



# New developments in irrigation scheduling

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# Main aims of Projects R448 and R445

- a) To improve irrigation scheduling for varieties that are less susceptible to common scab than Maris Piper and for salad potato crops where irrigation is often continued for 8 weeks after tuber initiation.
- b) Gain an improved understanding of the mechanism by which irrigation reduces the population build-up of pathogenic *Streptomyces* on tubers.
- c) Determine how soil structure within the ridge or bed influences the optimal irrigation regime for scab.
- d) Quantify the effects of over-watering on root and crop growth, tuber health and quality and nitrogen use efficiency.
- e) Quantify the effect of different late-season SMD regimes on bruising incidence and severity.
- f) Quantify the effect of different late-season SMD regimes on rate of skinset.

# Maris Piper (2009)

Unirrigated

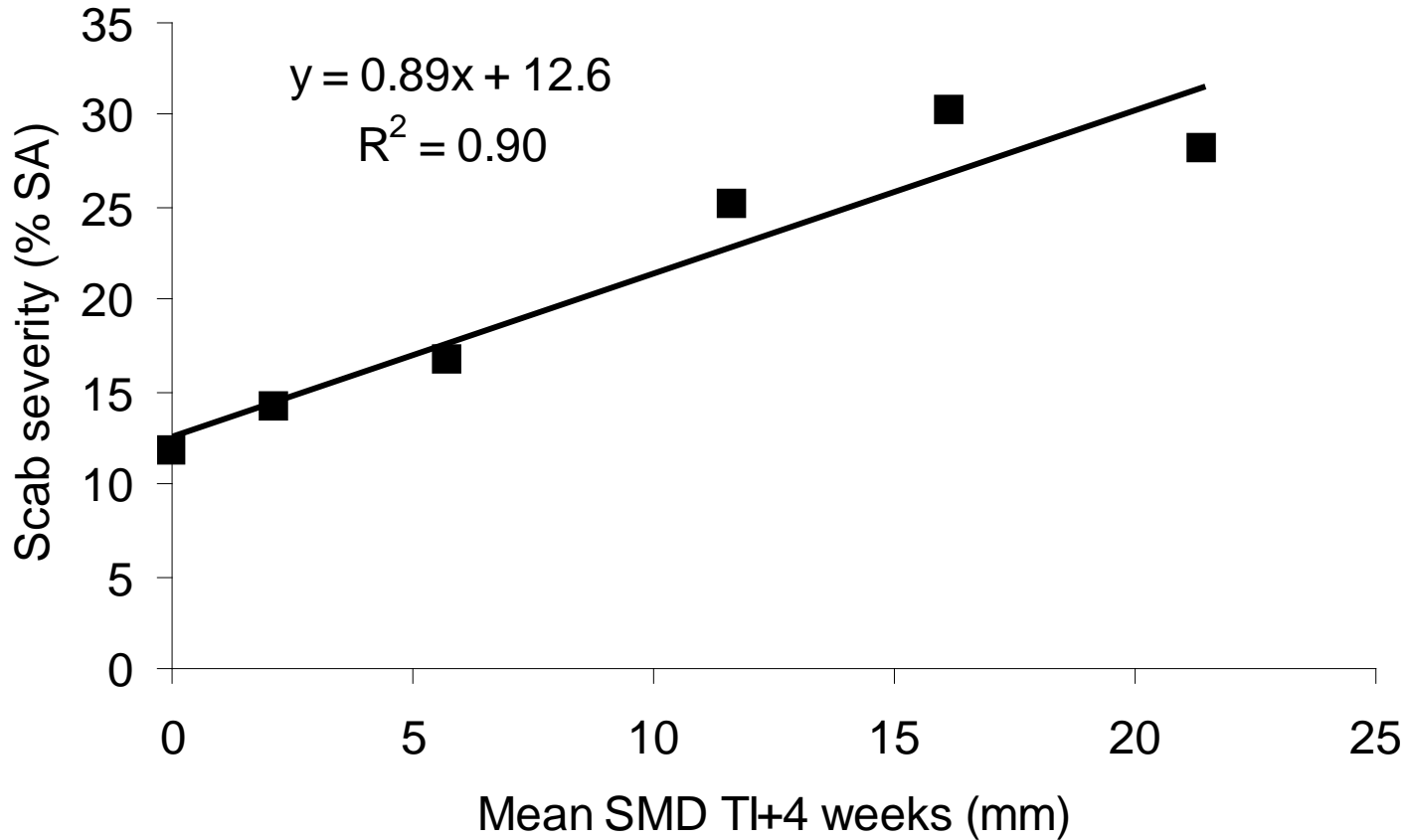
25 mm SMD

0 mm SMD



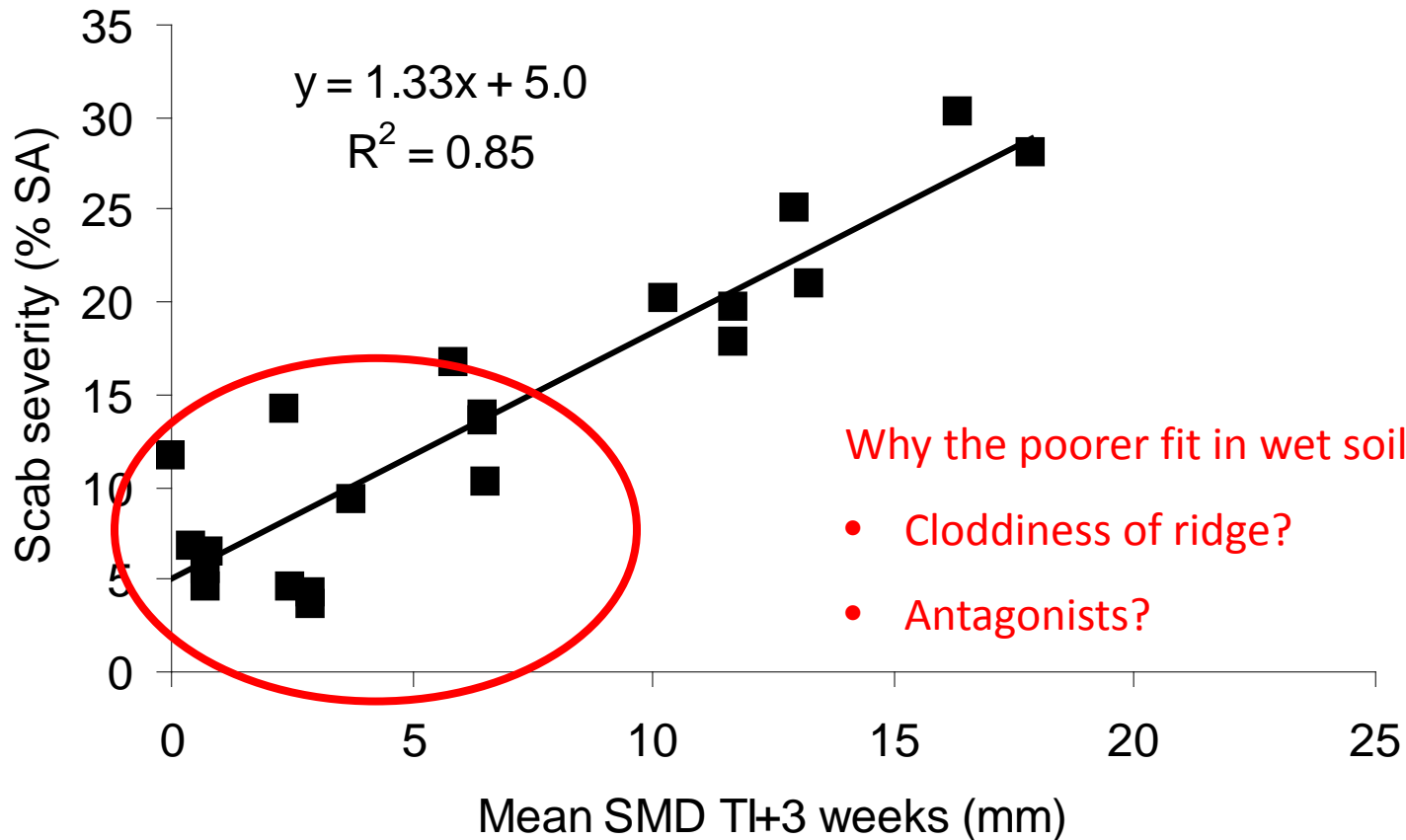
# Scab severity vs SMD

(Maris Piper 2010)



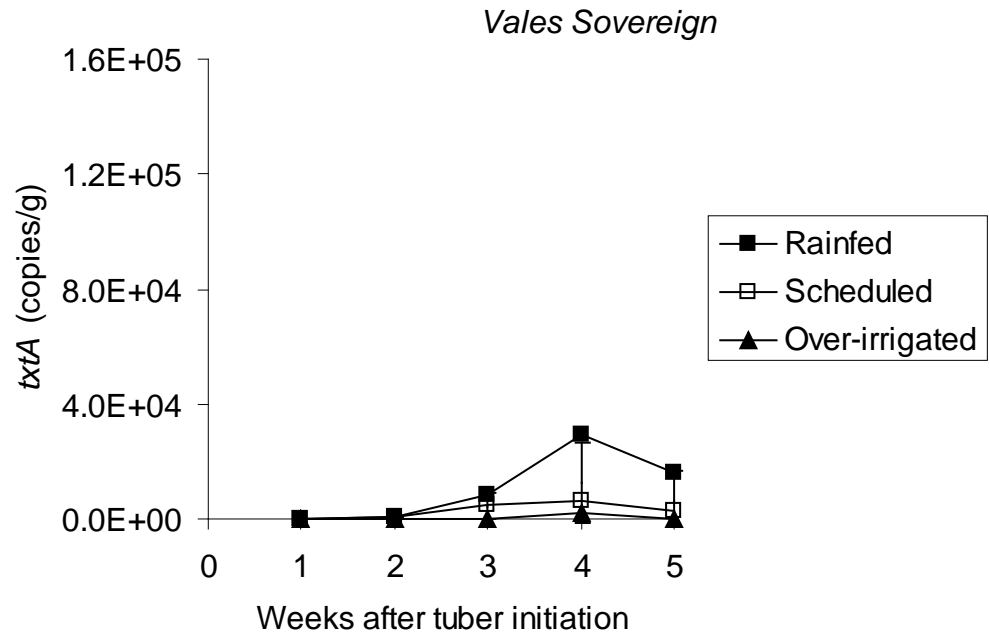
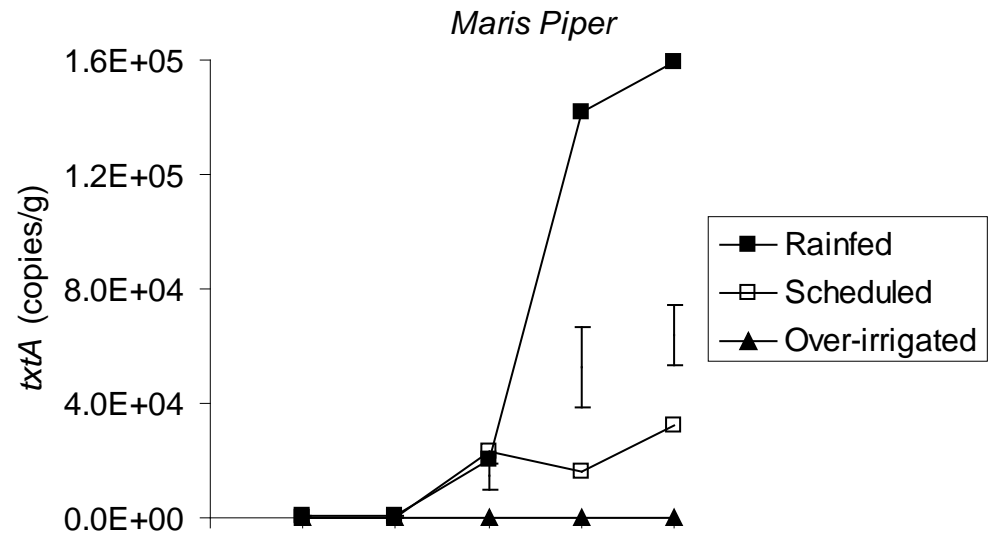
# Scab severity vs SMD

(Maris Piper 2007-2010 sprinkler irrigation)

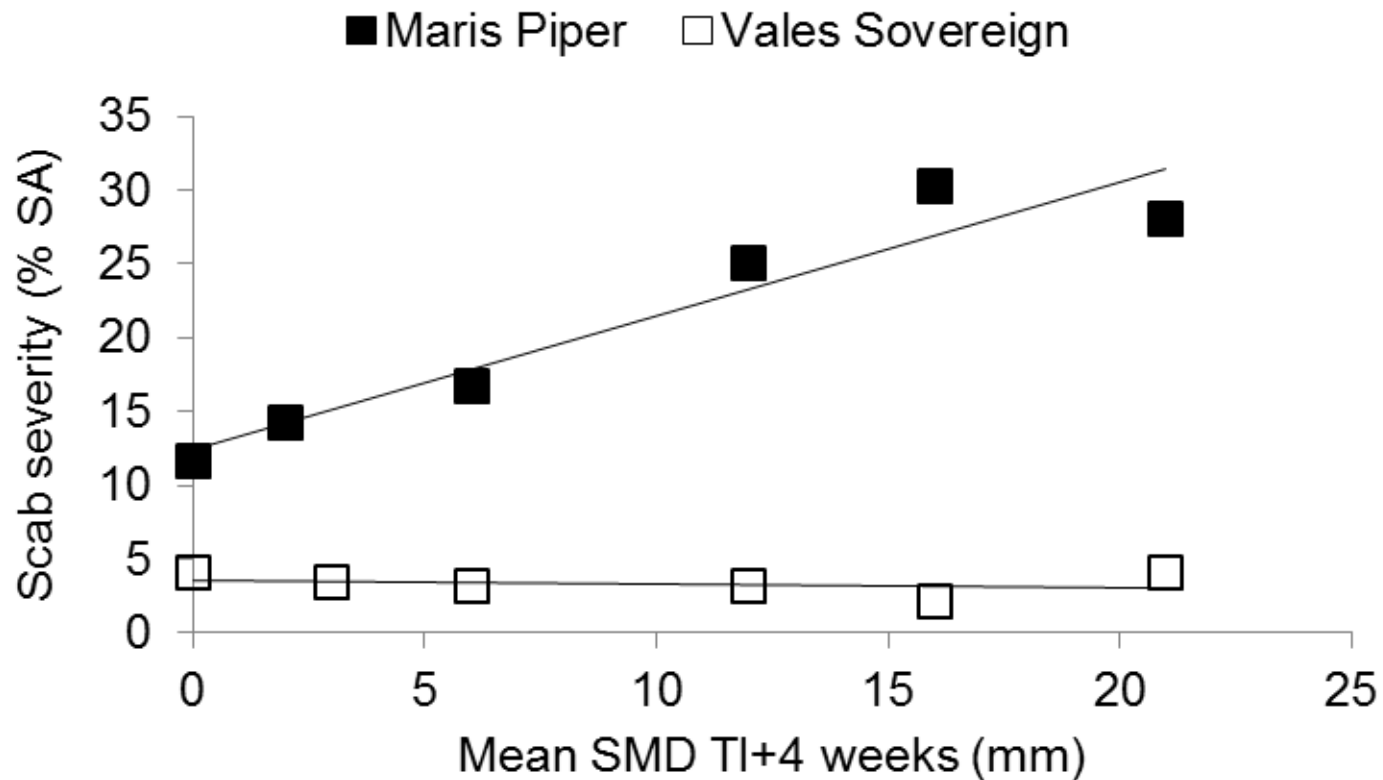


Increase in pathogenic *Streptomyces* populations is greater in dry soils than wet and smaller in more resistant varieties than very susceptible.

Peak populations at 4-5 weeks.



# Scab severity vs SMD (Vales Sovereign 2010)



# Maximum SMD (mm) for common scab control in different varietal scheduling groups

## Notes:

SMD for top 25 cm of ridge and stone-free ridge profile. This can be calculated by water balance ('model'), directly measured or converted from soil water tension.

†Marabel and Safari: tentative.

‡Excessively cloddy soils may need to be maintained at a smaller SMD.

Values in () are the rankings for common scab resistance in Potato Council Variety Database. 1 = most susceptible, 9 = fully resistant.

	Group	1. Susceptible	2. Intermediate	3. Resistant
	Varieties	Maris Piper(1) Maris Peer (5)	Charlotte (4) Desiree (4) Estima (6) Exquisa Flair King Edward (7) Marabel† Melody (7) Nectar (6) Rooster (6) Sylvana (7) Safari† (4) Venezia Vivaldi (5)	Bute (4) Electra (8) Elfe Jelly (6) Lanorma (7) Orchestra (8) Perline Regina Vales Sovereign (7) Volare (5)
Soil texture				
Sand		9.8	14.6	18.8
Loamy Sand		12.0	17.9	23.1
Sandy Loam		13.4	20.0	25.8
Sandy Silt Loam		14.4	21.5	27.7
Silt Loam		16.3	24.3	31.4
Clay Loam/Clay‡		14.4	21.5	27.7



For scheduling irrigation, need only consider SMD's in the ridge (top 25 cm)



# Relative proportions of bacterial orders on the surface of Maris Piper tubers in 2009



# Summary: antagonists

- Encouraging:
  - Thwaites & Stalham (2010) showed that populations of the bacterial orders *Flavobacteriales* and *Acidobacteriales*, that may be responsible for inhibiting *Streptomyces*, were higher in frequently-irrigated plots in 2008 than in unirrigated ones.
  - In a subsequent study in 2009, the two main orders of potential bacterial antagonists that were found to increase dramatically in irrigated soils were *Flavobacteriales* and *Bacillales*.
  - In a smaller-scale study reported by Thwaites & Stalham (2010), *Pseudomonadales* was up to ten times more abundant in irrigated than unirrigated plots.
- Unfortunately:
  - Whilst Project R448 demonstrated differences in populations of the major bacterial phyla *Actinobacteria*, *Bacteroidetes*, *Proteobacteria* and *Acidobacteria* on tubers grown in soils used for experiments, no clear correlation with common scab severity was found.
  - There was also no apparent link between bacterial community structure and populations of pathogenic *Streptomyces*, so clearly our understanding of the control agents is, at present, weak but is worthy of further research.

Venezia 4 wks



## Summary:

Venez

6 week irrigation period is adequate for scab control in Maris Peer (formerly 8 weeks)

Venez

4-5 weeks in less susceptible varieties (Perline, Regina, Venezia)

Salads: duration





# Cracking symptoms

Maris Piper



Vales Sovereign

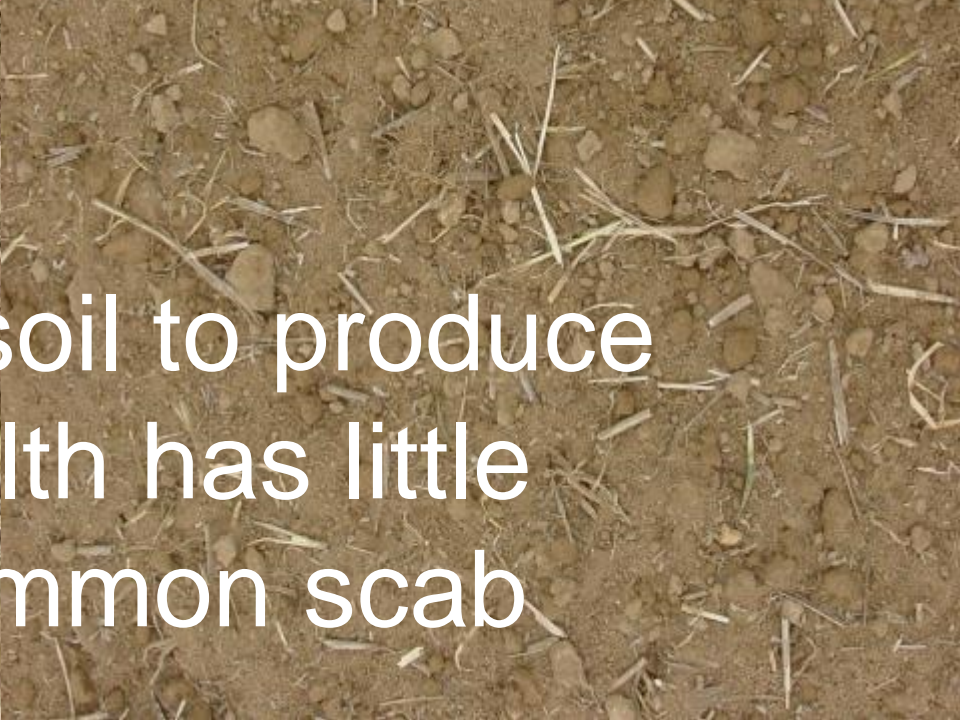
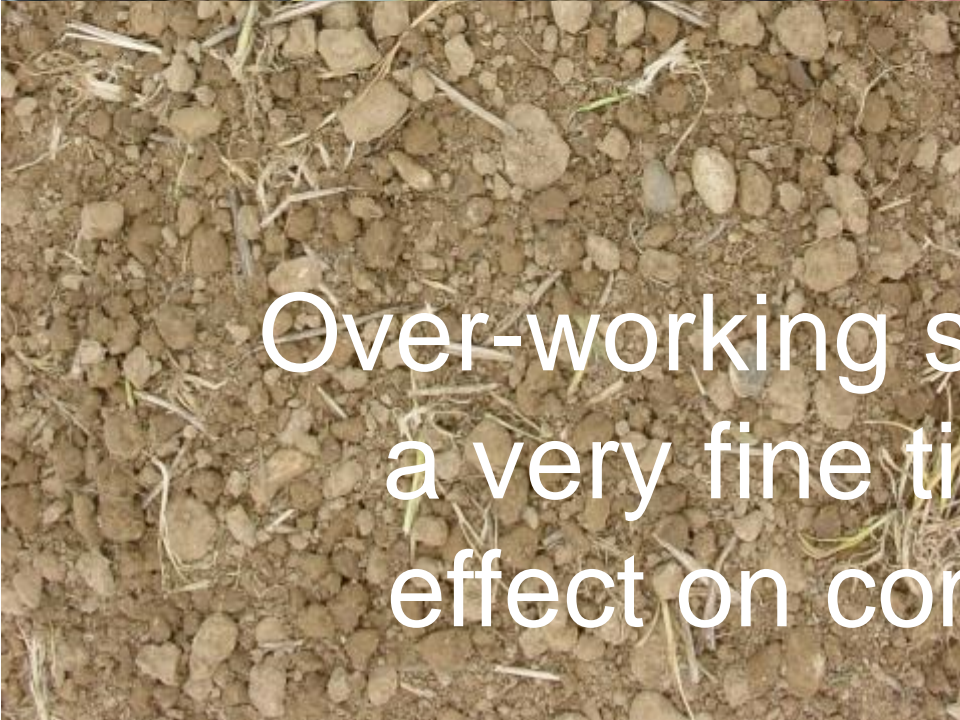


# Risk of cracking from over-watering during scab control

Group		
1. High risk	2. Moderate risk	3. Low risk
<b>Safari</b> <b>Estima</b> <b>Vales Sovereign</b> <b>Melody</b> <b>Orchestra</b> <b>Nectar</b> <b>Maris Piper</b> <b>Lanorma</b> <b>Bute</b> <b>Sylvana</b>	<b>Flair</b> <b>Jelly</b> <b>King Edward</b> <b>Maris Peer</b> <b>Volare</b>	<b>Desiree</b> <b>Elfe</b> <b>Exquisa</b> <b>Marabel</b> <b>Perline</b> <b>Regina</b> <b>Venezia</b> <b>Vivaldi</b>

Listed in Group 1 by decreasing risk





Over-working soil to produce a very fine tilth has little effect on common scab

# Common scab and bed tilth

## Project R459 (12 experiments, 2013-14)

Bed tilth prior to planting	Scab incidence (<5 % SA)	Scab severity (% SA)
Cloddy	94.9	0.88
Commercial	94.3	1.01
Fine	94.9	0.97
S.E.	1.75	0.312

No effects on greening or cracking either



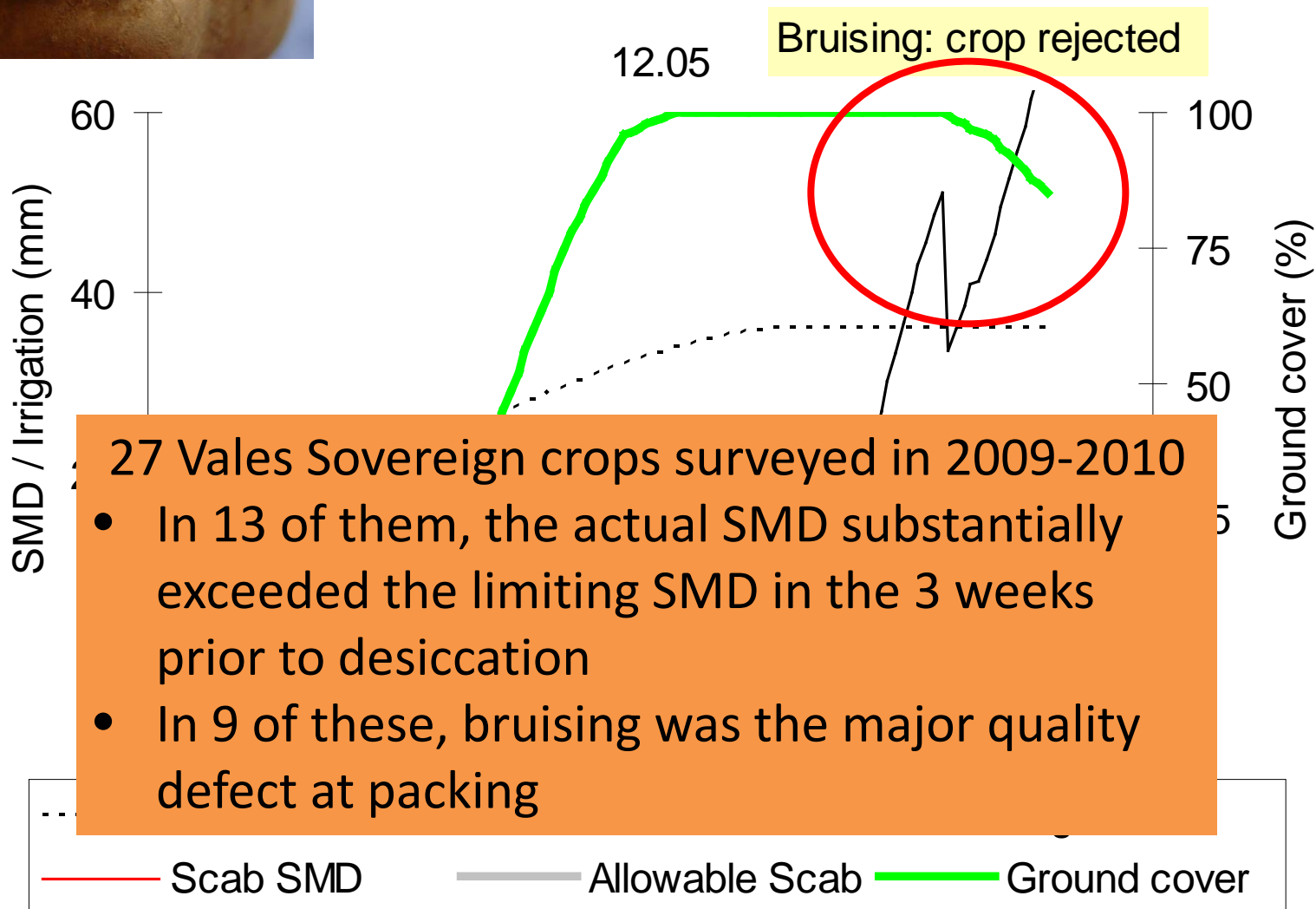
# Late season irrigation (R445)

Year	Field	Blackspot incidence (%)			Skinning (% SA)		
		-I	+I	S.E.	-I	+I	S.E.
2011	Chapmans	61.3	61.0	2.60	12.2	10.2	1.82
	Craft	37.8	39.0	1.74	10.6	11.5	0.71
2012	Ashby	42.3	29.3	2.14	35.8	36.5	1.61
	Beacon	38.0	29.7	2.41	20.0	20.1	1.28
2013	Redhouse	29.3	20.5	2.09	11.8	13.5	0.83
	Foxholes	45.0	31.7	3.19	17.9	19.8	1.47
Mean		42.2	35.2	2.00	18.1	18.6	1.09

- In seasons where significant deficits accumulated and rain did not interfere, bruising was significantly greater where irrigation was withheld in the 3 weeks prior to desiccation.
- There was no effect of watering on skinset.
- Bruise reduction is the key target of late-season irrigation scheduling.

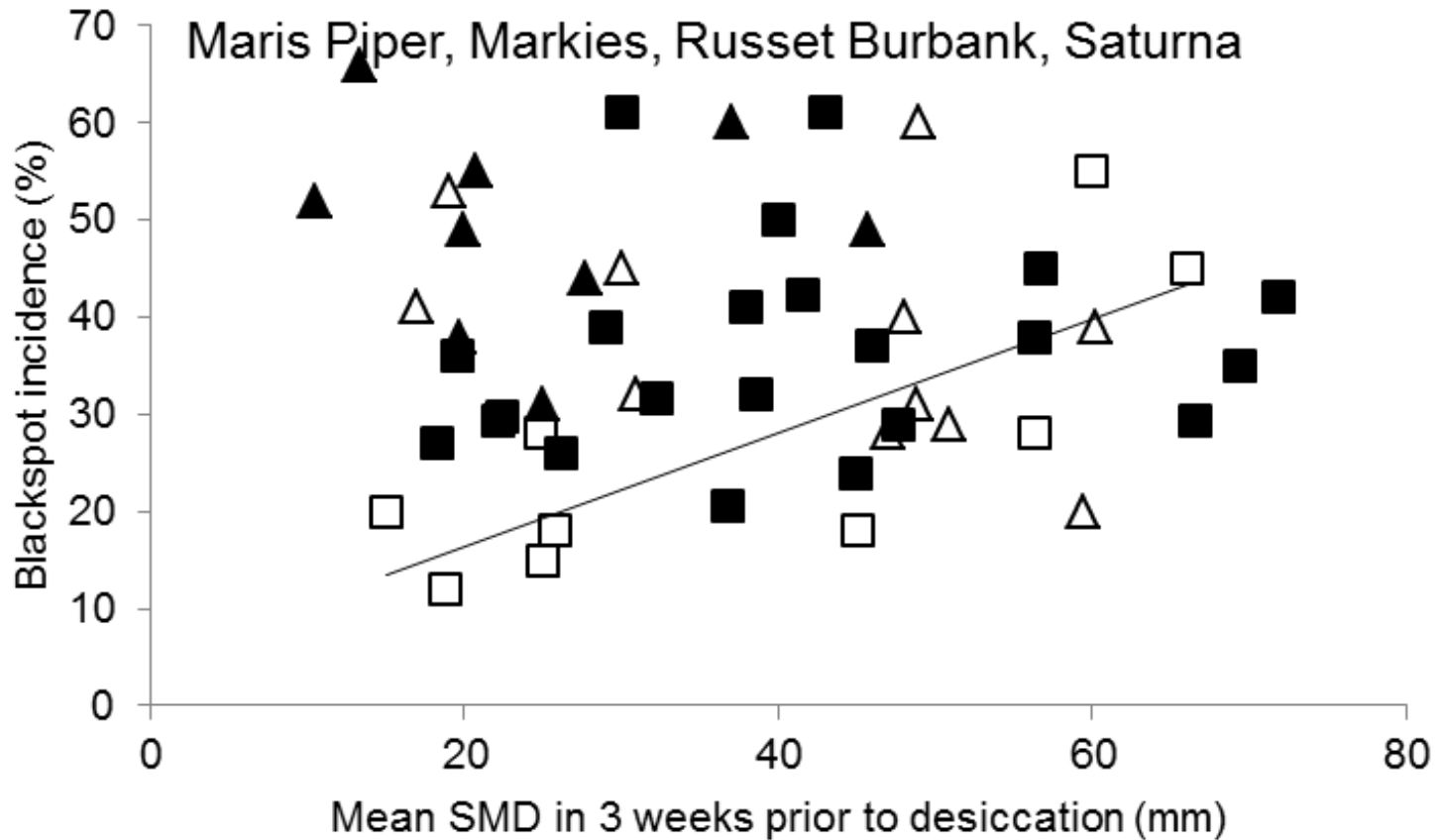


# Late-season soil water stress



# Bruising vs SMD prior to desiccation

Markies: Blackspot =  $0.58 * \text{SMD} + 4.7$   $R^2 = 0.61$



# Recommendations

1. **Varietal scheduling.** Irrigation regimes for scab should be adapted according to varietal susceptibility (higher allowable SMDs for more resistant varieties).
2. **Delayed start irrigation.** For all varieties other than Maris Piper, delaying start of irrigation until 1 week after initial TI would produce equally good control of scab to commencing irrigation at TI. Delayed-start irrigation should be based on initial TI.
3. **Duration of irrigation for salad varieties.** A 6-week period for scab control is sufficient in susceptible varieties such as Maris Peer and Charlotte and 4-5 weeks in less susceptible varieties such as Regina, Perline or Venezia.
4. **Processing crops.** The best time to irrigate is between 1 and 3 weeks after TI, since this coincides with the most rapid phase of pathogen development on tubers. Only irrigating for 2 weeks after TI often results in worse common scab.
5. **Risk of over-watering.** Over-watering during TI and the scab control phase should be avoided as this increases the incidence of tuber cracking and rotting diseases, reduces nitrogen uptake and promotes early senescence.
6. **Soil structural conditions.** Growers should not be producing overly-fine seedbeds as this does not improve control of common scab.
7. **Late-season irrigation.** Growers should monitor and maintain moderate deficits close to haulm destruction in order to maintain tuber hydration and reduce bruising. This will not delay skinset.