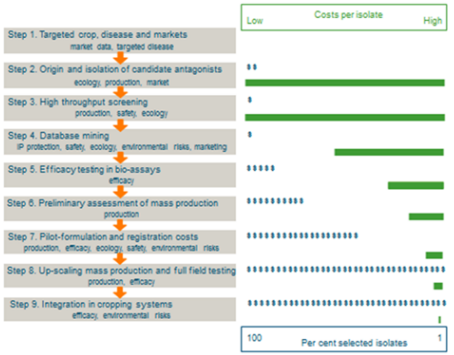
Summary:
Development of new fungal biocontrol products

- Efficacy against pathogens is one selection criterion besides many other criteria
- Expertise in plant pathology must be combined with expertise's from biotechnology to marketing
- Opportunities for pubic-private collaborations
- ... and what are the challenges?



Public-private collaboration in the development of alternative crop protection products: Challenges

- Intellectual property protection versus publication: CO versus PU
- Competing companies in one consortium: Content, structure and rules
- Decision making process in companies

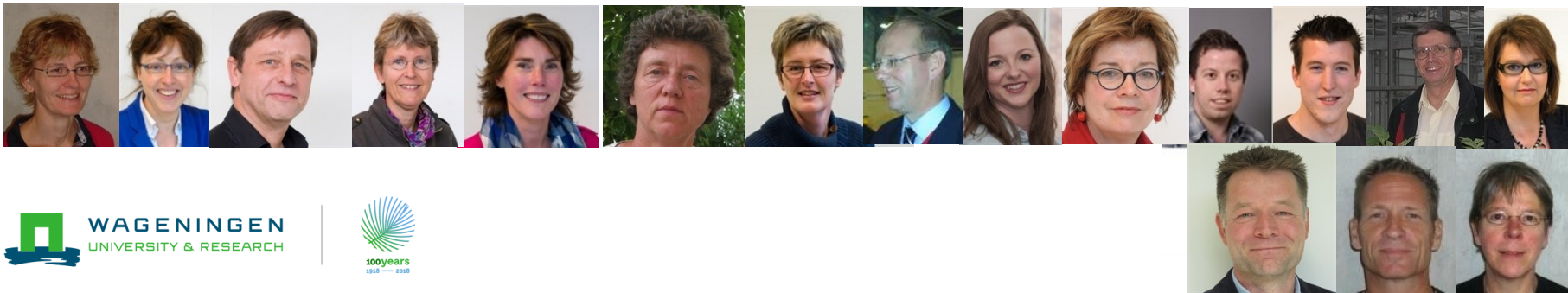


! **The Opportunities are worth to manage the challenges**

Thank you for your attention

The research has been funded by

- European Commission: REPCO, ENDURE, PURE, CO-FREE and BIOCOMES
- Dutch Ministry of Agriculture, Nature and Food Quality



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