Yes, we can!

Integrated control of *Pythium* root rot in flower bulb production

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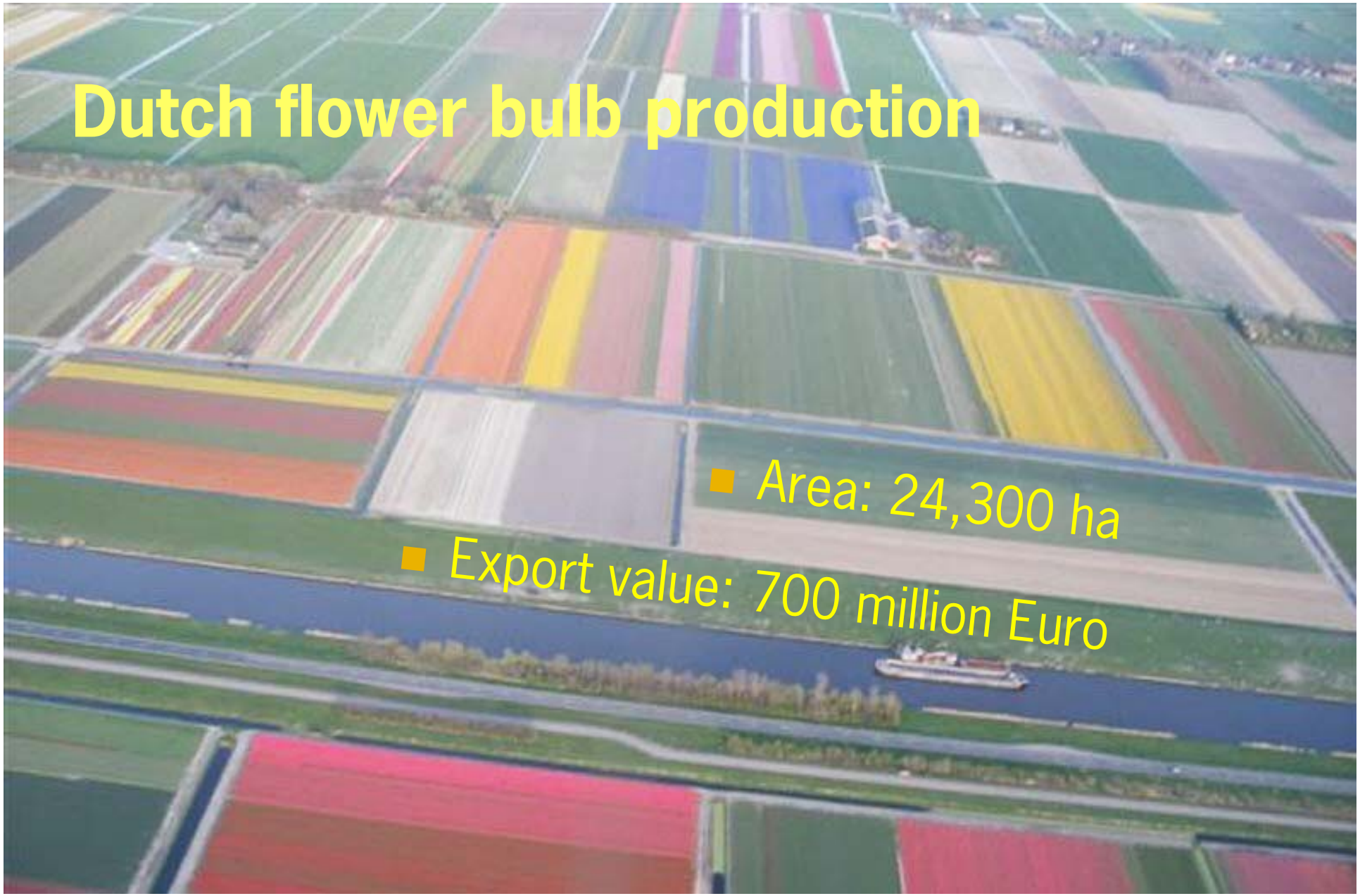
For quality of life



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Important cultivation area behind the Dutch dunes

- Dune area has been levelled, resulting in arable land:
- Sandy soil
- Easy tillage
- Well drained
- Groundwater level: - 50 cm
- Soil organic matter 1%
- pH 7, calcium rich
- Exclusively bulb crops rotation 1:4

Pythium root rot is a huge problem


Hyacinth


Iris


Crocus

Several Pythium species:

P. intermedium

P. irregulare

P. ultimum

and others

Reduction of bulb yield

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Conventional chemical control of *Pythium*

- Fumigants:
  - Dichloropropene - not allowed
  - Metamsodium - allowed 1:5, not effective
- One fungicide available, with insufficient effect

(Metalaxyl)

Biological control of Pythium

Research focus:

- Soil organic matter and general disease suppression
- Green manure crops
- Antagonist
- Combinations

IPM principles:

- Measures for prevention and suppression
- Non-chemical methods to be preferred.

General disease suppression

Untreated soil with natural soil microflora

Sterilized soil without soil microflora

Competition for food and space by the soil microflora can suppress Pythium.

Destruction of the soil microflora eliminates disease suppression.

Organic matter and disease suppression

- Addition of organic matter may increase microbial biomass and biodiversity:
  - Stable organic matter **>** variation in physical and chemical soil properties
  - Decomposable organic matter **>** food for microflora

  and by doing so:
- Increase in SOM may stimulate the soil microflora and improve general disease suppression.

Organic matter and disease suppression

Creating three levels of soil organic matter (SOM) with 95% peat + 5% cattle manure

- 0.7 % SOM
- 1.2 % SOM
- 2.4 % SOM

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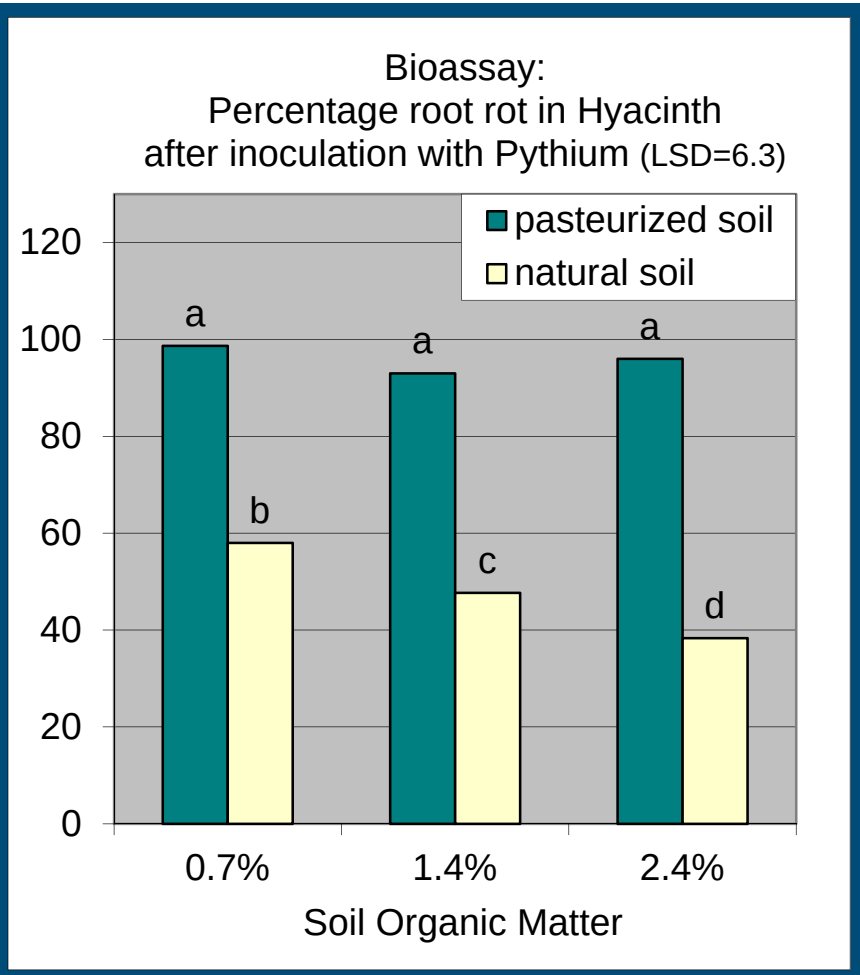
TopSoil+ (2005-2009)

Soil organic matter and disease suppression



- Less disease at higher SOM

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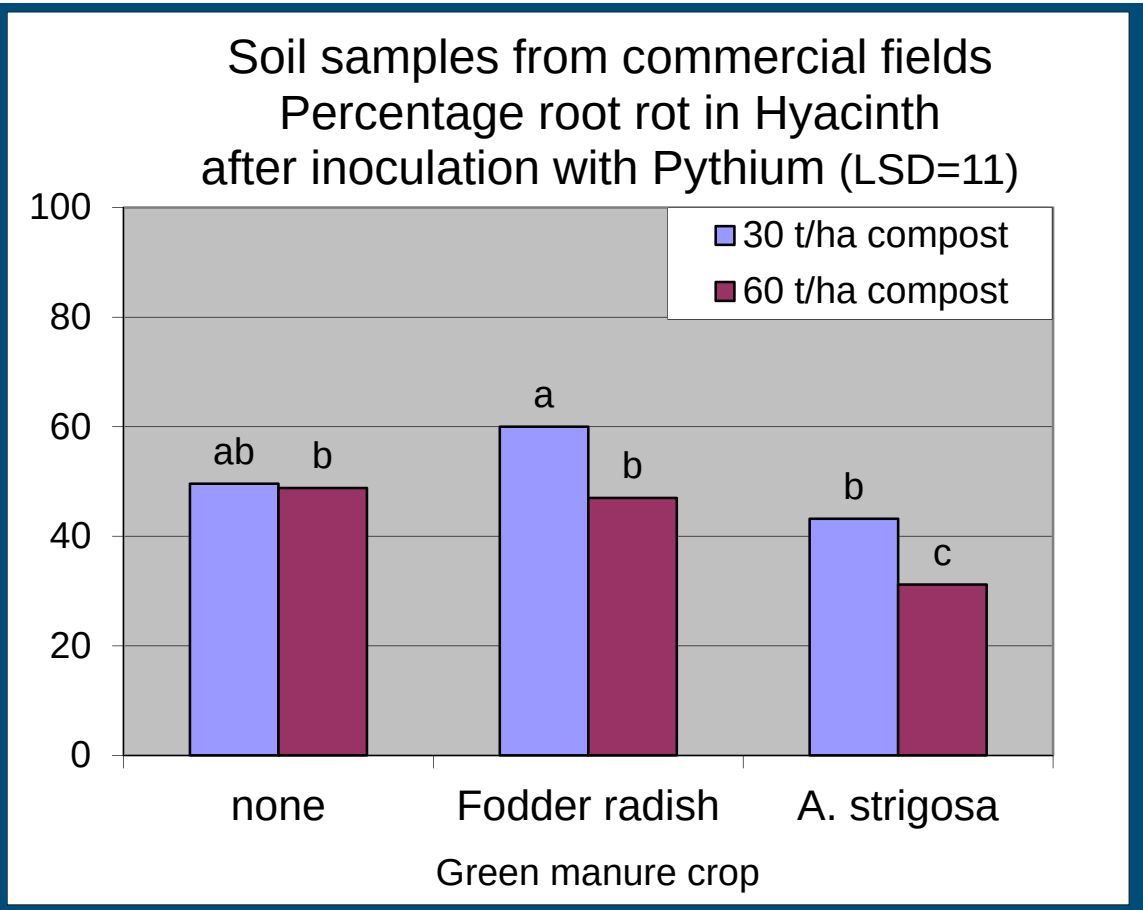
TopSoil+ (2005-2009)

Soil organic matter and disease suppression



- Additional compost + *A. strigosa* enhanced disease suppression.

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* Luxurial, Innoseeds

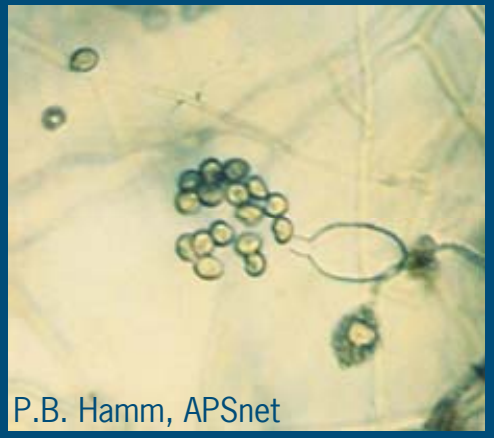
Biological control of Pythium: antagonist

Pseudomonas fluorescens SS101*:

- Originating from Dutch agricultural soil
- Colonizes the root surface
- SS101 genome has been sequenced

Modes of action:

- Biosurfactants destroy Pythium zoöspores
- Competition on the root surface
- Stimulation of plant growth



P.B. Hamm, APSnet

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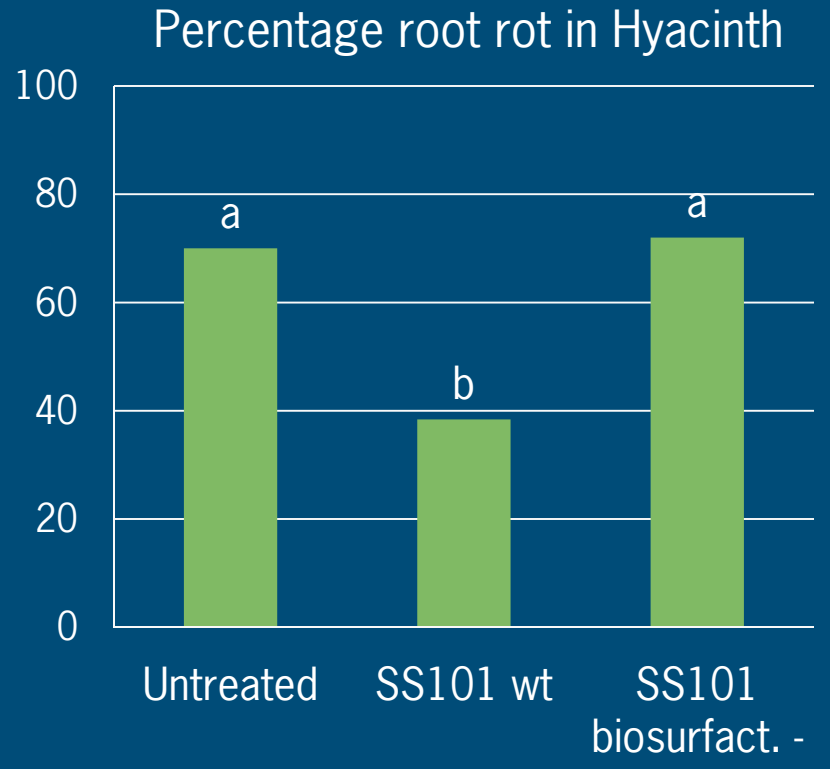
*Genes, regulation etc investigated by Jos Raaijmakers and co workers, Phytopathology Wageningen University

P. fluorescens SS101

Bioassay: Soil infested with Pythium

Untreated control With SS101



Minimal inoculum dosage of $5_{*}10^{7}$ cfu/ml SS101 is necessary for significant disease reduction.

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P. fluorescens SS101

Bioassay: Non-infested control treatments

Without SS101 With SS101

SS101 promotes root growth in Hyacinth and Arabidopsis*.

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*Jos Raaijmakers and co workers, Phytopathology Wageningen University

Fieldexperiment in infested soil 2008–2012

Implementation of measures within the crop rotation:

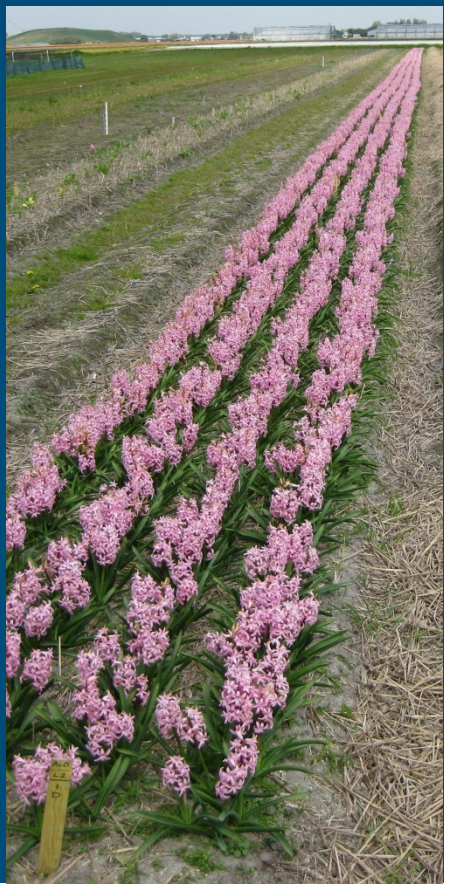
- Pseudomonas SS101
- Ridomil Gold
- Combination of both

Applied at planting in successive years

2009	2010	2010-2011	2011-2012
Hosta	Dahlia	Tulip	Hyacinth

Results after four years in Hyacinth (2012):

- Root colonization
- Bulb yield



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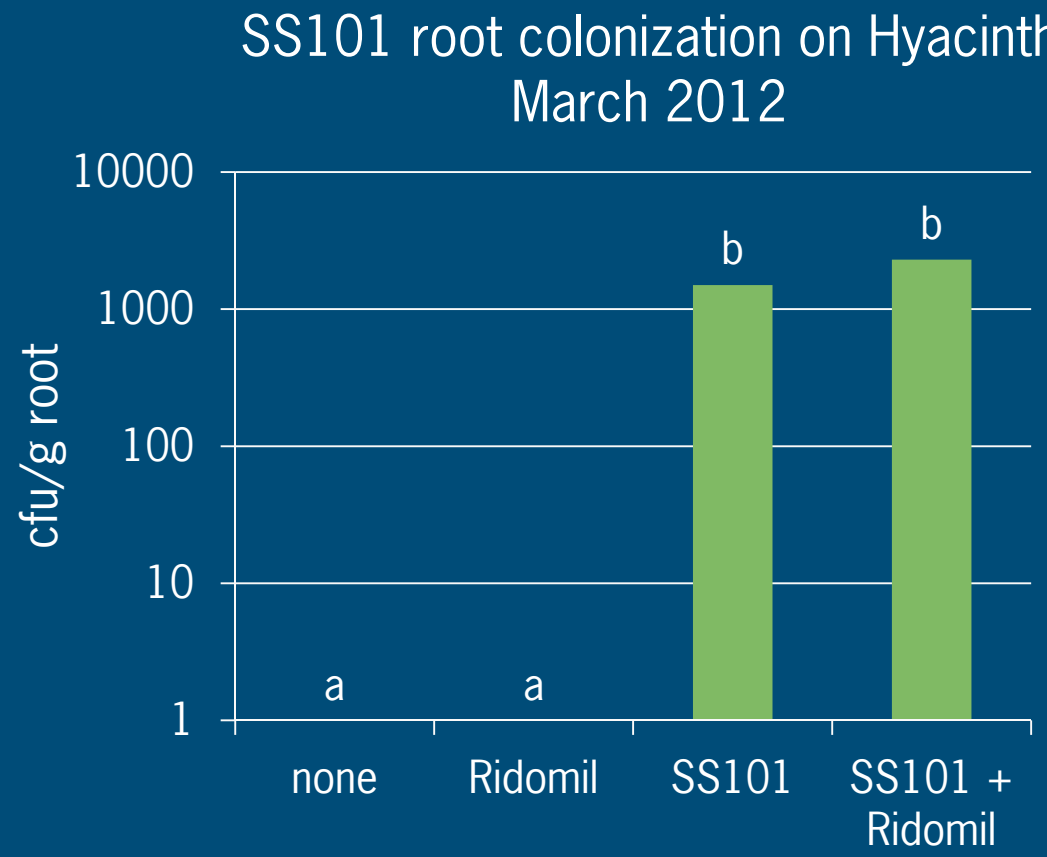
Fieldexperiment in infested soil 2008–2012

$5_{*}10^{7}$ cfu/ml SS101 (rifampicin resistant) was poured over the bulbs at planting.



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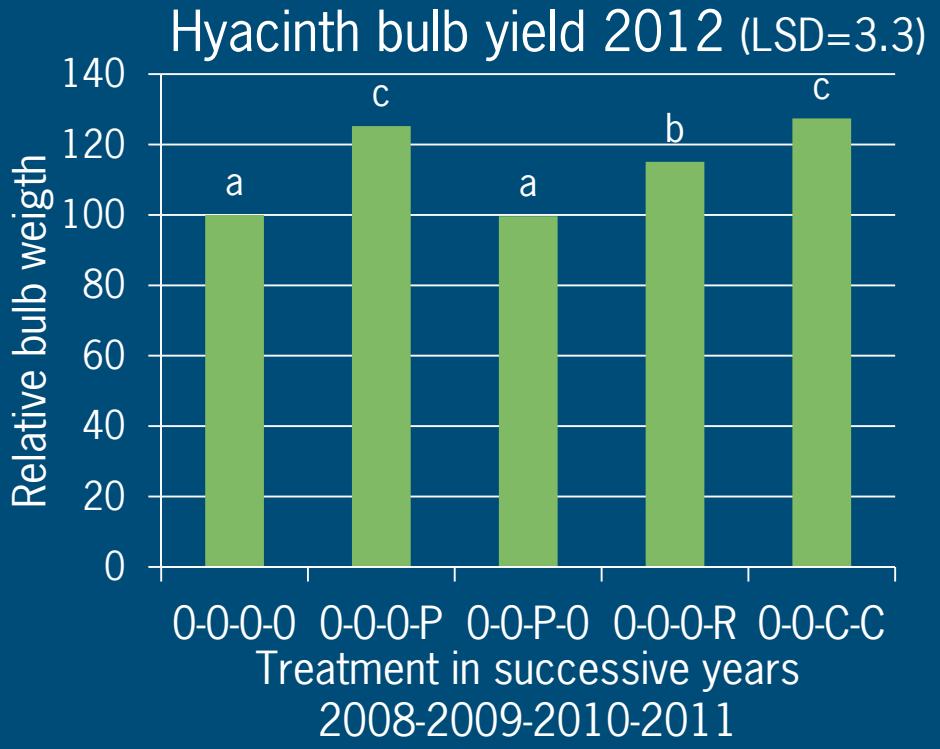
Fieldexperiment in infested soil 2008–2012

Hyacinth on Pythium infested soil (May)



0 No treatment
P Pseudomonas SS101
R Ridomil Gold
C Combination SS101 + Ridomil Gold

- SS101 increased bulb yield, but did not fully control Pythium.

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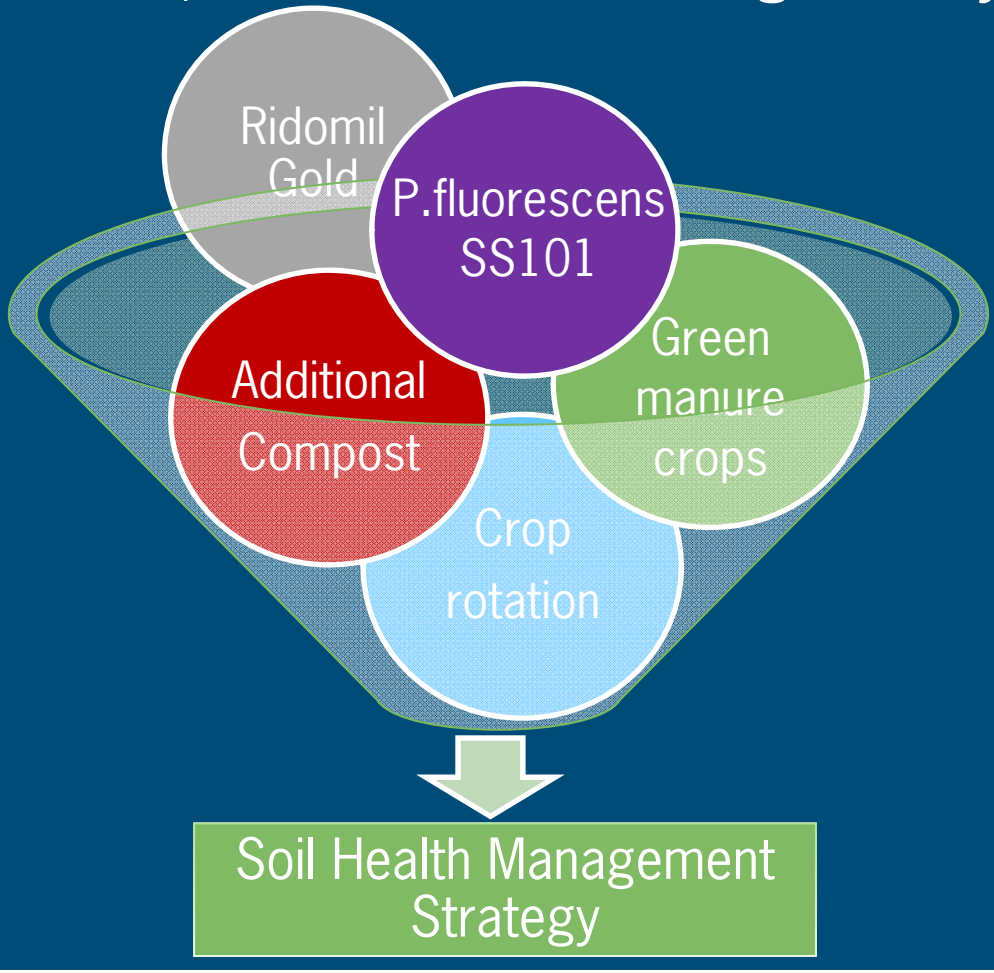
Practical application

- Commercial production SS101 is under investigation.
- Individual measures do not fully control Pythium root rot.
  A combination of measures is needed.

Therefore, an ***integrated control strategy*** will be the answer, using various measures with different modes of action!

Integrated control strategy against Pythium

For the growers, this will need a change in way of thinking.



Thank you for your attention.

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