

Rhizoctonia solani:

Importance of soil infection in intensive crop rotations

Reto Flückiger and Andreas Keiser, HAFL



Bern University
of Applied Sciences



Rheinland-Pfalz
DIENSTLEISTUNGSZENTREN
LÄNDLICHER RAUM
DLR Rheinhessen-Nahe-Hunsrück



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Introduction

- Vorderpfalz in Southern Germany / 6'000 ha early potatoes
- Intensiv crop rotations: often only 1–2 years break between two potato crops
- Main quality problems: Black scurf and Drycore (*R. solani*) and wireworm damage
- Efficiency of fungicide seed treatments to low too protect plants from infections of *R. solani*



On-Farm project with randomized field trials on 18 potato farms in 2010 and 2011 / variety Berber

Vorderpfalz in Germany

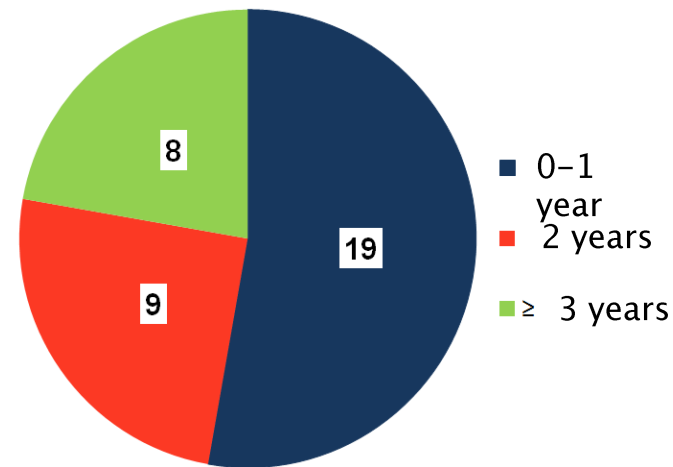


Soil type

Sandy clay loam / silty loam
pH: (5.8) – 7.7
org. matter (%): 0.8 – (1.8)
Clay content (%): 17–35

Crop rotation:

Years between two potato crops /
36 fields 2010 and
2011



Objectives

- Determination of the main source of infection for *R. solani* in the Vorderpfalz: Seed or soil ?
- Factors which favour the formation of Drycore symptoms?



Experimental design

18 field trials in 2010 and 2011



Control 1:

- Sclerotia free seed tubers
- Fungicide seed treatment (Pencycuron)
- No Goldor Bait (Fipronil)



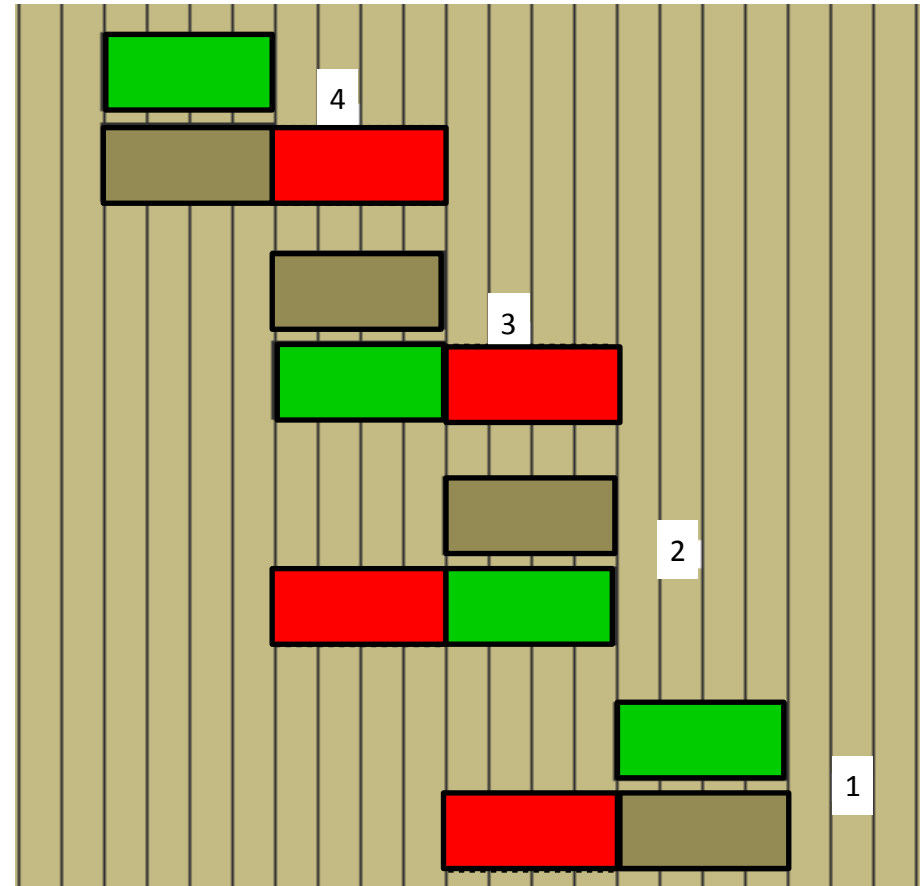
Control 2:

- Commercial seed of the farm
- No fungicide seed treatment
- No Goldor Bait



Farm treatment:

- Commercial seed of the farm
- Fungicide seed treatment (Pencycuron)
- With Goldor Bait (Fipronil)



Control of tuber quality: Seed and harvest

Seed tubers: % of seed tubers with black scurf

Harvest:

Control of 100 tubers per treatment and replication (35 – 65 mm):

- **Black scurf:** % tuber surface (Scale 1 – 6)

1 = 0%; 2 < 1%; 3 = >1-5%;

4 = > 5-10, 5 = >10-15%; 6 > 15%

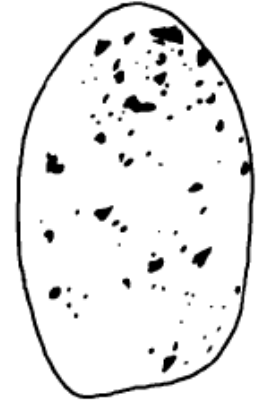
- **Drycore, wireworm, slugs**

(number of holes per tuber)

- **Misshapen tubers**



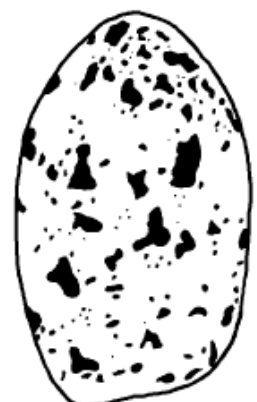
1 %



5 %



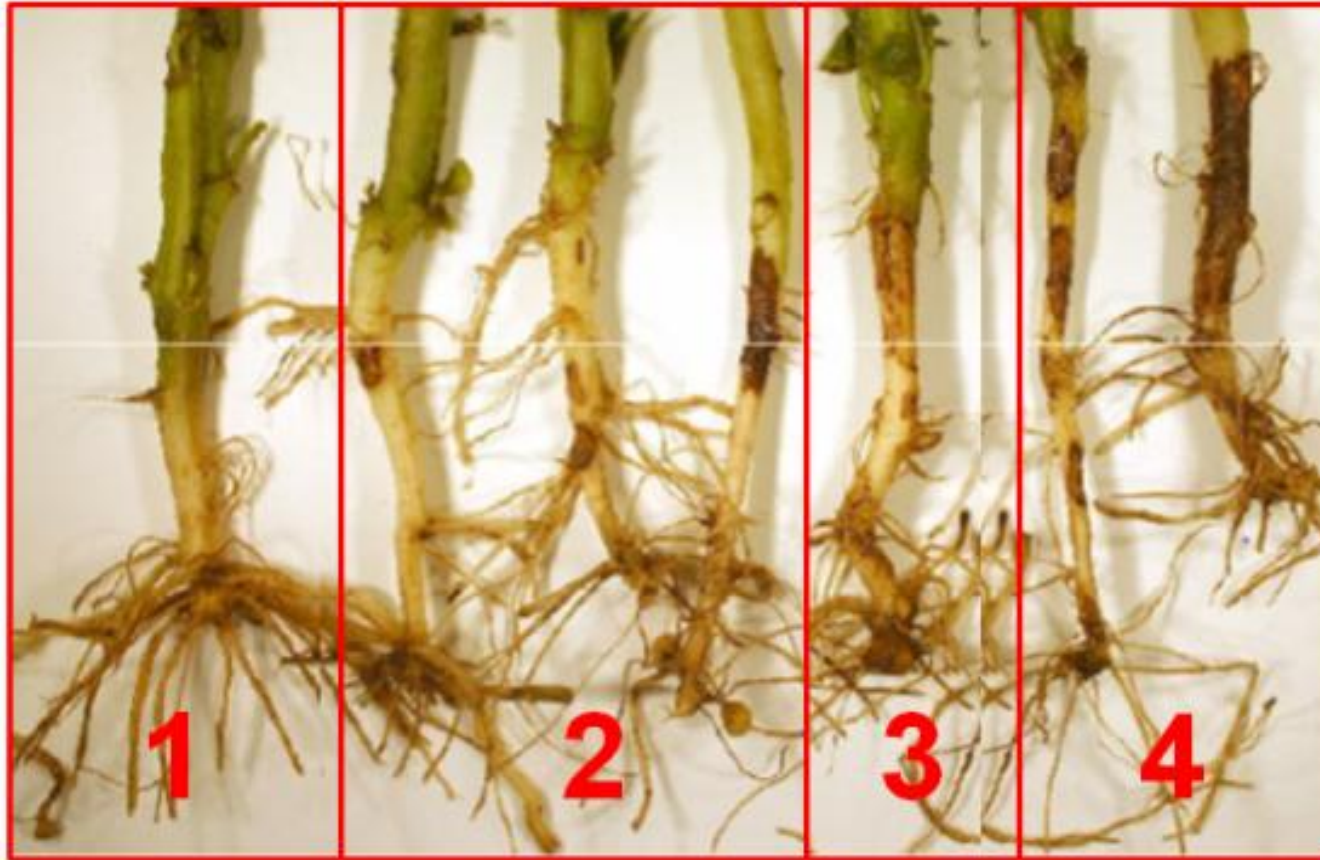
10 %



15 %



Stem canker in % of the underground surface of the stem (EPPO-Richtline PP1/32(2))



Sample size:
2 x 10 plants per
treatment and
replication

no stem canker

$< \frac{1}{3}$

$\frac{1}{3} - \frac{2}{3}$

$> \frac{2}{3}$

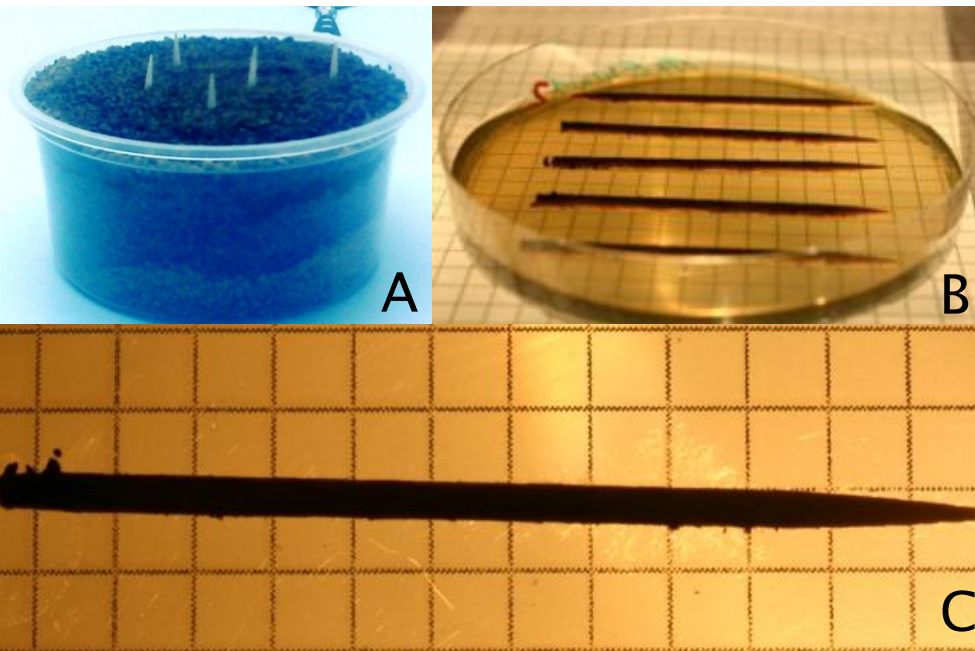


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Analysis of the soil infestation with *R. solani* (2011)

Toothpick baiting (Paulitz und Schröder 2005)

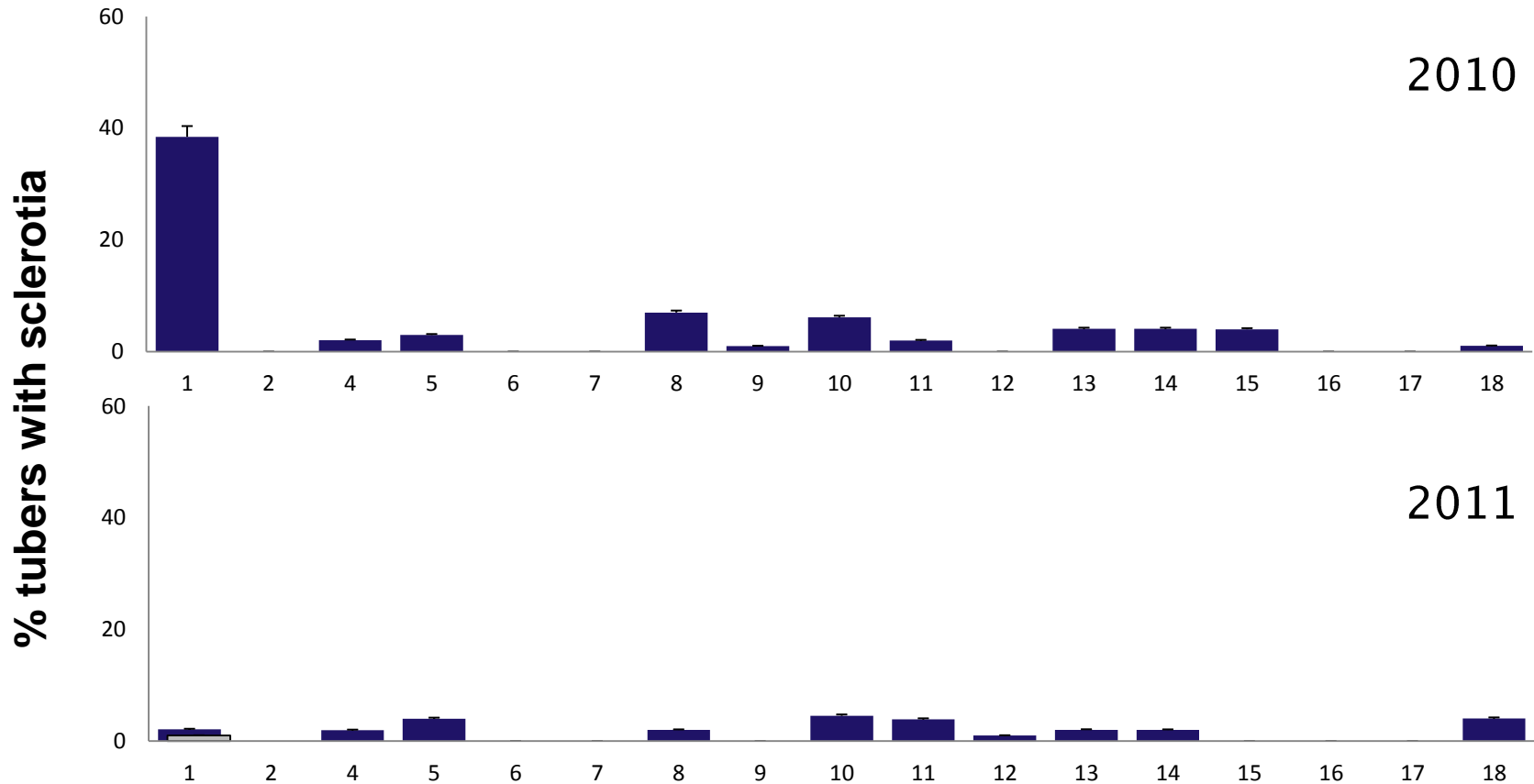


- A Incubation of the toothpicks at 20 – 22 °C for 48 h
- B 10 toothpick per soil sample on Ko & Hora medium (Castro et al. 1988)
Incubation at room temperature for 24 h.
- C Count of the number of squares with hyphae of *R. solani*
- D Identification of AG 3 with specific primers (isolates from toothpick + 26 isolates from harvested tubers).
Used primers: PT1 and PT2

Results

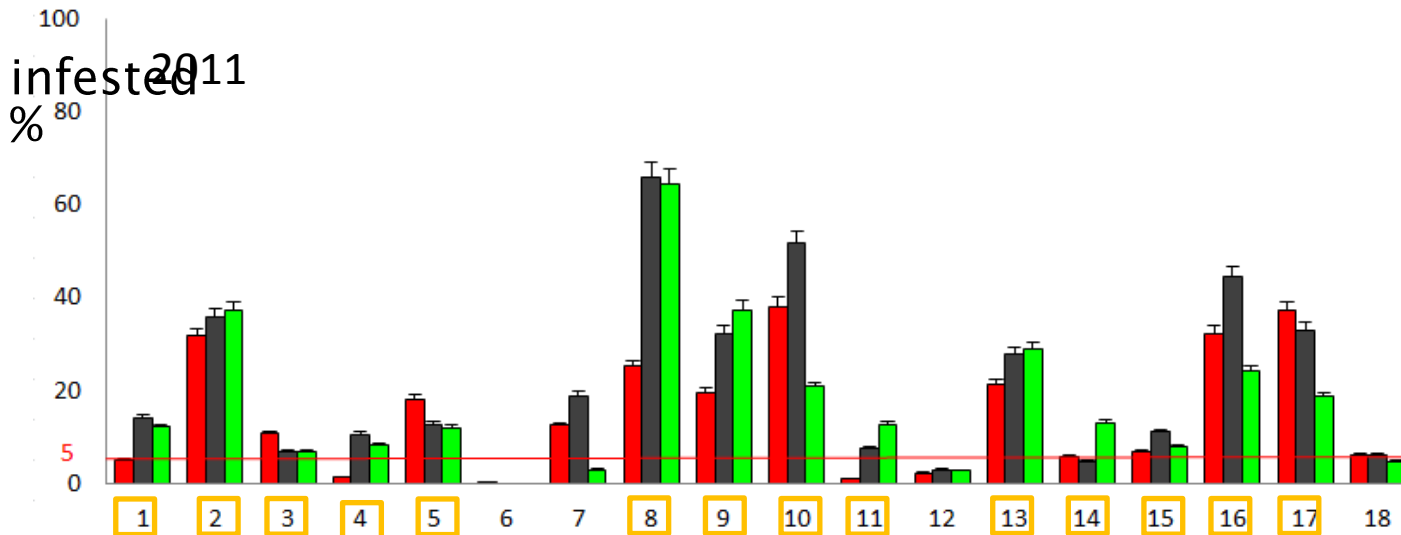
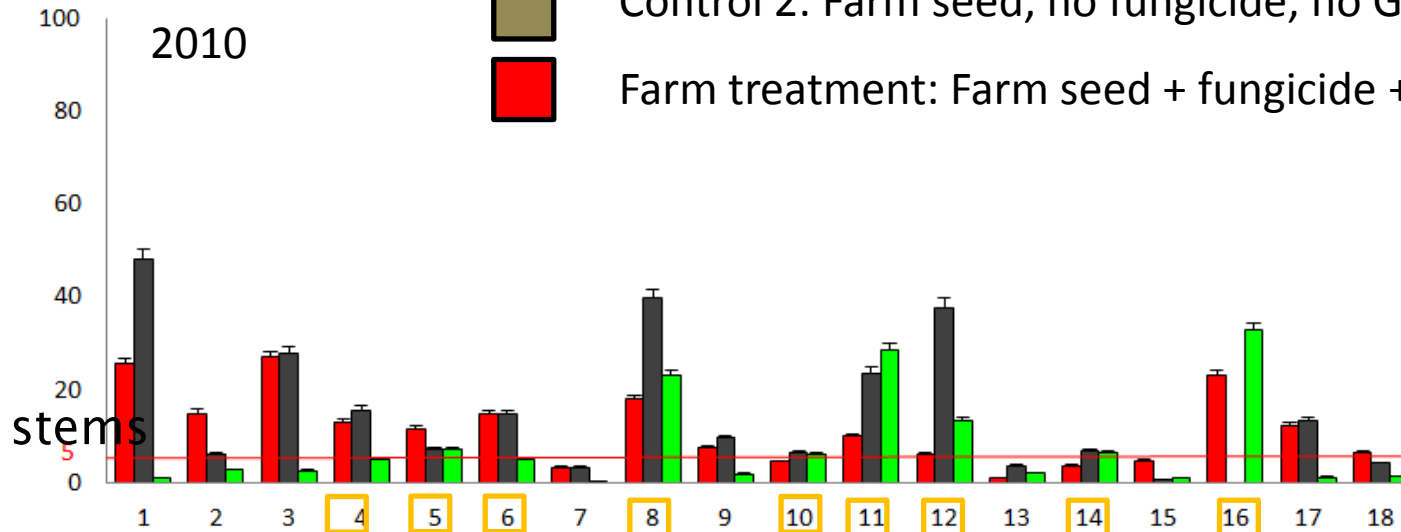


Seed quality (% tubers with sclerotia)

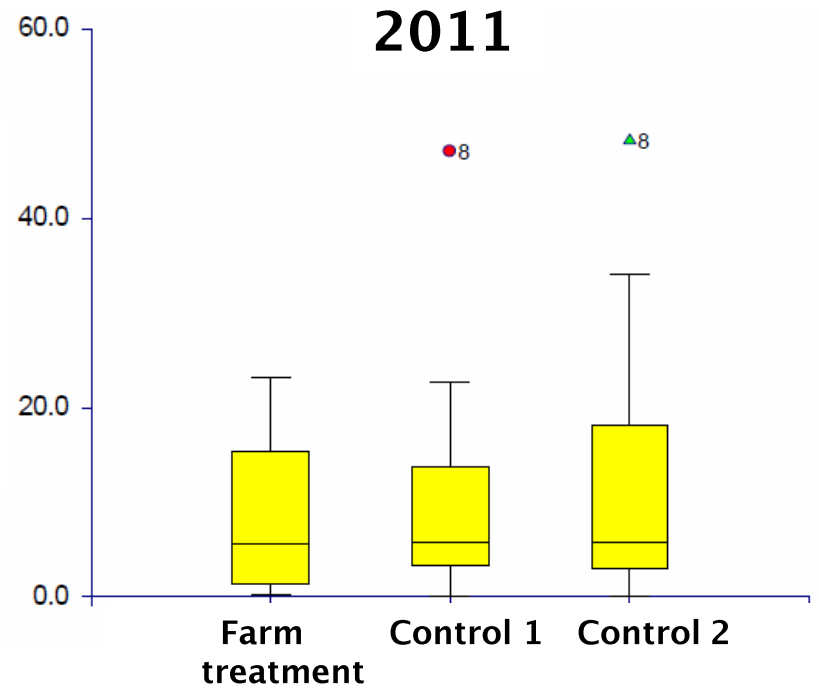
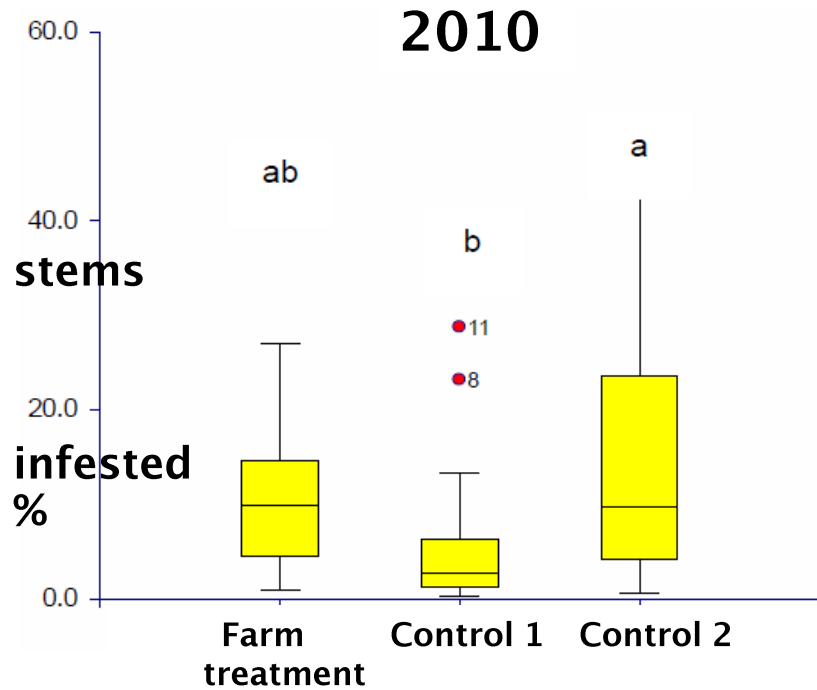


Stem canker (% infested stems)

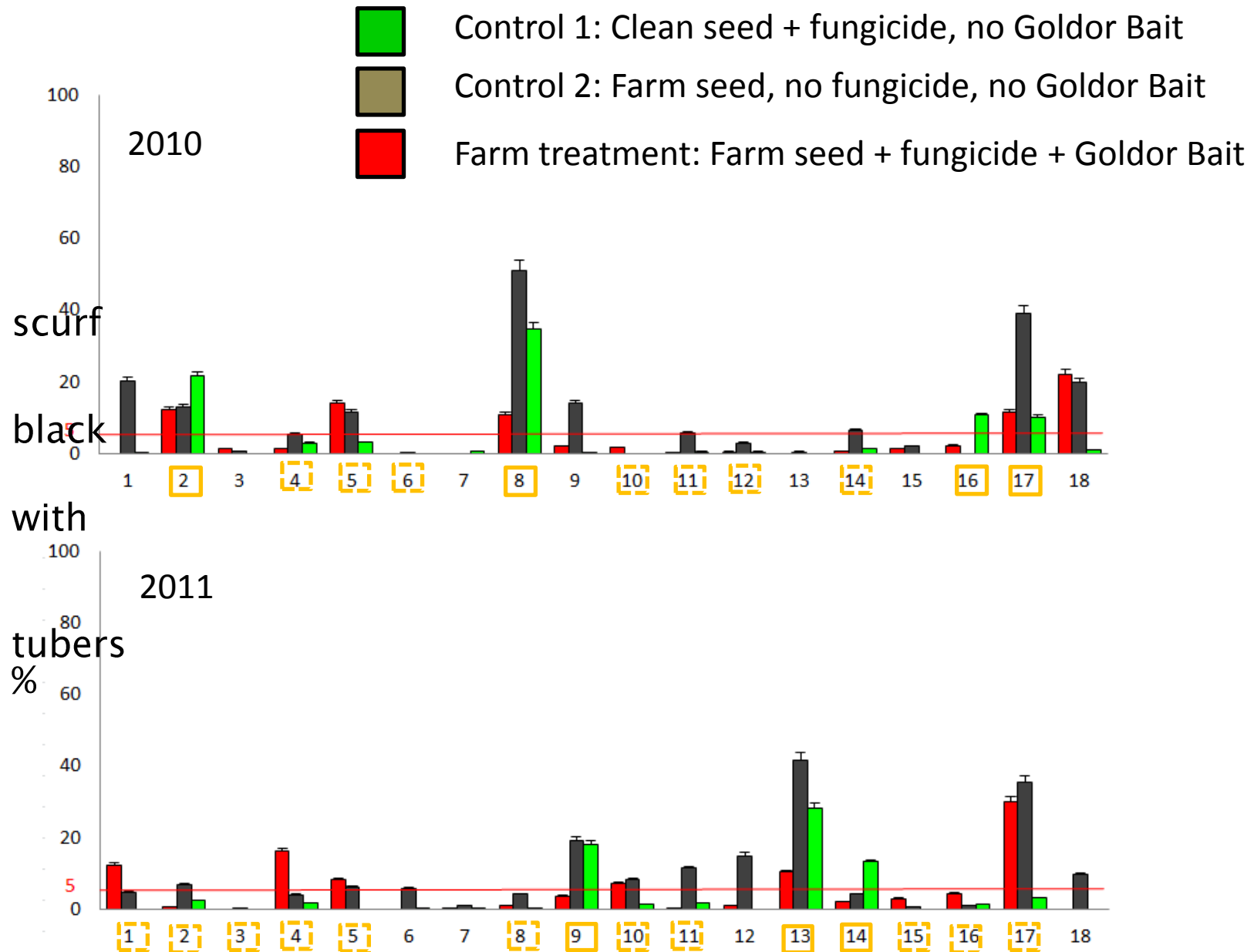
- Control 1: Clean seed + fungicide, no Goldor Bait
- Control 2: Farm seed, no fungicide, no Goldor Bait
- Farm treatment: Farm seed + fungicide + Goldor Bait



Stem canker (% infested stems)



% tubers with black scurf



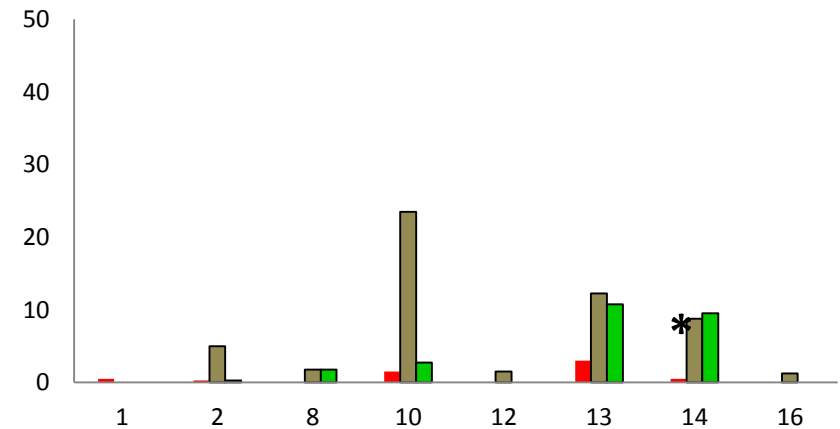
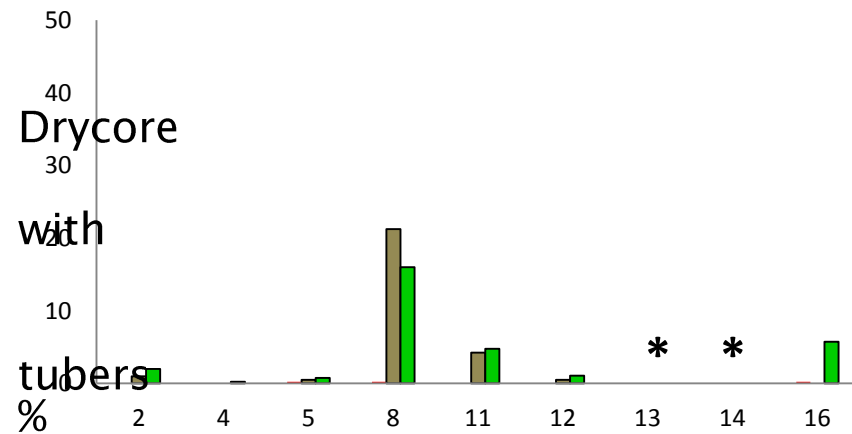
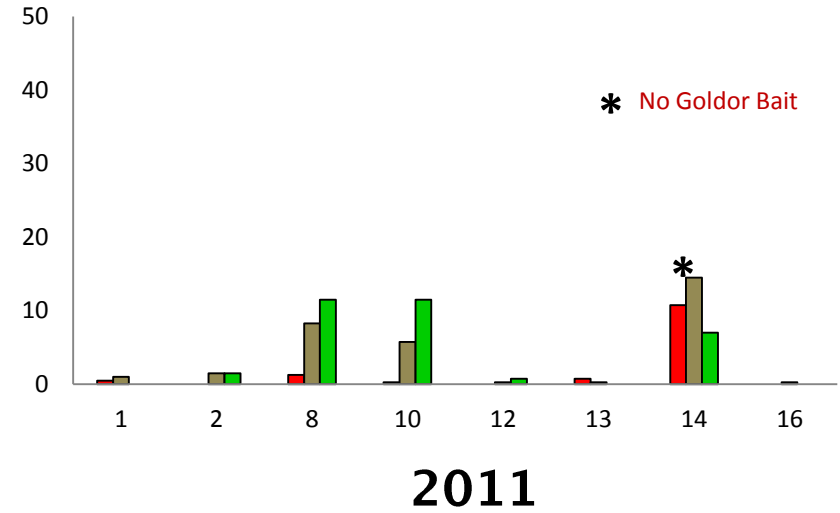
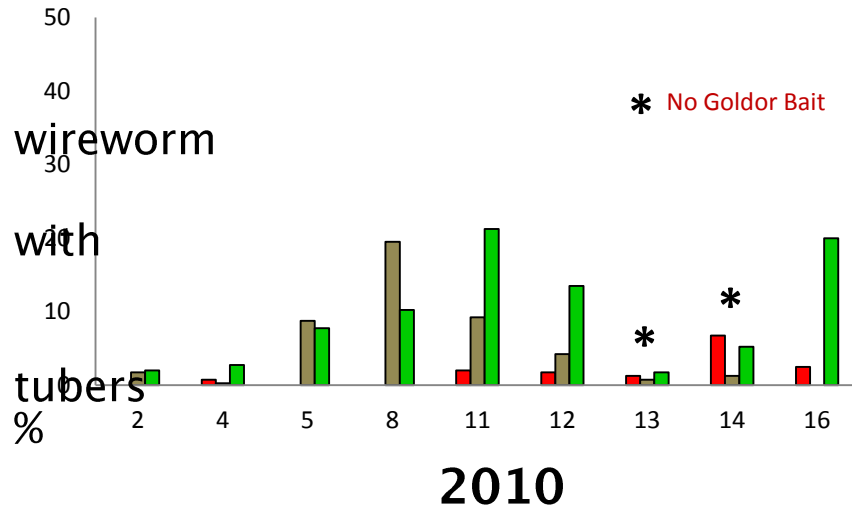
Drycore and wireworm damage



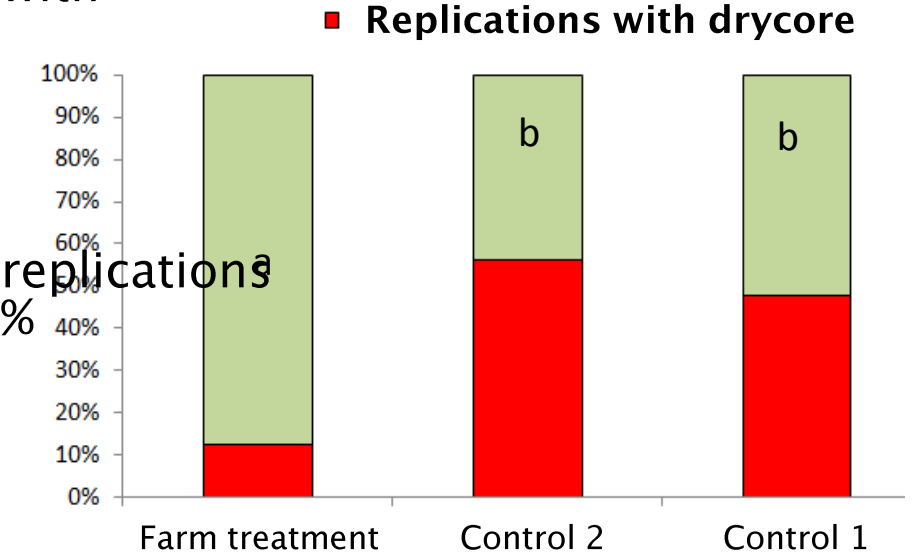
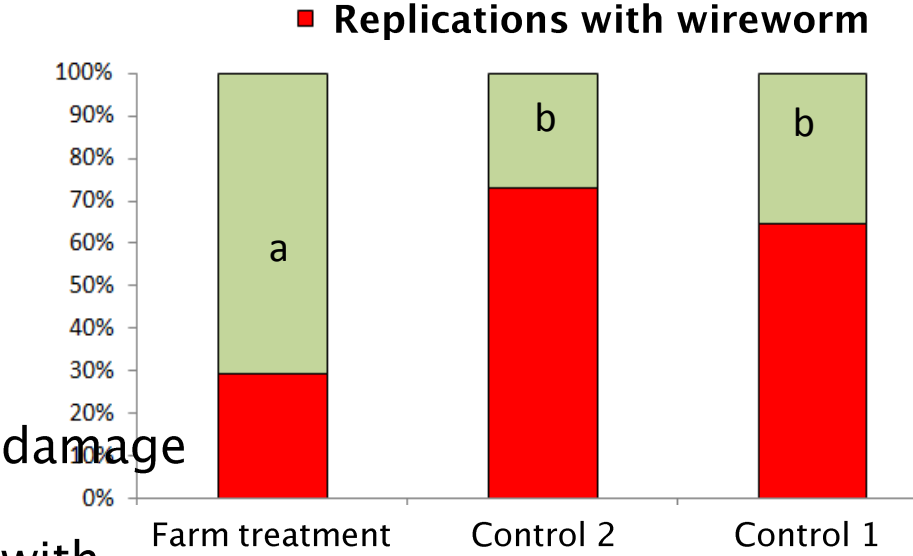
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Farm treatment: Farm seed + fungicide + Goldor Bait

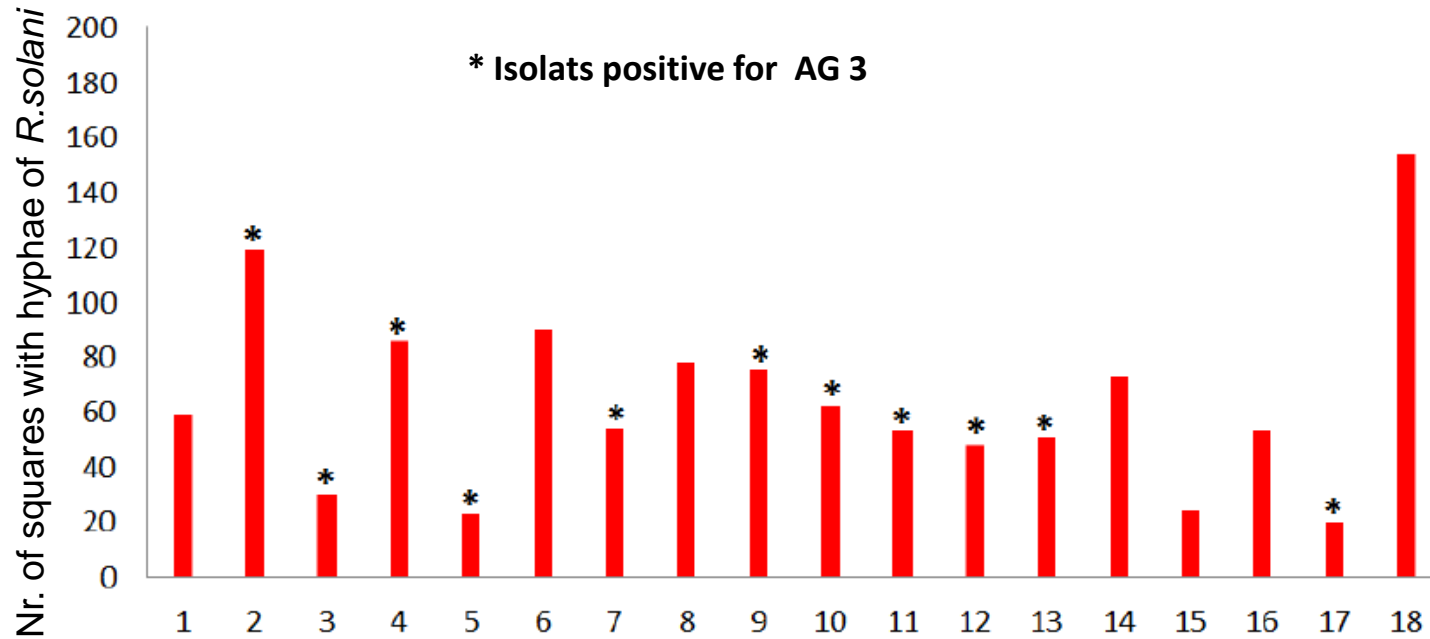


Drycore and wireworm damage



Toothpick methode:

Number of squares (from 200) with hyphae of *R. solani*



25 of 26 isolates from sclerotia on harvested tubers (2011) were positive for AG3.



Summary / Discussion

- Seed infection was lower than expected.
- Soil infection was the main source of infection on potato fields in the Vorderpfalz in 2010 and 2011 (25 of 36 fields in the project).
- Fungicide seed treatments could not protect plants from stem canker and black scurf (efficiency lower than 60%).
- These results are in contradiction similar to projects in Switzerland
crop rotations ≥ 4 years \rightarrow low soil infestation
 \rightarrow high fungicide efficiency against seed borne infection .
- The results confirm results found in Switzerland that wireworm damage favours the formation of drycore. Therefore the reduction of wireworms by Goldor bait indirectly reduces drycore damage.
- **A good rotation with at least 4 years break is the most important measure against *R. solani* (and other diseases)!!**

Outlook

Research project 2014/2015

(in combination with a master thesis)

- Detection of soil infection with Real Time PCR on potato fields with different crop rotations in Switzerland and Germany

TaqMan Analyse:

AG3_F / AG3_R / AG3_P (Budge et al. 2009)

RsTqF1 / RsTqR1 / RQP1 (Lees et al. 2002)

- Observation of the development (reduction?) of *R. solani* inoculum in infested soils after a potato crop, when no more potatoes are grown.
- Influence of different intercrops on the development of *R. solani* in the soil?



Thank you!



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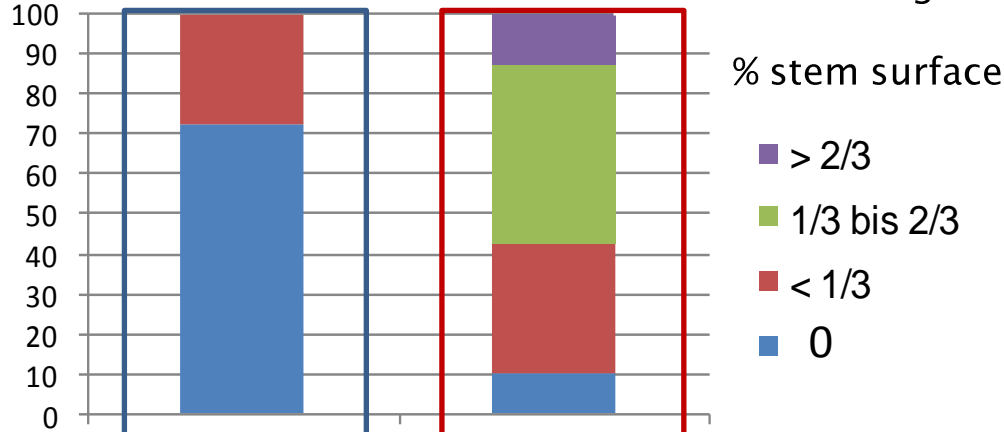
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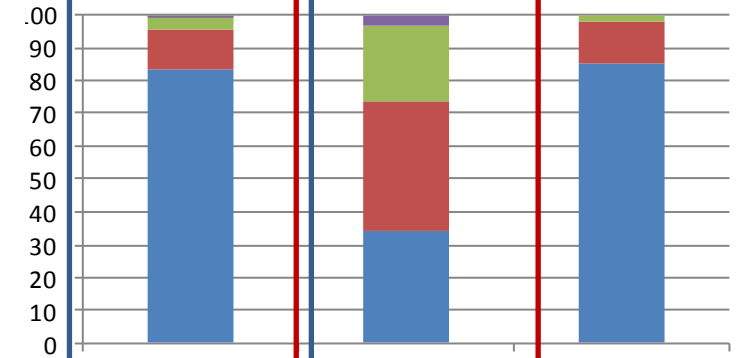
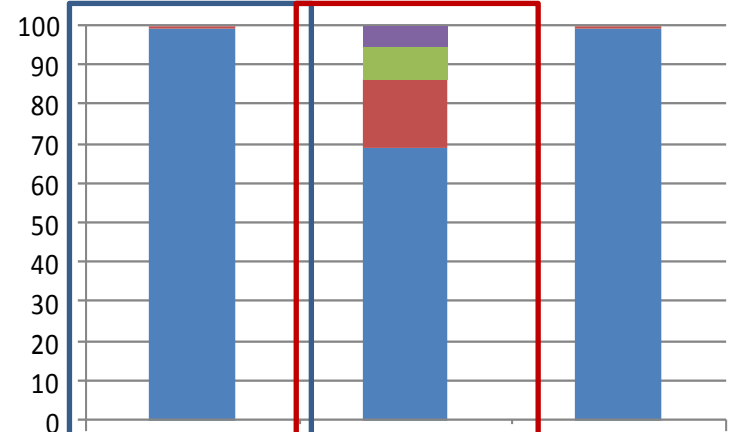
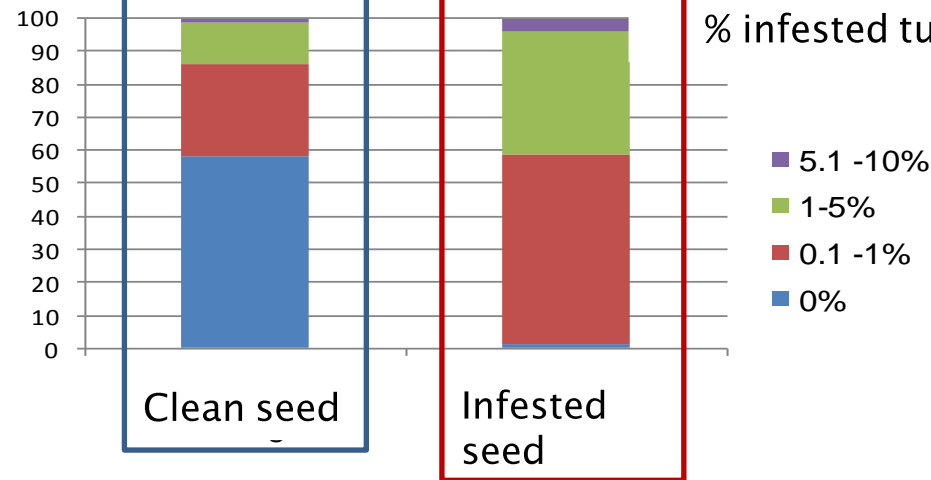
Niedersachsen 2009 (Eilte) / 2 years break between 2 potato crops

Switzerland 2009 (Frieswil), 4 years break between 2 potato crops

Stem canker begin of June



Black scurf at harvest
% infested tubers



Clean seed
Infested seed
Infested seed +
Monceren