

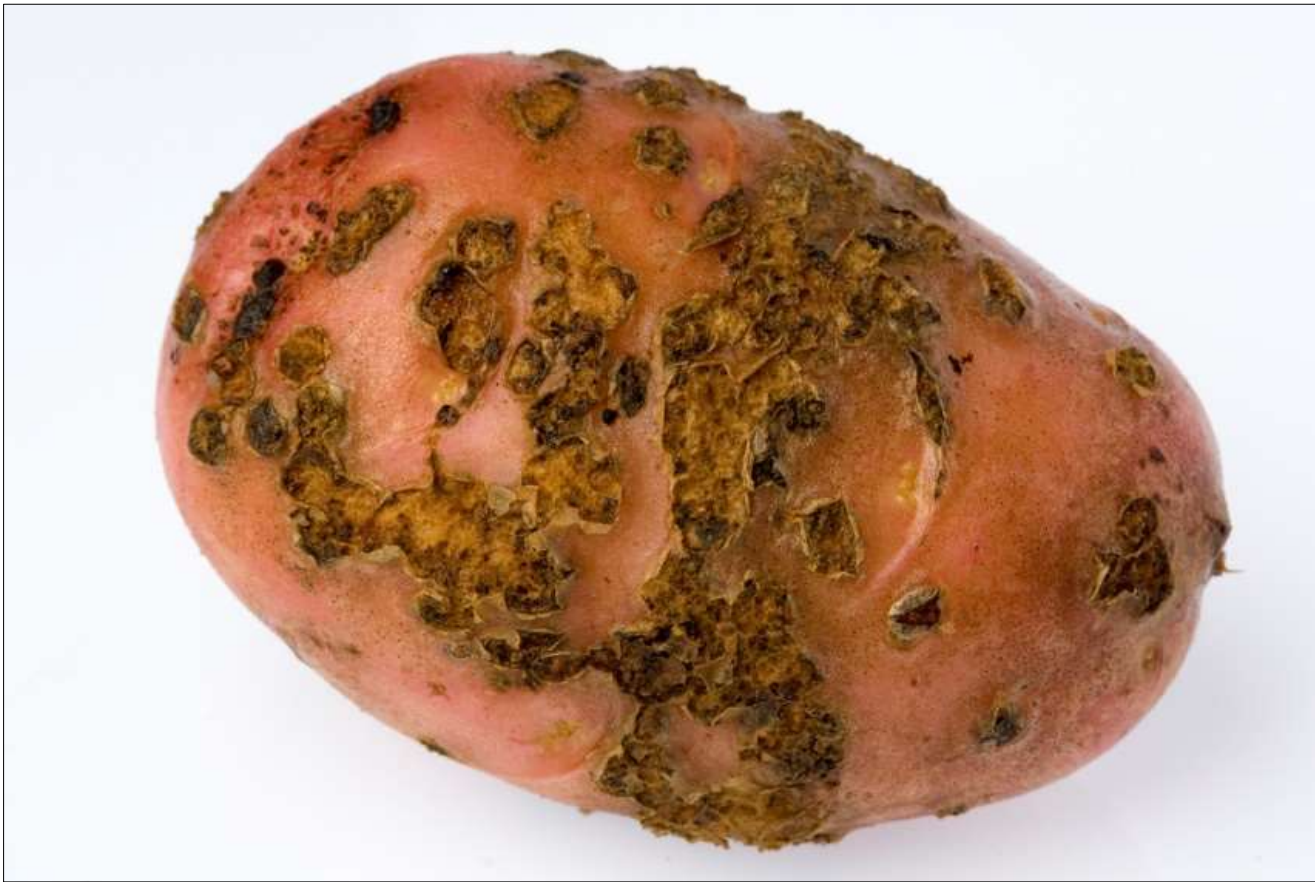


Discussion paper

**The diseases of *Solanum tuberosum*
caused by *Spongospora subterranea*:
disrupted root function, root hyperplasia
and powdery scab on tubers**

Richard Falloon and Ueli Merz

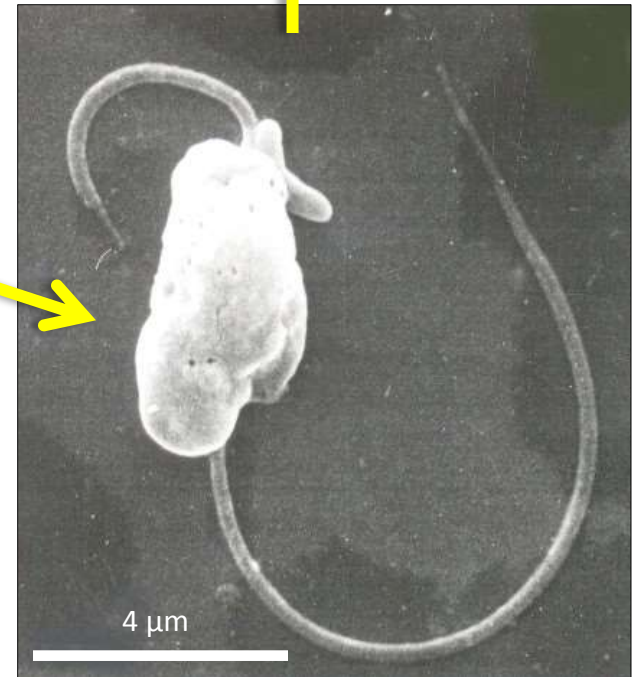
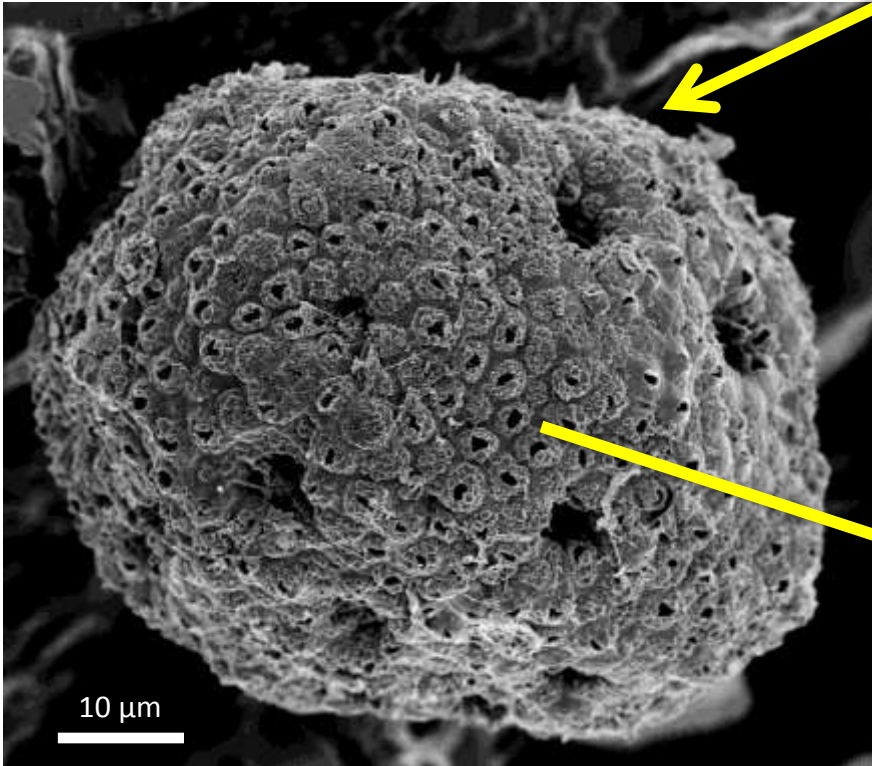
Plant & Food Research, New Zealand and ETH Zurich, Switzerland



Discussion paper

- **Summarise some experimental evidence**
- **Put forward a suggestion**
- **Gain response from this Workshop**

Spongospora subterranea



Effects on total crop yield

Field trial (1994): powdery scab controlled with soil treatments

	% diseased	total yield (tonnes ha ⁻¹)
no chemical	19	44.7
fluazinam	6	57.3

+28%

(increased weight/tuber)



Glasshouse experiment

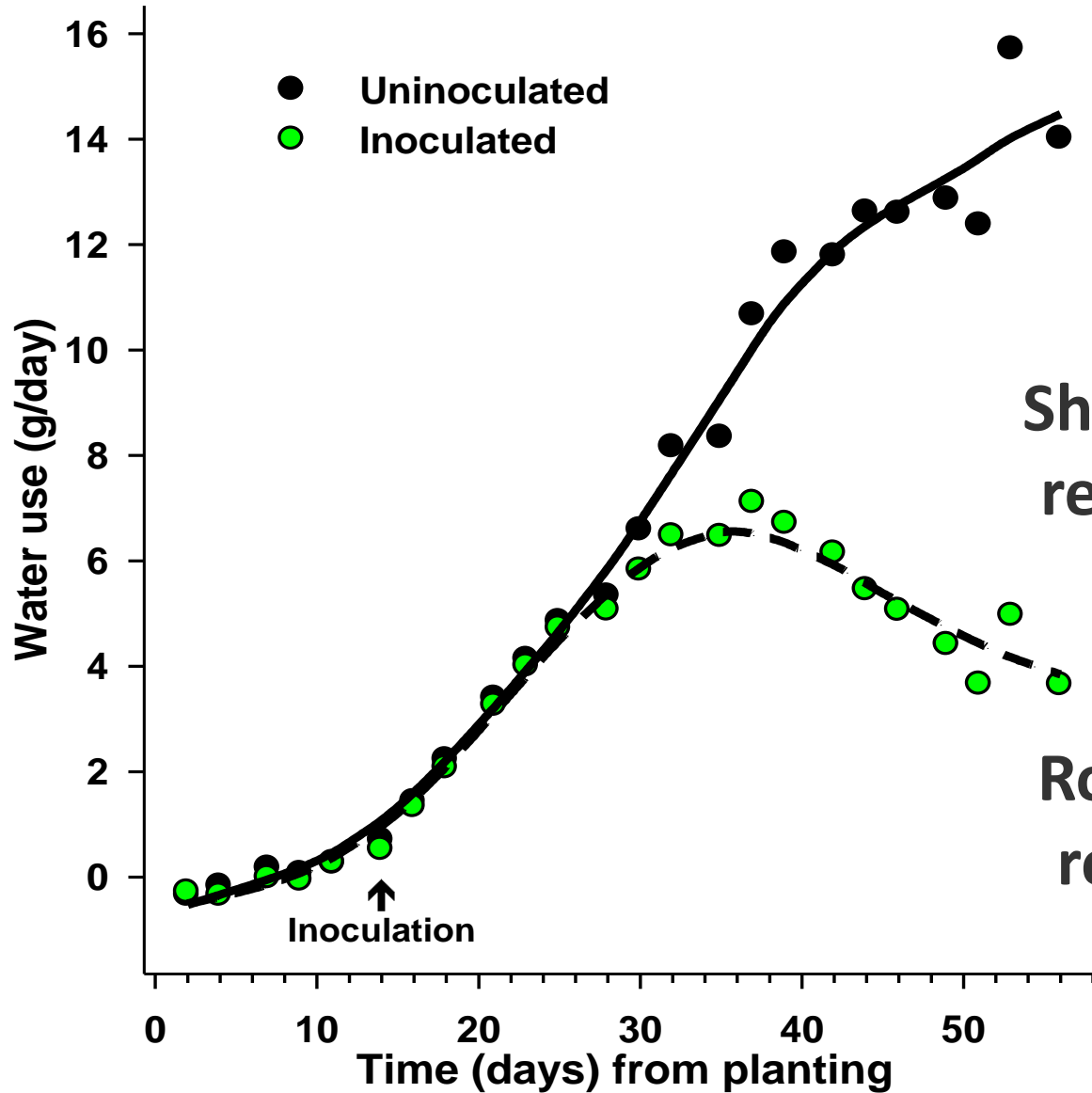
- Uninoculated
- Inoculated with
S. subterranea

Water uptake,
plant parameters



Water use

Cv. 'Iwa'



Shoot dry weight
reduced by 27%

Root dry weight
reduced by 6%



Change in shoot nutrients due to *Spongospora* inoculation



<i>Nutrient</i>	<i>Change</i>	<i>Nutrient</i>	<i>Change</i>
Na	+ 64 %	K	- 11 %
Mg	+ 11 %	S	- 11 %
Ca	+ 6 % †	Fe	- 12 % †
N	+ 4 %	P	- 15 %
B	+ 2 % †	Mn	- 25 %
		Zn	- 48 %
		Cu	- 59 %

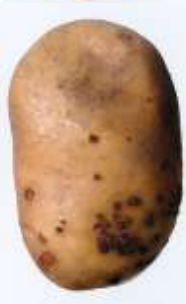
† P>0.05

Glasshouse experiment

Eight cultivars **uninoculated** or **inoculated** with *S. subterranea*



- **Very resistant**
'Gladiator', 'Moonlight' 'Red Rascal'



- **Moderately resistant**
'Russet Burbank', 'Ranger Russet',
'Umatilla Russet'



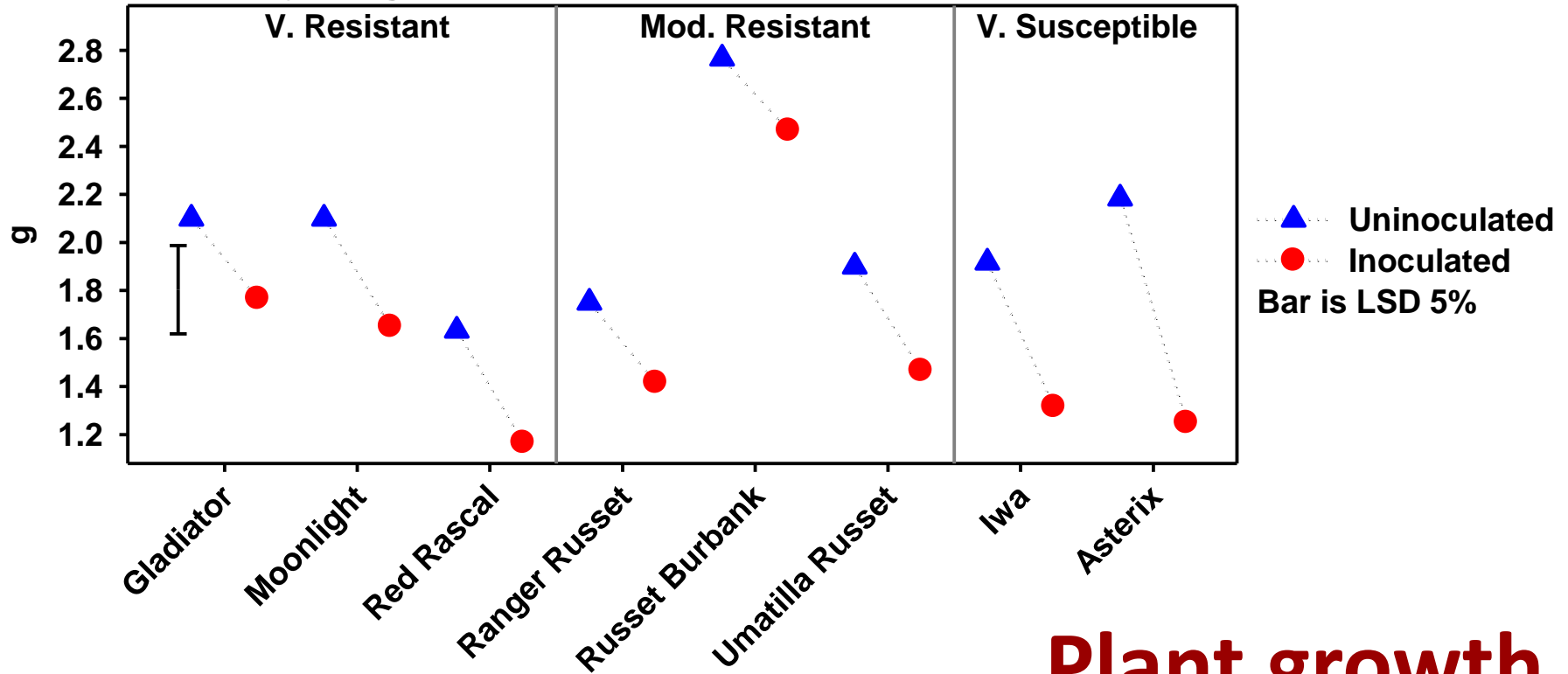
- **Very susceptible**
'Iwa', 'Asterix'

- **Plant parameters**
- **Water use**
- ***Spongospora* severity**

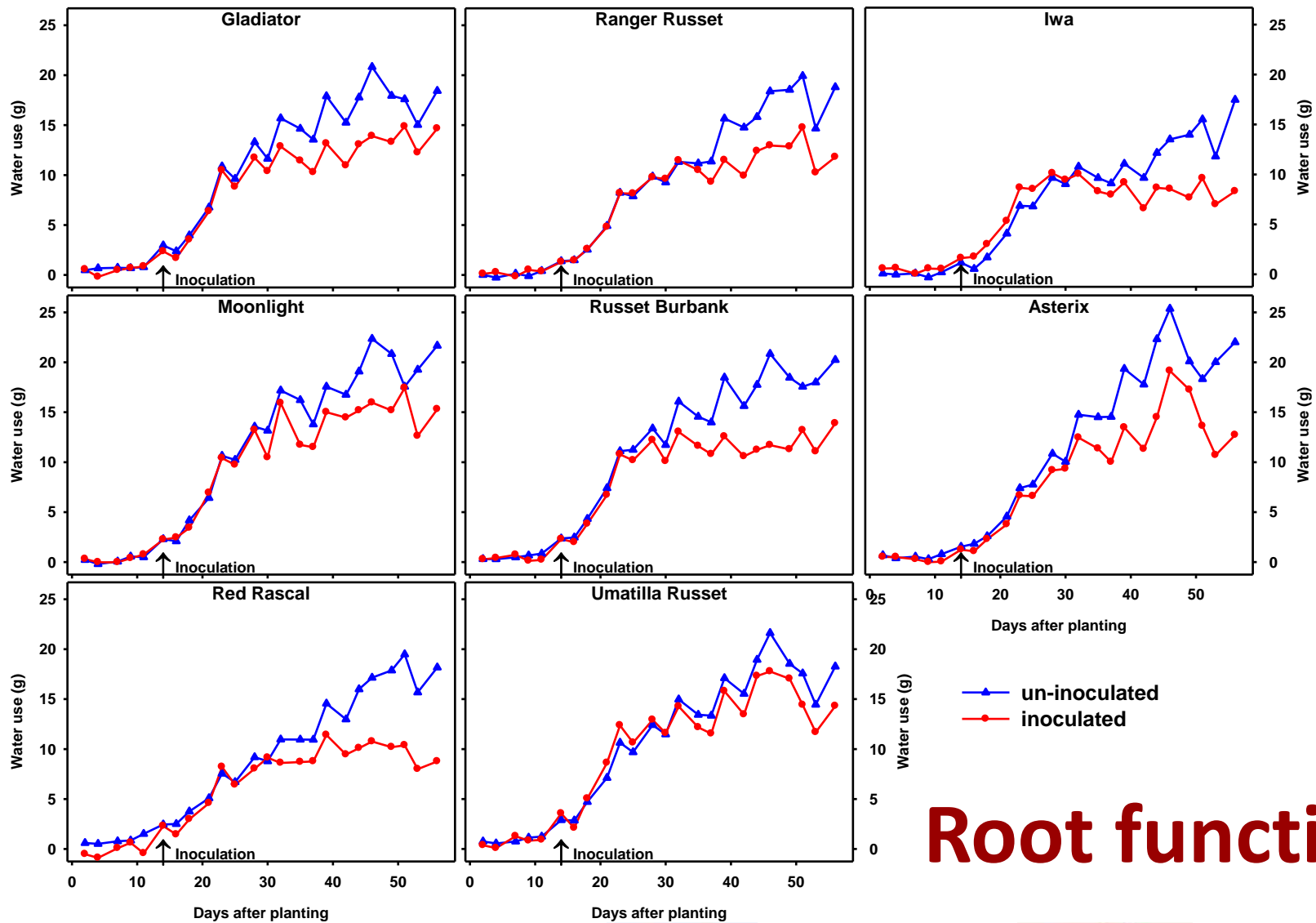




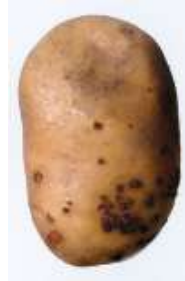
Shoot Dry Weight

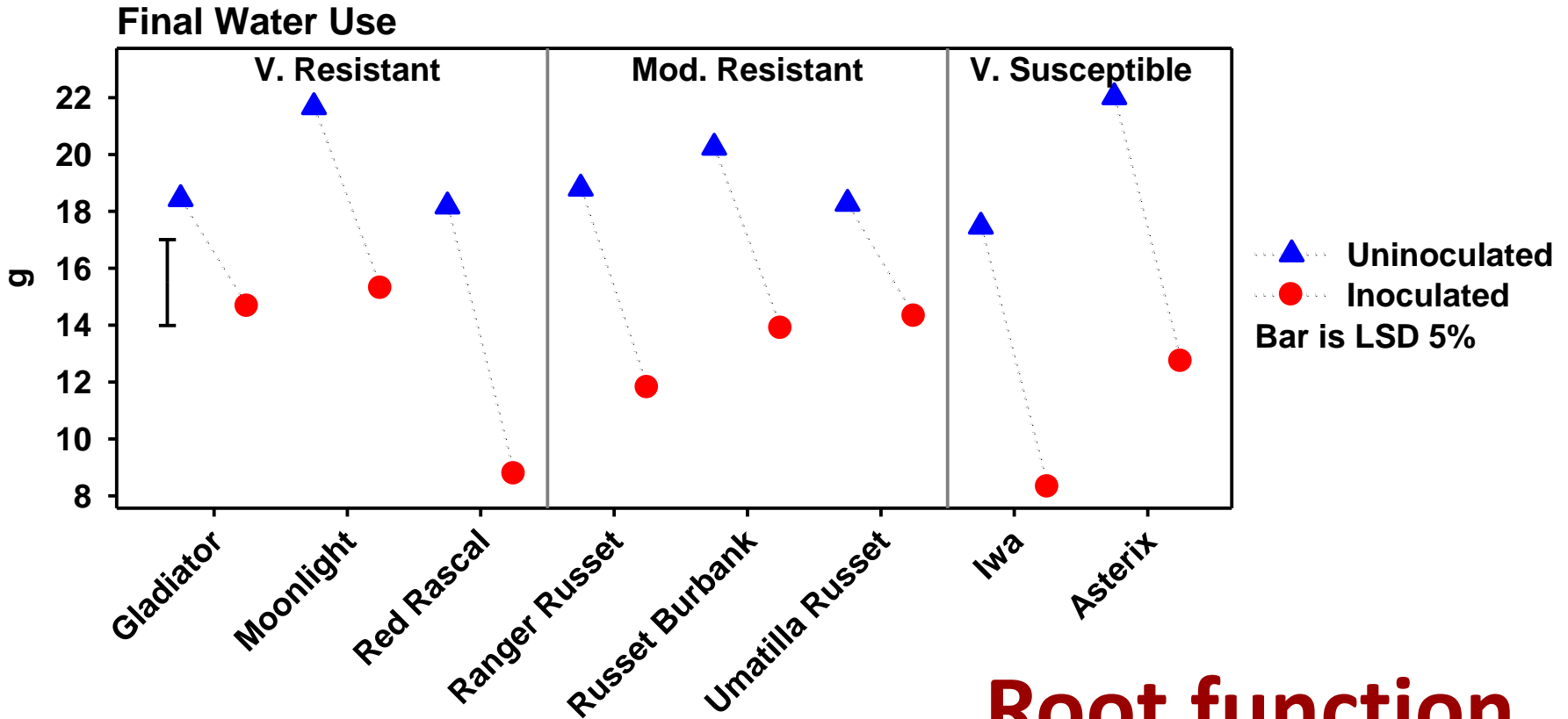


Plant growth

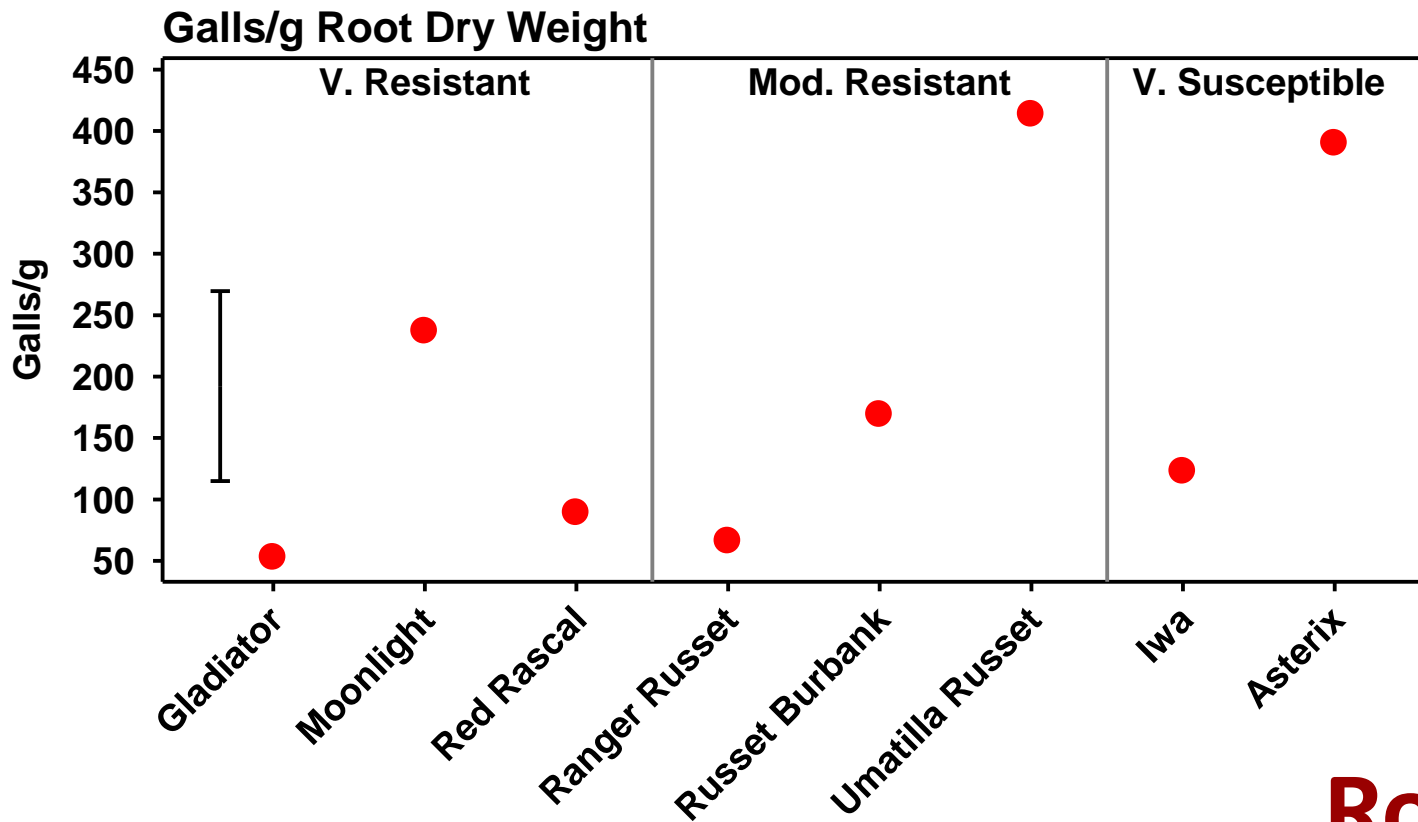


Root function



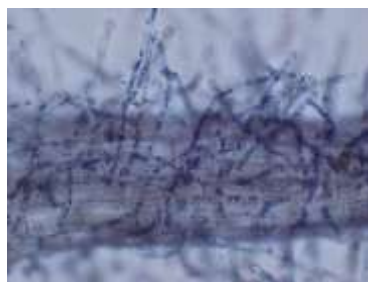
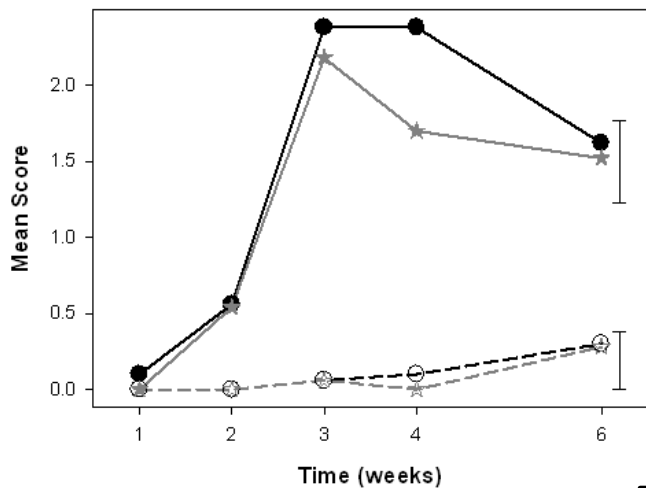


Root function

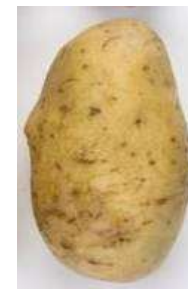


Root galls

Zoosporengia in roots

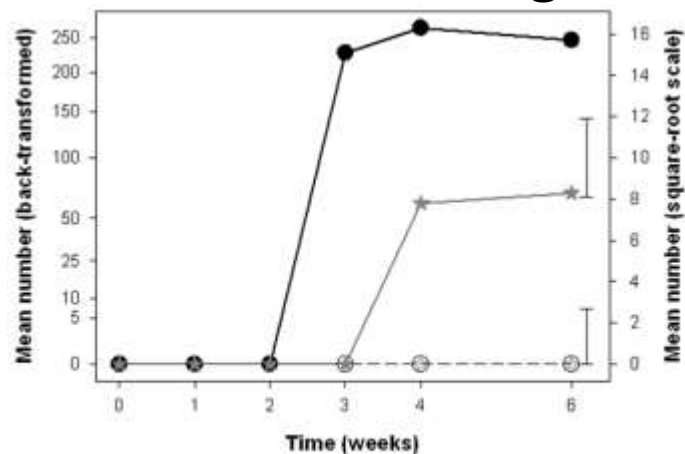


'Iwa'

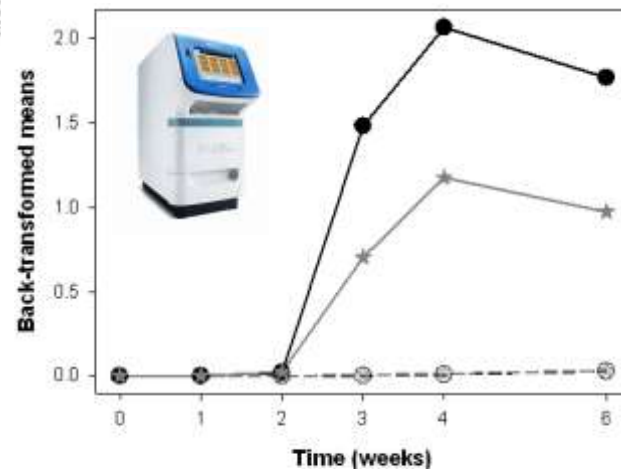


'Gladiator'

Numbers of root galls



Amounts of DNA



Hernandez Maldonado *et al.* (2013)
Plant Pathology 62: 1089-1096



Shah et al. (2012). *Aust. Plant Pathol.* 41: 219-228



Plant parameters at harvest

	Mean wgt (kg) tubers per plant
Uninoc^d	2.93
Inoc^d	1.70
change	-42%



Plant parameters at harvest

	Mean wgt (kg) tubers per plant	Mean no. tubers per plant
Uninoc^d	2.93	12.1
Inoc^d	1.70	9.0
change	-42%	-26%



Plant parameters at harvest

	Mean wgt (kg) tubers per plant	Mean no. tubers per plant	Mean wgt (g) per tuber
Uninoc^d	2.93	12.1	242
Inoc^d	1.70	9.0	188
change	-42%	-26%	-22%





Soil moisture measurements

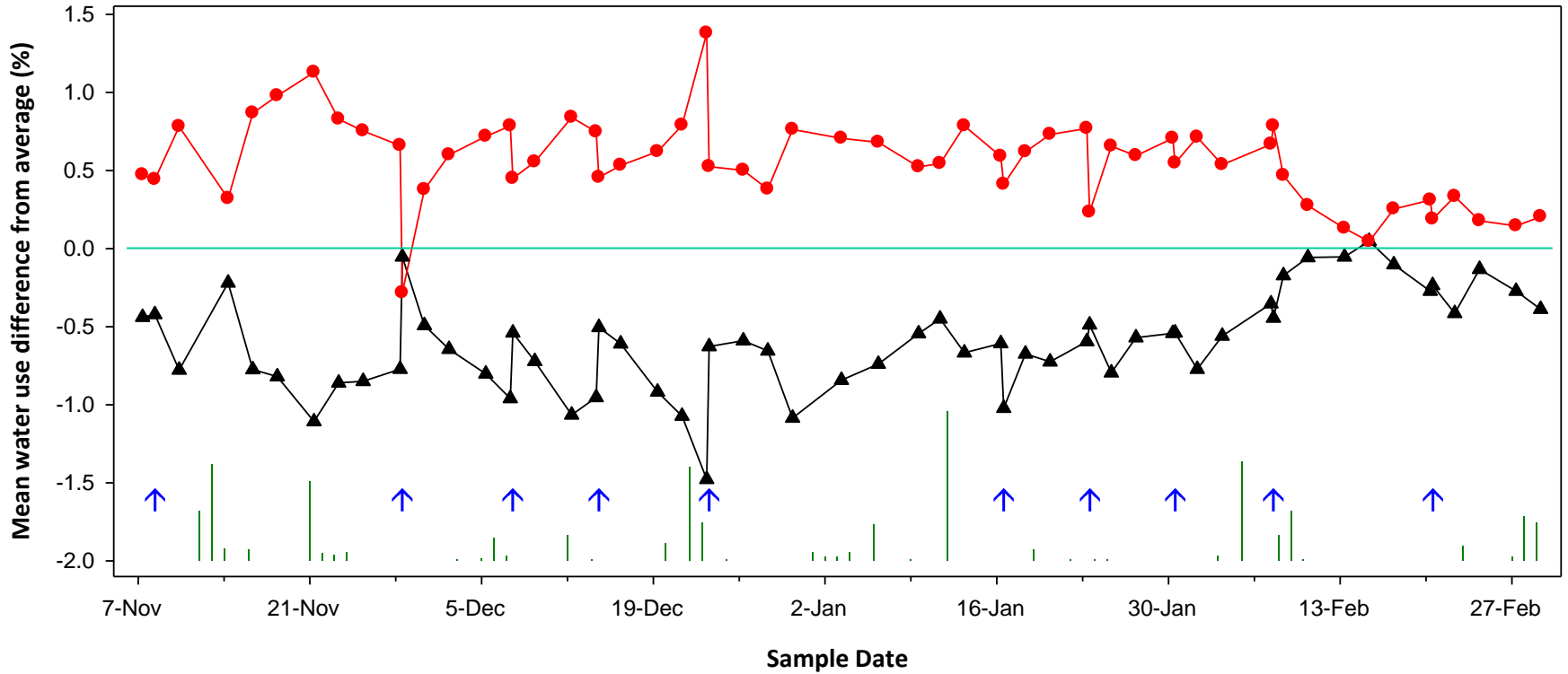
Time domain reflectometry

Dr Steve Thomas

Dr Ruth Butler



Water use



- ▲ Uninoculated
- Inoculated
- ↑ Irrigation
- Rain



Field observations in Tasmania

February 2008

- 19 fields surveyed at tuber filling
- (Russet Burbank, Umatilla Russet, Shepody, Bondi)
- 18 fields had plants with *Spongospora* root galls
- 90% sampled plants had root galls
- 59% sampled plants had tuber lesions

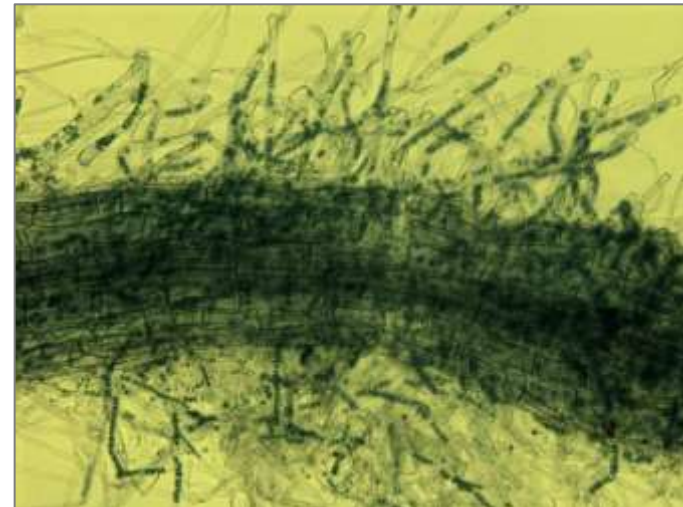


Simplot, Tasmania

USA reports

- Yields of russet varieties of field-grown potatoes in Washington State, reduced by 5-12 t ha⁻¹ due to root infection by *Spongospora*
- Potato plants grown in soil inoculated with *Spongospora* had reduced plant growth and tuber yields.

Nitzan *et al.* (2008) *Plant Disease* 92: 1643-1649
Houser & Davidson (2010) *Am. J. Pot. Res.* 87: 285-298





Antioquia, Colombia (2010)



“La enfermedad en las raíces redujo la producción a la mitad”
“This root infection reduces my yields by half”

Field survey in Canterbury 2012/13

Potatoes NZ/McCain Foods, Ravensdown

**11 crops, examined every 2 weeks from establishment
(‘Russet Burbank’, ‘Innovator’)**

- five crops without potatoes (10+ years)
- six crops with potatoes (≥ 1) in last 10 years

**Six crops with severe galls (5 old, 1 new)
Five without galls (1 old, 4 new)**



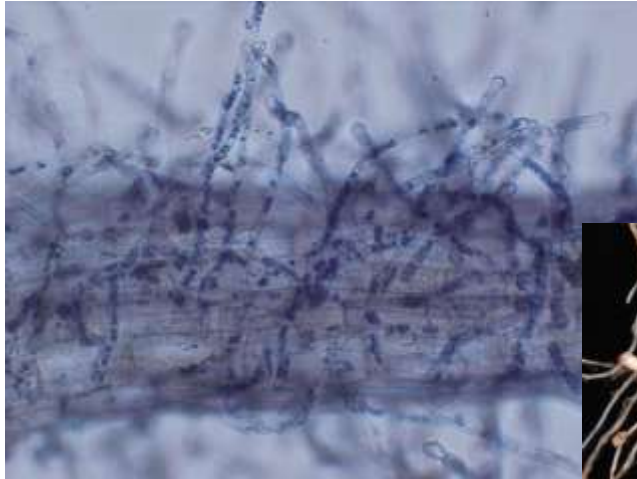
Conclusions

- *Spongospora* adversely affects host plant growth and productivity
- Deleterious effects occur both in tuber-resistant and tuber-susceptible cultivars
- Reduced root function, root galling and tuber powdery scab may not be related

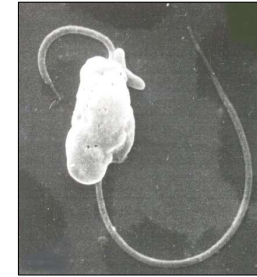
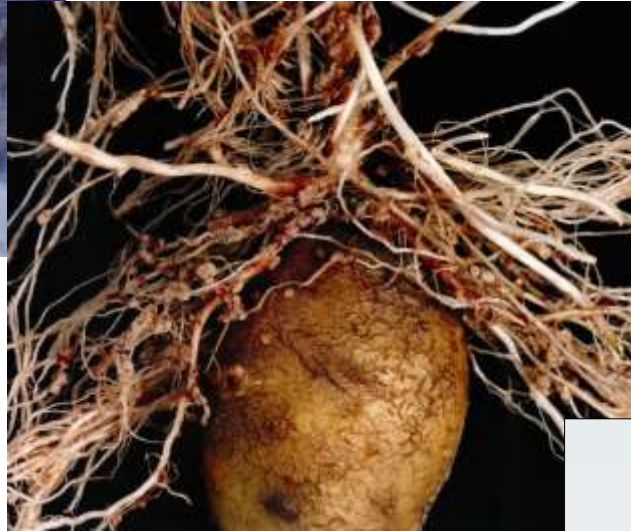


The diseases of *Solanum tuberosum* caused by *Spongospora subterranea*

disrupted root function



root hyperplasia



tuber powdery scab



Disease:
disturbance that interferes with normal growth and development (structure, function).