"SaatMaisPlus – developing non-chemical seed treatments for maize”

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With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

Projektträger Bundesanstalt für Landwirtschaft und Ernährung

The people behind the project and their tasks



- Isolation and Screening
- Greenhouse tests
- Supply of infected seed lots
- Field trials
- Assessment of root colonization

Julius Kühn-Institut
Federal Research Centre for Cultivated Plants

C A U
Christian-Albrechts-Universität zu Kiel


- Greenhouse tests
- Field tests
- Quantification of fusaria in plants and in soil

DSV

- Supply of seed lots
- Application of seed treatments
- Field trials


EVONTA
EVONTA-Service GmbH

- Adaptation, optimisation and application of electron seed treatment

ABiTEP GmbH



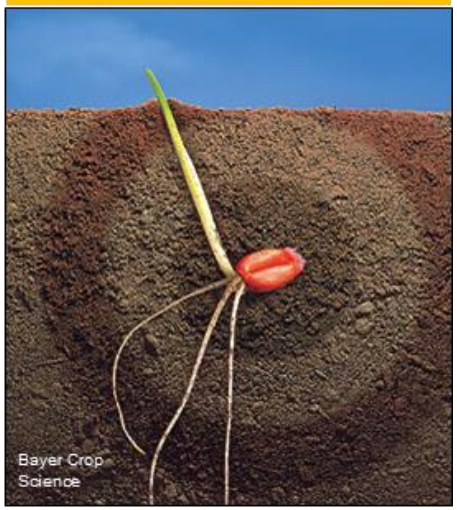
- Supply, selection, production and formulation of spore forming microorganisms
- Physiological characterization
- Assessment of growth promoting properties

Why seed treatment ?

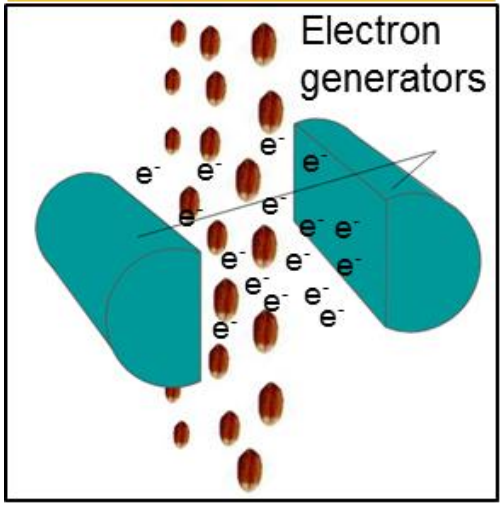
- **Protection against pathogens in or on seed (seed-borne pathogens)**
- **Protection against pathogens from the soil (soil-borne pathogens)**
- **Application of growth-promoting agents**
- **Application of agents affecting nutrient uptake (e.g. Phosphorus)**
- **Protection against insects, bird repellents, ….**
- **…..**

Seed treatment methods and their modes of action

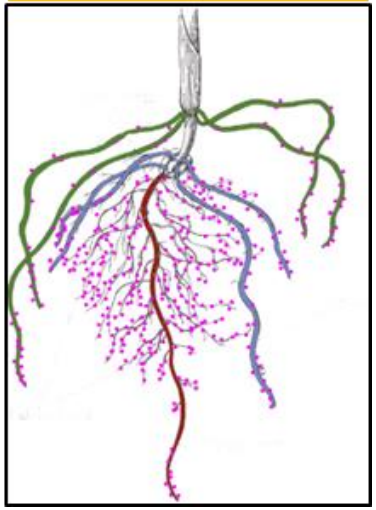
chemical seed treatment



electron seed treatment



root-colonizing microorganisms



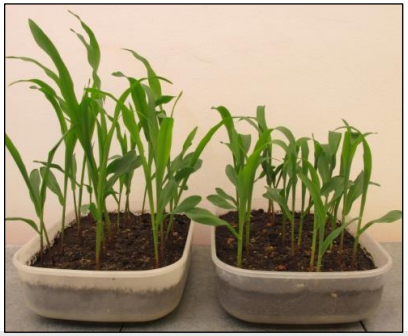
Chemical seed treatments for maize

Product	Active ingredients
FLOWSAN FS and others	**Thiram (TMTD)** **Group: Dithiocarbamates**
MAXIM XL	**Fludioxonil *+ Metalaxyl M***
MAXIM Quattro (not approved)	**Fludioxonil + Metalaxyl M + Thiabendazole + Azoxystrobin**

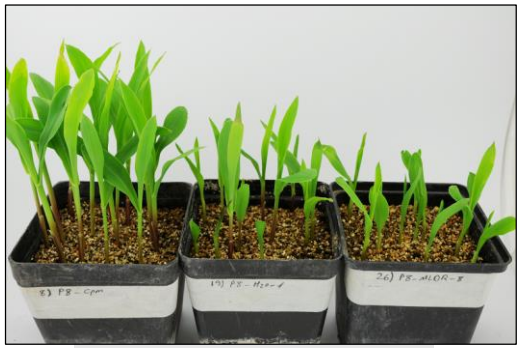
*** candidates for substitution**

Considerations affecting the set up of the screening (Pathogens)

- **What are the most important seed- and soil-borne pathogens of maize ?**



***Fusarium* sp.**
Seed- and soil-borne



***Pythium* sp.**
Soil-borne

***Rhizoctonia* sp.**
Soil-borne

- **How important are the seed-borne versus the soil-borne pathogens in maize ?**
- **Is one of the two easier to control by seed treatment than the other ?**

Considerations affecting the set up of the screening (Antagonists)

- **Are microorganisms from maize roots more effective than microorganisms from other plants ?**
- **Is there a specific interaction between electron seed treatment and microorganism ?**
- **Should the emphasis of the screening be on growth promotion or fungicidal activity ?**

Approach

Isolation of microorganisms from maize roots

↓

Pot tests with *Fusarium culmorum* - infected substrate using healthy, electron treated seeds

↓

Selection of active strains

↓

Identification

a. Fatty acid analysis (MIS)
b. Molecular biology
c. Spektroscopy (MALDI-TOF)

Pot tests for determining activity against

a. Fusarium (soil-borne) (+seed-borne)
b. Pythium ultimum
c. Rhizoctonia solani

Charakterisation of activity *in vitro*

(„Dual cultures“)

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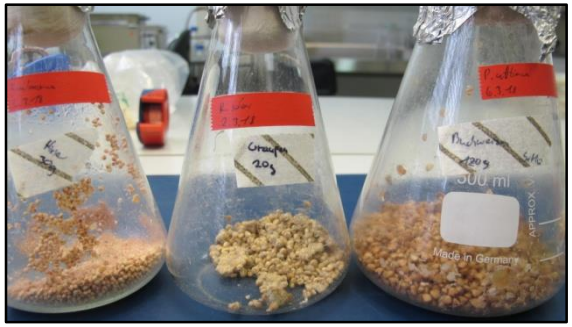
Development of formulations

↓

Tests in greenhouse and field; combination with electron treatment

Determination of activity against soil-borne *Fusarium culmorum*



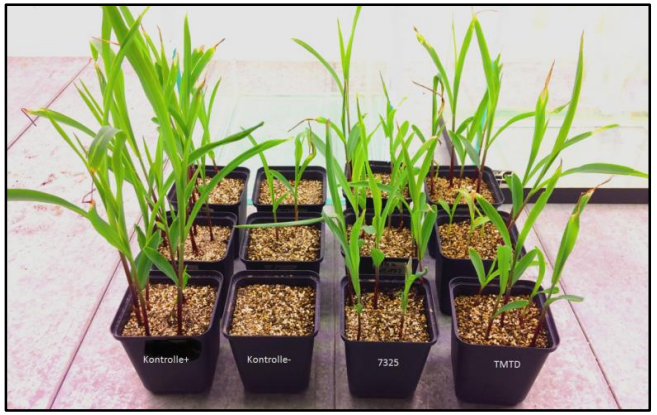
Cultivation of *F. culmorum* on millet seeds

Growth of bacteria in liquid cultures

Placement of seeds in bacterial suspensions

Mixing of inoculum into potting substrate

Sowing of treated seeds



After 14 days determination of plant number, fresh and dry weight per pot

Microorganism studied in pot tests for activity against *F. culmorum*:

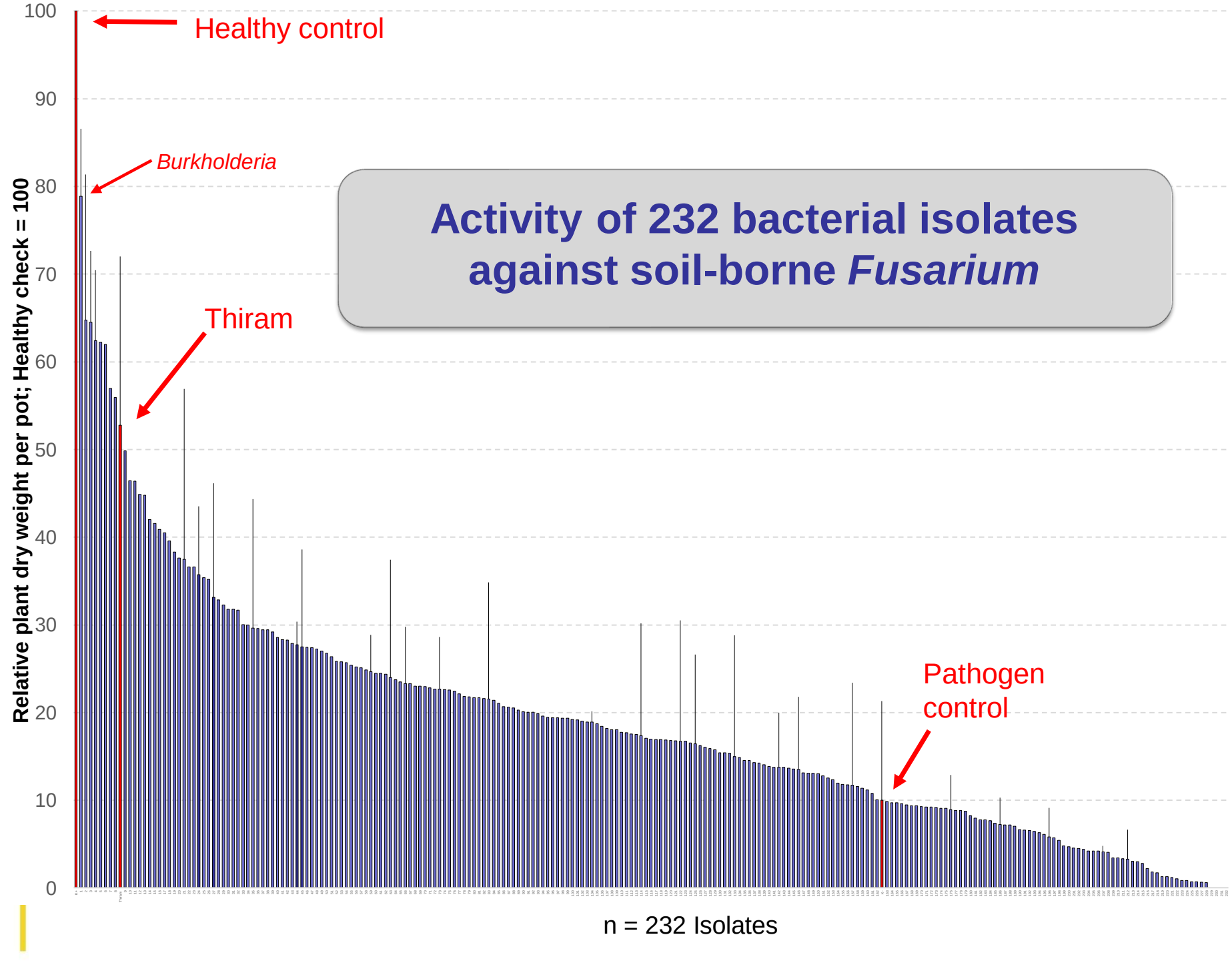
Bacteria: 232, including

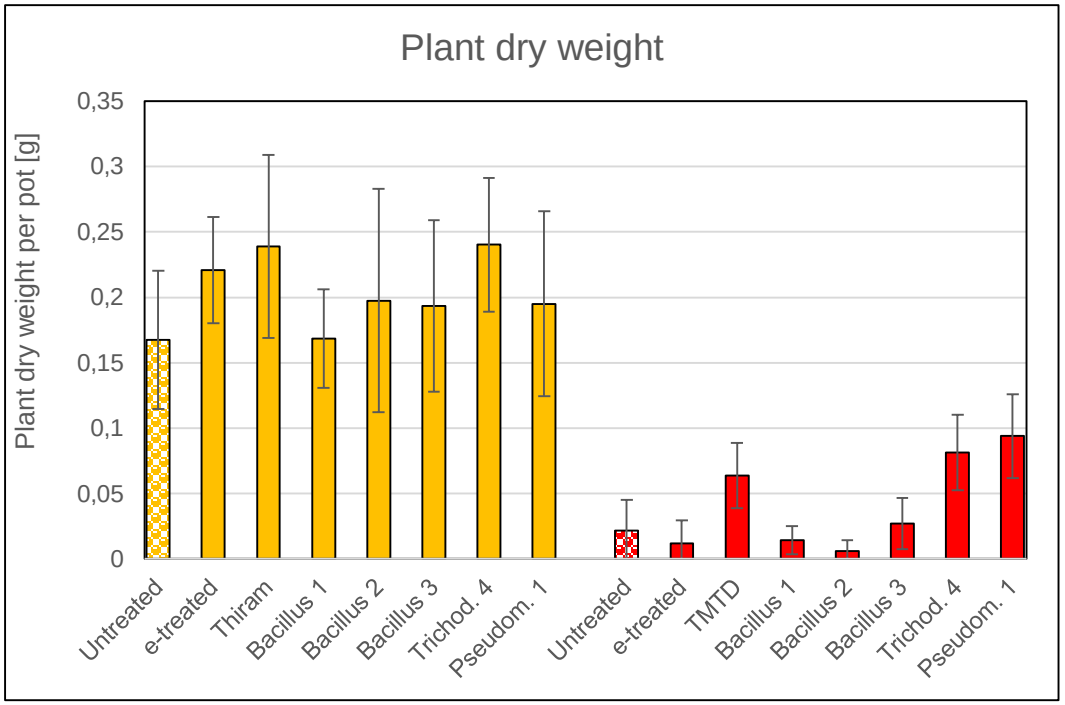
192 fresh isolated from maize roots
40 isolates from the institute collection, including some commercial strains

Mostly spore formers (genera *Bacillus, Paenibacillus* etc.),
some gram-negative isolates, few actinomycetes.

Fungi: ca. 20 isolates, mostly *Trichoderma*

Chemical standards:
TMTD (Thiram), Maxim XL


Activity of 232 bacterial isolates against soil-borne *Fusarium*
Healthy control
Burkholderia
Thiram
Pathogen control
Relative plant dry weight per pot; Healthy check = 100
100
90
80
70
60
50
40
30
20
10
0
n = 232 Isolates



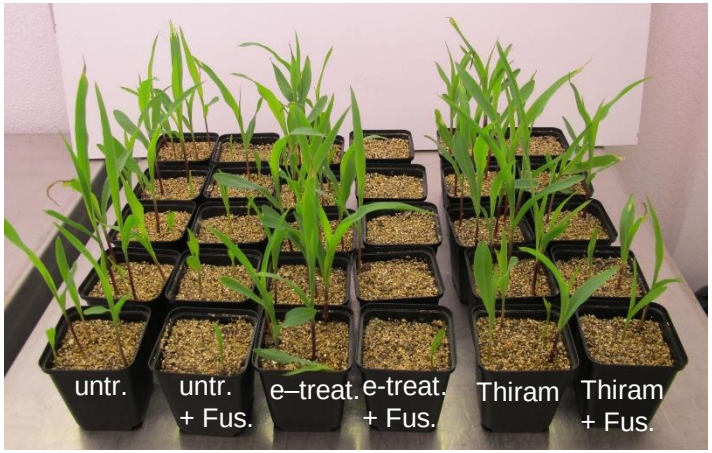
***Fusarium* – <u>infected seeds</u>**

seeds sown in

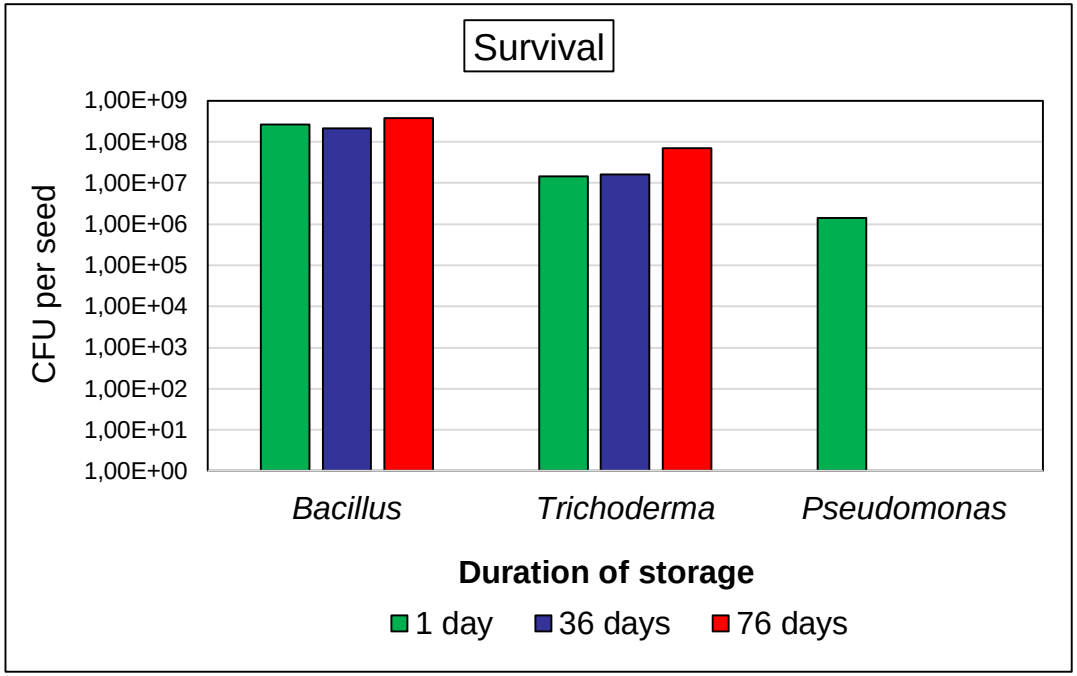
non-inoculated potting substrate

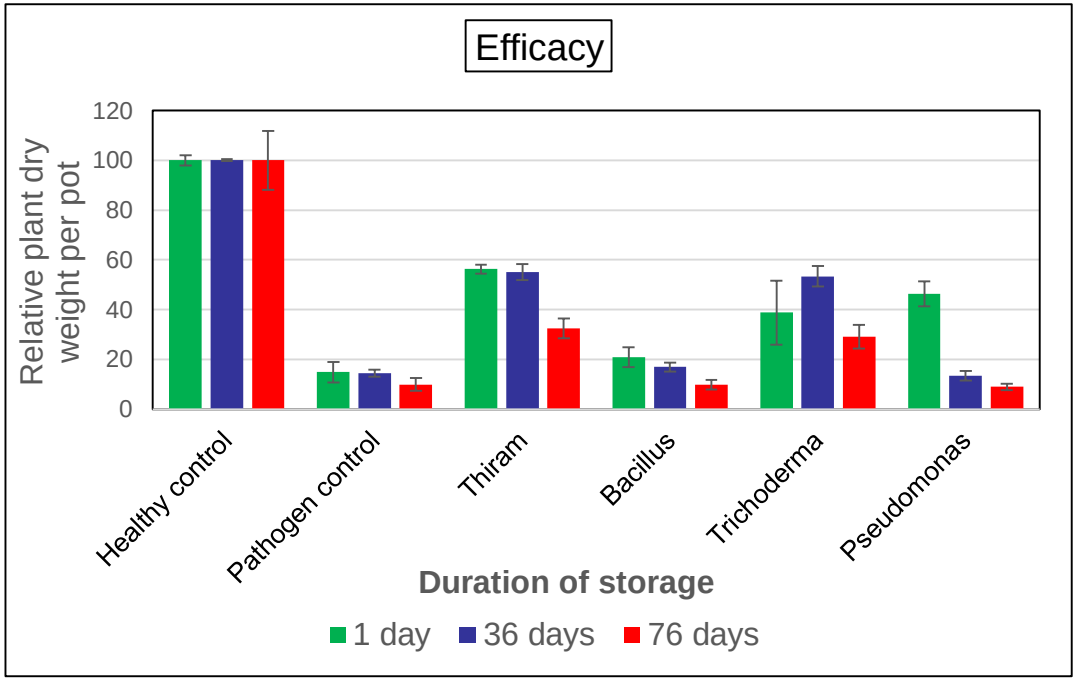
potting substrate with *Fusarium*

5 pots per treatment,
5 seeds per pot

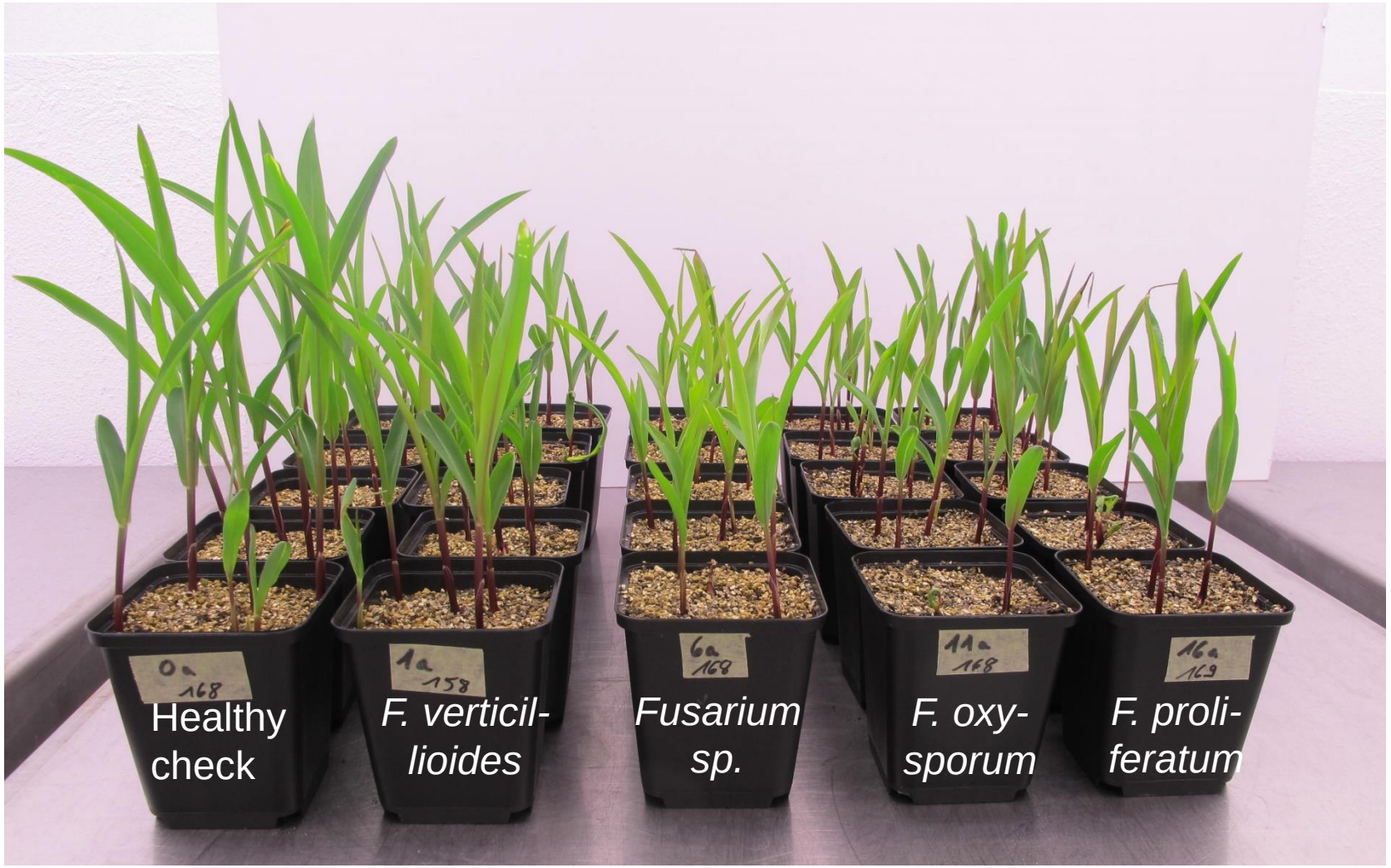


Effect of storage after seed treatment on survival of antagonists on seeds and efficacy against *F. culmorum* in a pot test

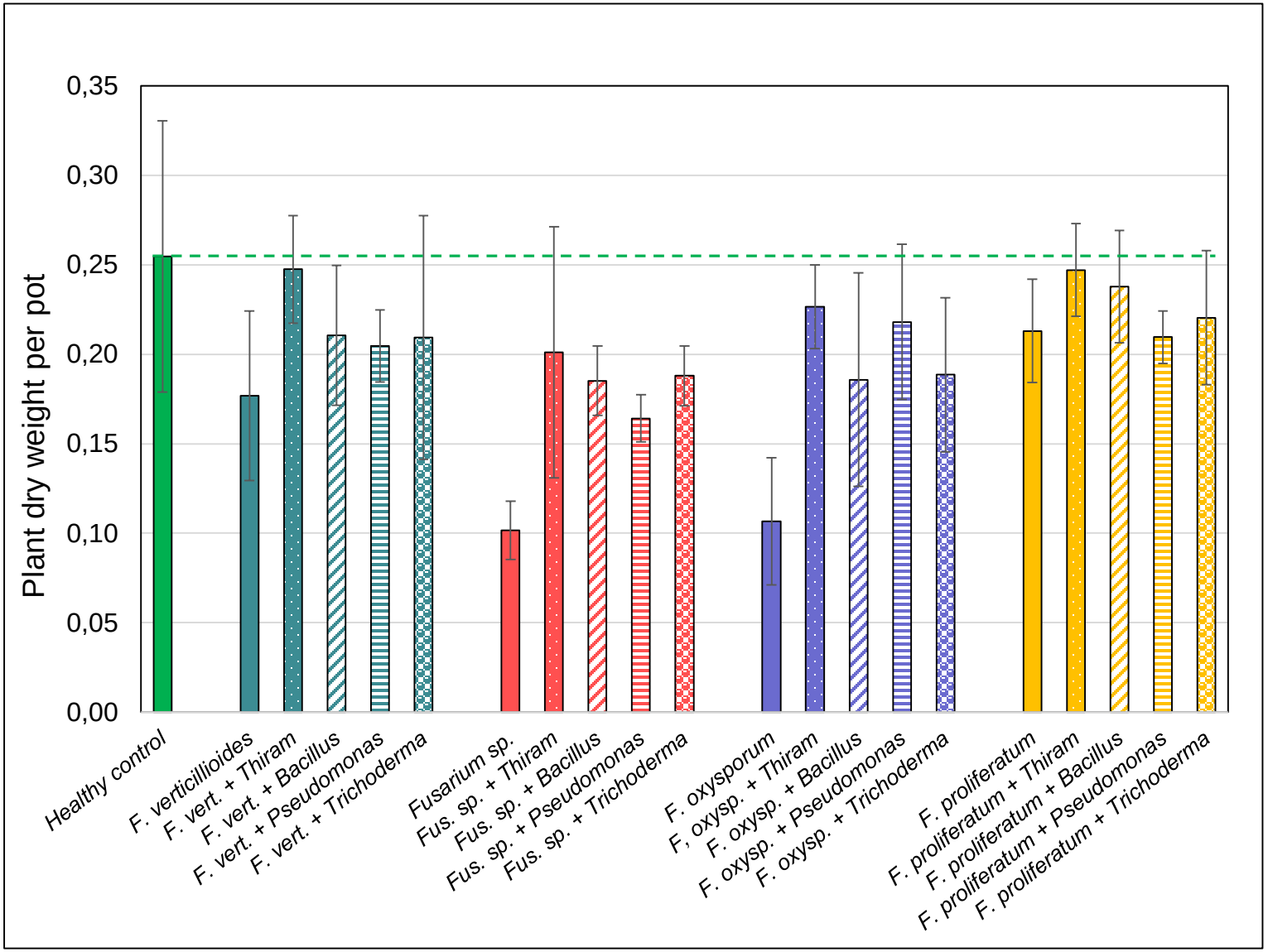


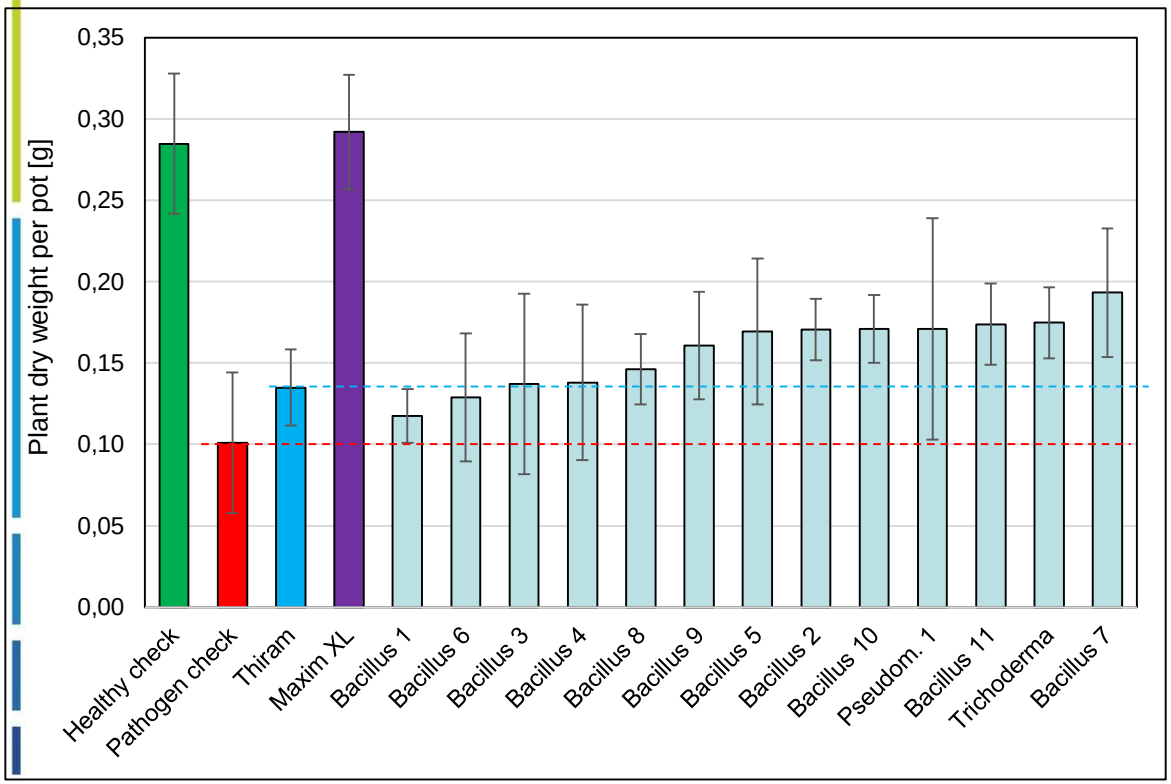


Activity against different soil-borne fusaria (I)

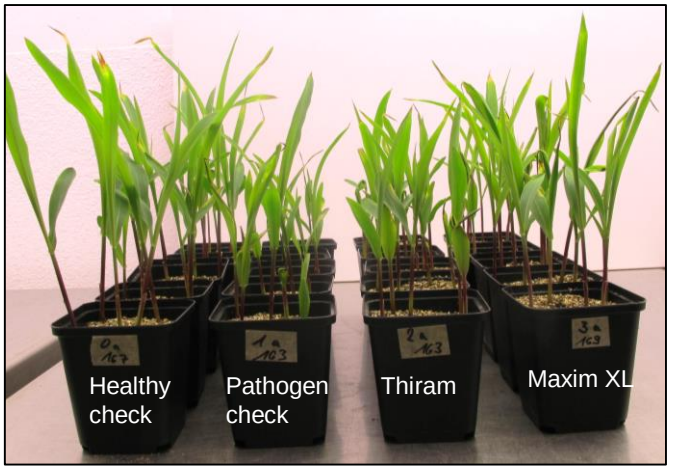


Activity against different soilborne fusaria (II)

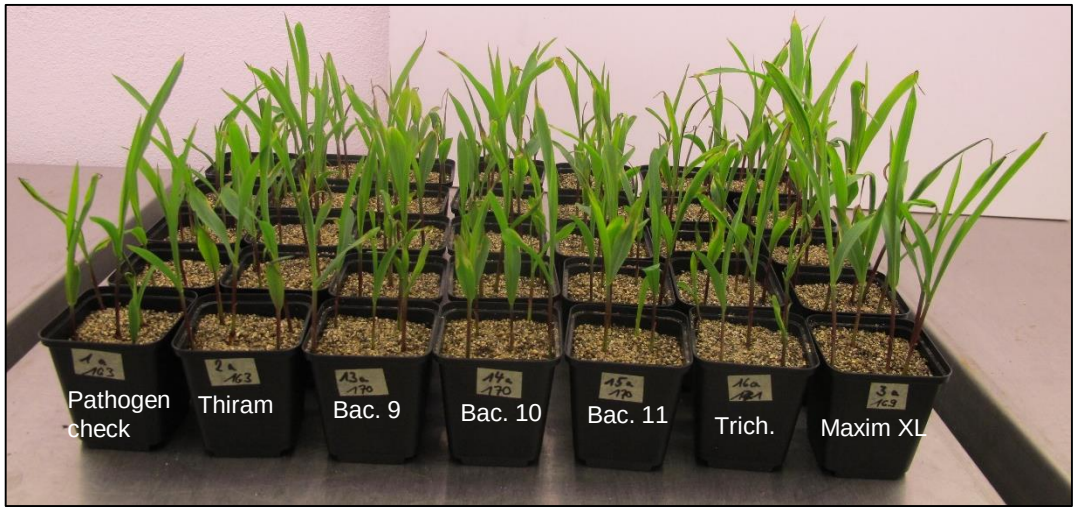




3 reps with 5 pots each, 5 seeds per pot



Efficacy against *Pythium ultimum* using formulated preparations



Summary

- In screening experiments performed in pots about 20 out of 232 tested bacteria were similar in activity as the standard Thiram (TMTD)
- Two of the most effective isolates belonged to the genus *Burkholderia* (Risk group 2)
- When *Fuarium*-infected seeds were sown in healthy soil, most treatments including electron treatment provided an increase in germination, but the efficacy was nil or very low when infected seeds were sown in inoculated soil (including Thiram)
- Storage of treated seeds for up to 75 days had no impact on the survival of *Bacillus* and *Trichoderma*, whereas the populations of *Pseudomonas* dropped to undetectable levels
- The selected strains where active against different species of *Fusarium*
- The activity of the selected strains against *Pythium ultimum* was significantly lower than against *Fusarium*. However, the standard Thiram also had only low activity against *Pythium*.
- The challenge is to translate the overall positive results from the greenhouse into a similar good performance in the field

Acknowledgement

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Thank you for your attention !