SPotFarm Results 20 January 2021

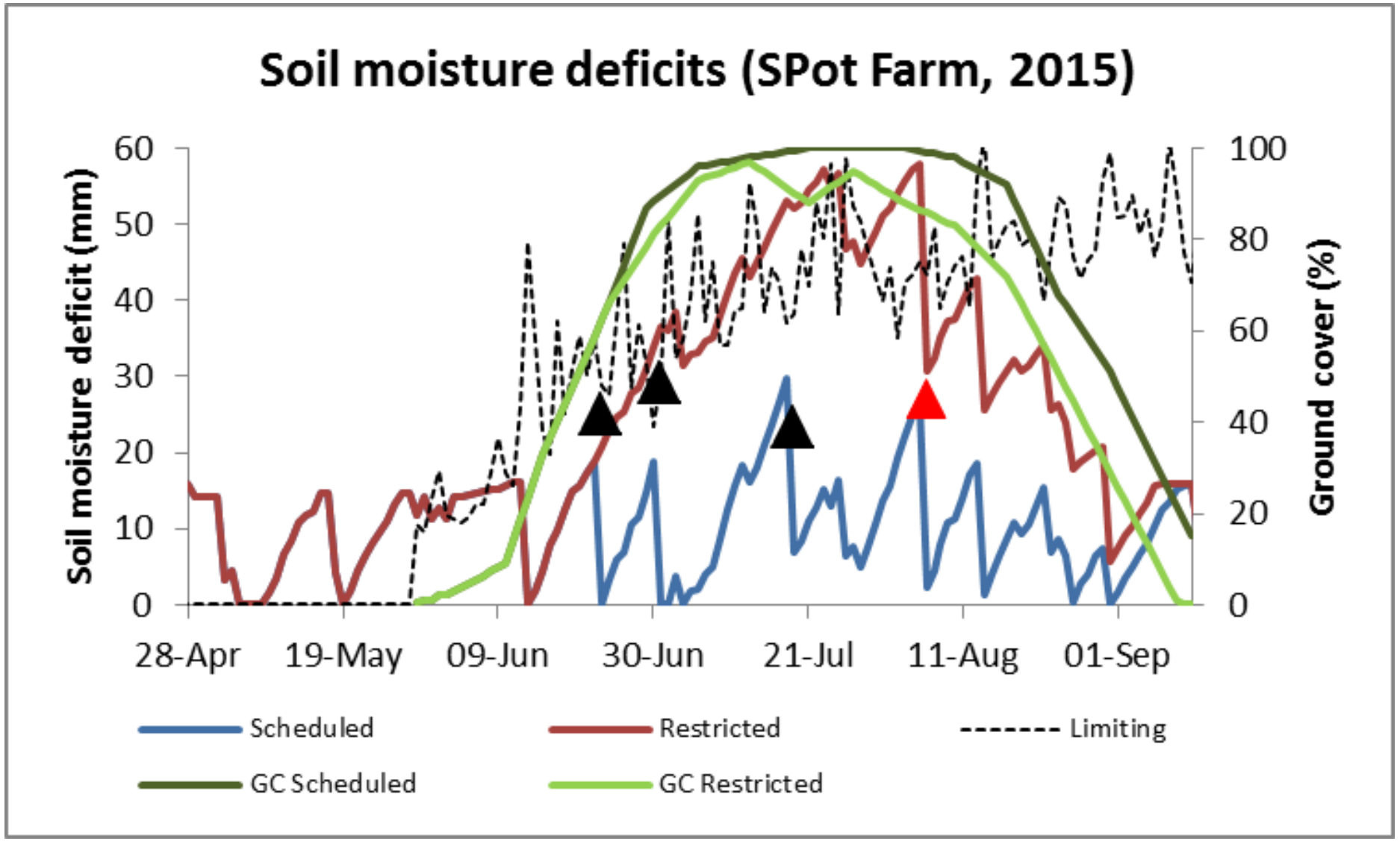
Which approach to potato irrigation? Findings from SPot Farm Trials, 2015-2018

Mark Stalham, Will Gagg, Amber Barton and Bob Hillier *et al.*

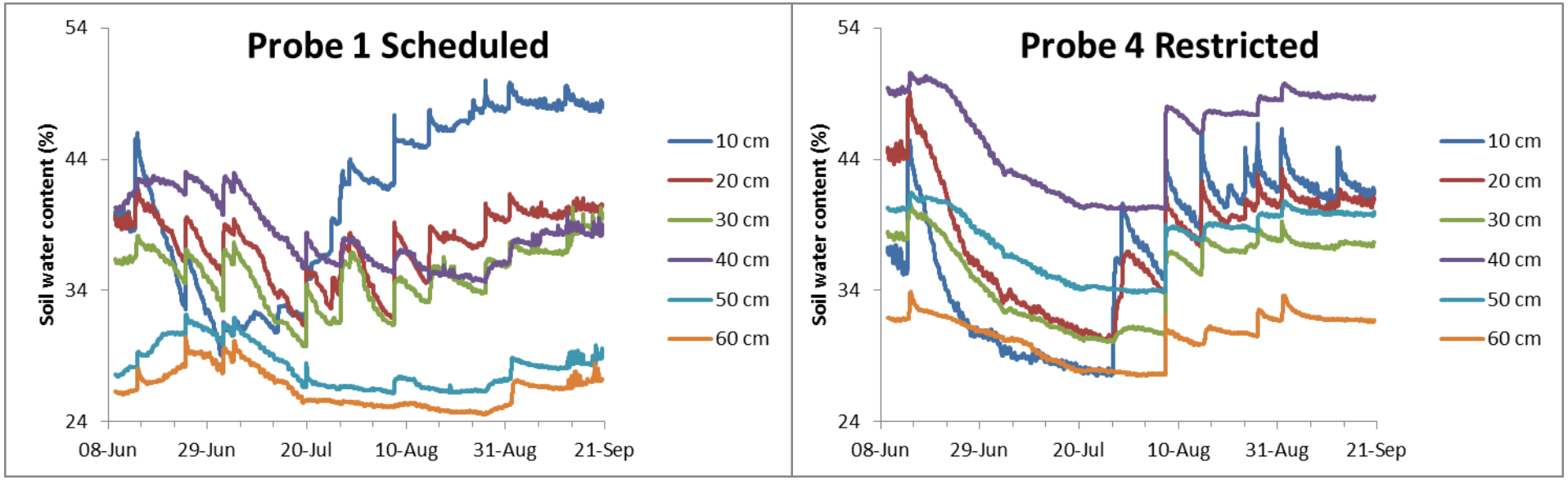
2015-2018 SPot Farm Irrigation Trials Aims

Aims

- 2015 (SPot West): To demonstrate and compare scheduling methods
- 2016/17 (SPot East)
  - Effect of rate and timing of irrigation on yield and N utilization
  - Scab control for new varieties


Soil moisture deficits (SPot Farm, 2015)
Soil moisture deficit (mm)
60
50
40
30
20
10
0
100
80
60
40
20
0
Ground cover (%)
28-Apr
19-May
09-Jun
30-Jun
21-Jul
11-Aug
01-Sep
Scheduled
Restricted
Limiting
GC Scheduled
GC Restricted

Agrii Soil Moisture Probe Plots SPot West 2015 (Location 1)



Note almost complete cessation of water uptake in 40, 50 and 60 cm horizons in Restricted treatments from 21 July to 5 August . Daily water use according to the NIAB CUF Model was only 1.9 mm/day c.f. 2.8 mm/day in Scheduled, with most water uptake predicted by the model to be occurring in 40+ cm horizons.

Water use and yields

	Rain (mm)	Etpot (mm)	Irrig. (mm)	Drain. (mm)	Water use (mm)	Potential (%)
Scheduled	170	201	105	31	195	97
Restricted	170	177	30	10	147	83

					Proportion > 90 mm length	
	Tuber no. (000/ha)	**Total yield (t/ha)**	**Yield >40 mm (t/ha)**	**[DM] (%)**	**No. (%)**	**Yield (%)**
Scheduled	317	56.5	55.6	22.3	55	70
St. Dev.	14.6	1.78	2.12	2.13	3.5	3.1
Restricted	367	47.0	44.8	21.8	29	42
St. Dev	29.5	2.51	2.99	1.06	13.3	12.3

Ratios Restricted : Scheduled

Potential water use	0.85
Yield	0.83

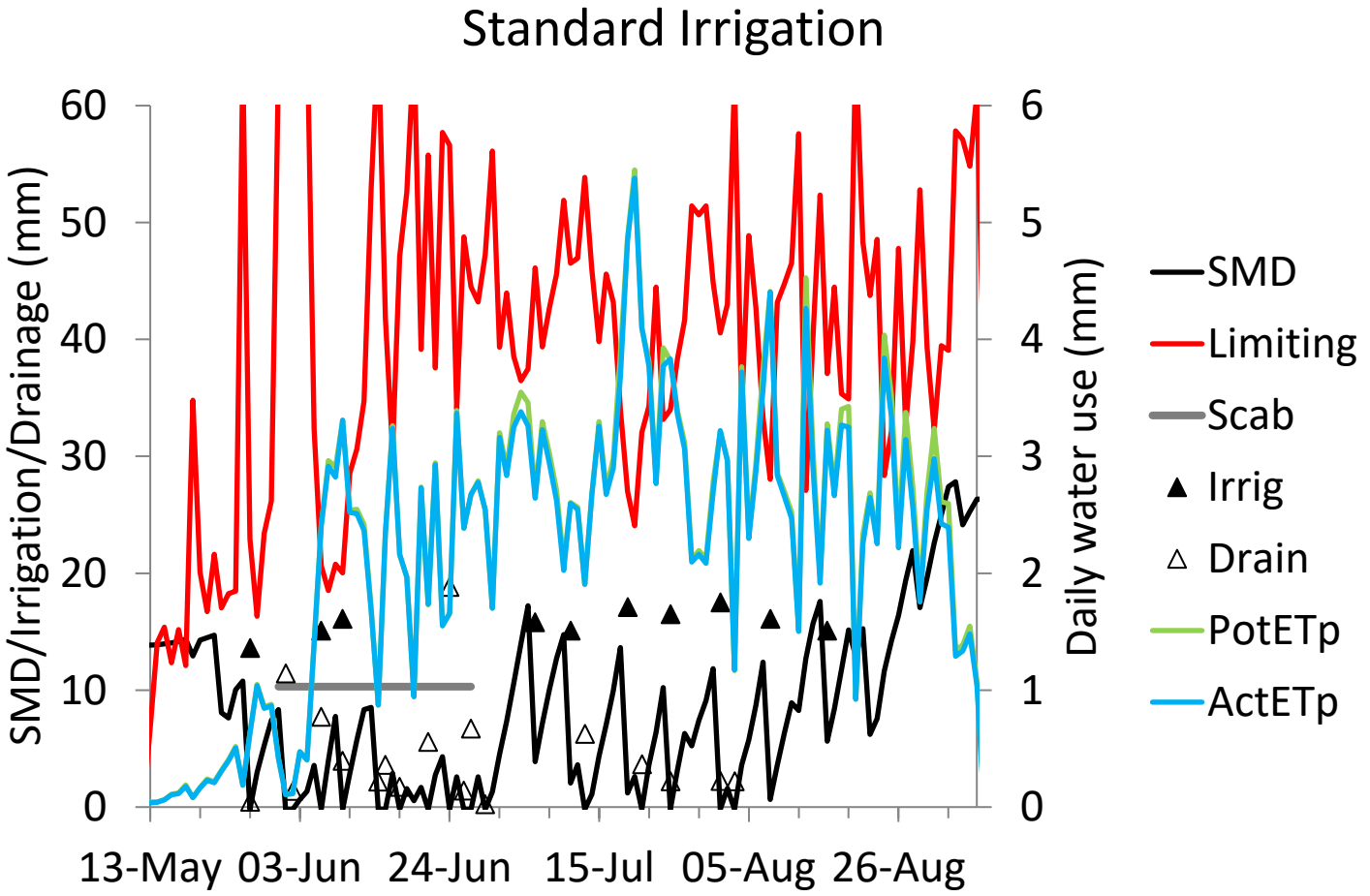
SPot Farm East Results, 2016-2017 Irrigation and nitrogen

Mark Stalham & Marc Allison

Trials conducted by NIAB CUF

- N * Irrigation (sandy loam, 80 % S, 13 % C)
  - N (260 kg)
    - Standard Split N
    - All N in seedbed
  - Irrigation
    - Standard (15 mm @ 15 mm SMD)
    - Frequent (2 x 8 mm rather than 15 mm dose)
    - Over-water (25 mm @ 15 mm SMD)
- Irrigation start date for processing crops
  - Standard 15 mm @ 15 mm SMD from TI
  - Delayed start (1 week after TI)
- Scab control for packing crops (sand, 14 varieties)
  - Standard 10 mm SMD in bed from TI for 4 weeks, 15 mm application
  - Half-frequency 20 mm SMD in bed, 25 mm application

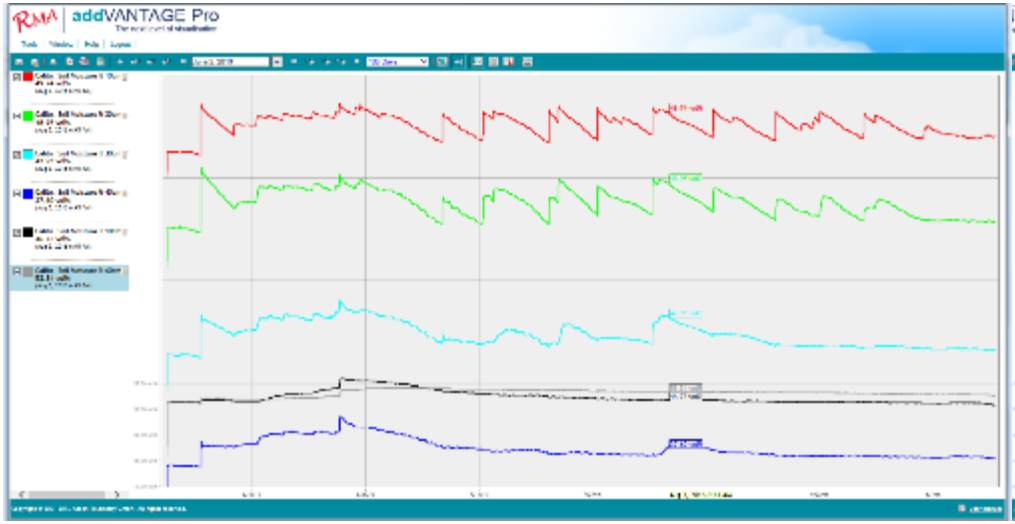
N * Irrig: soil moisture deficits

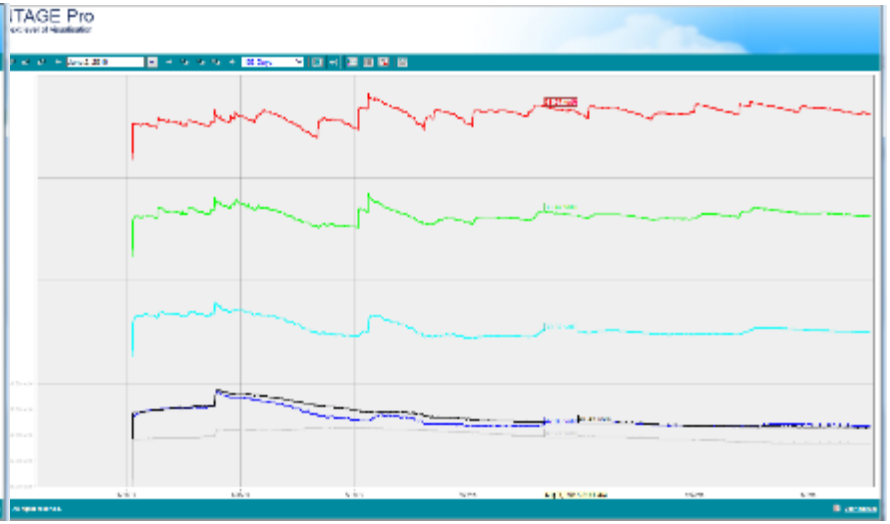


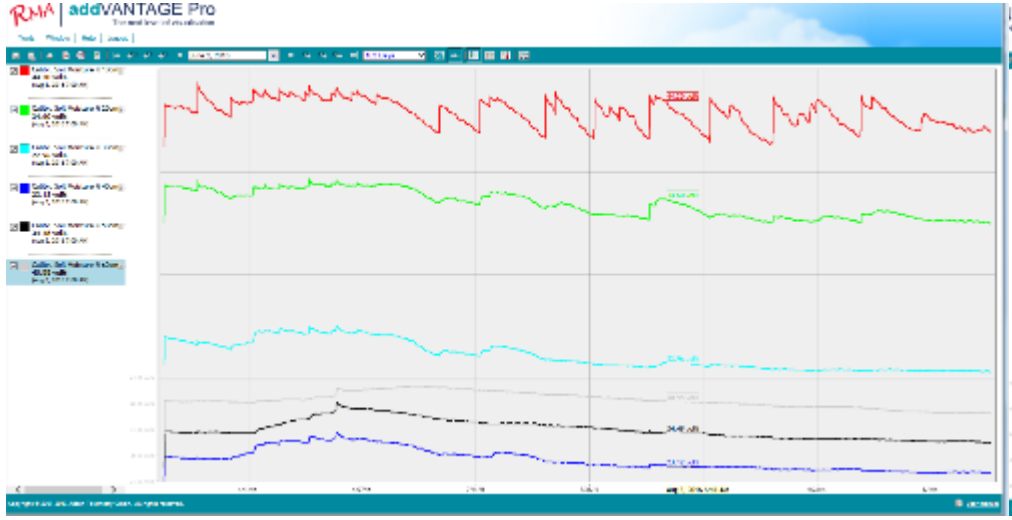
Agrii Soil Water Sensor Data

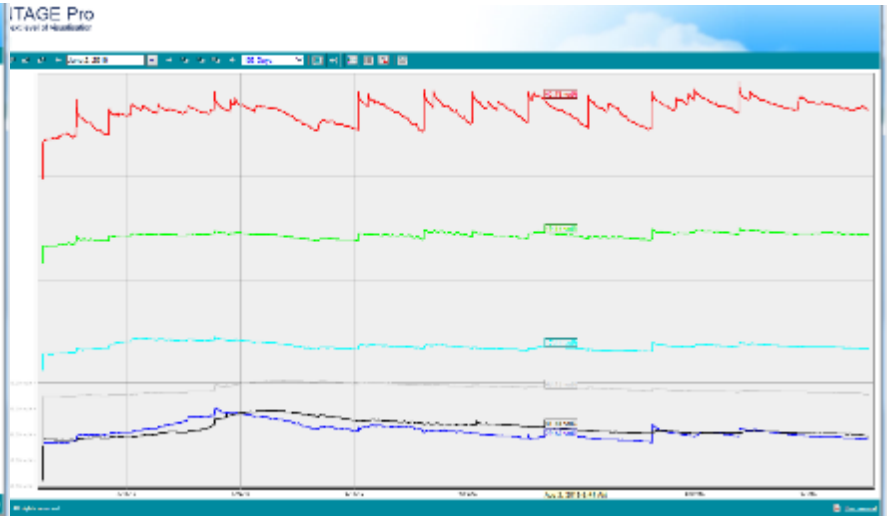
Standard

Over water

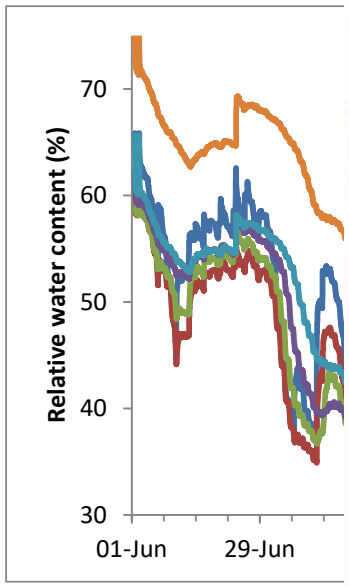


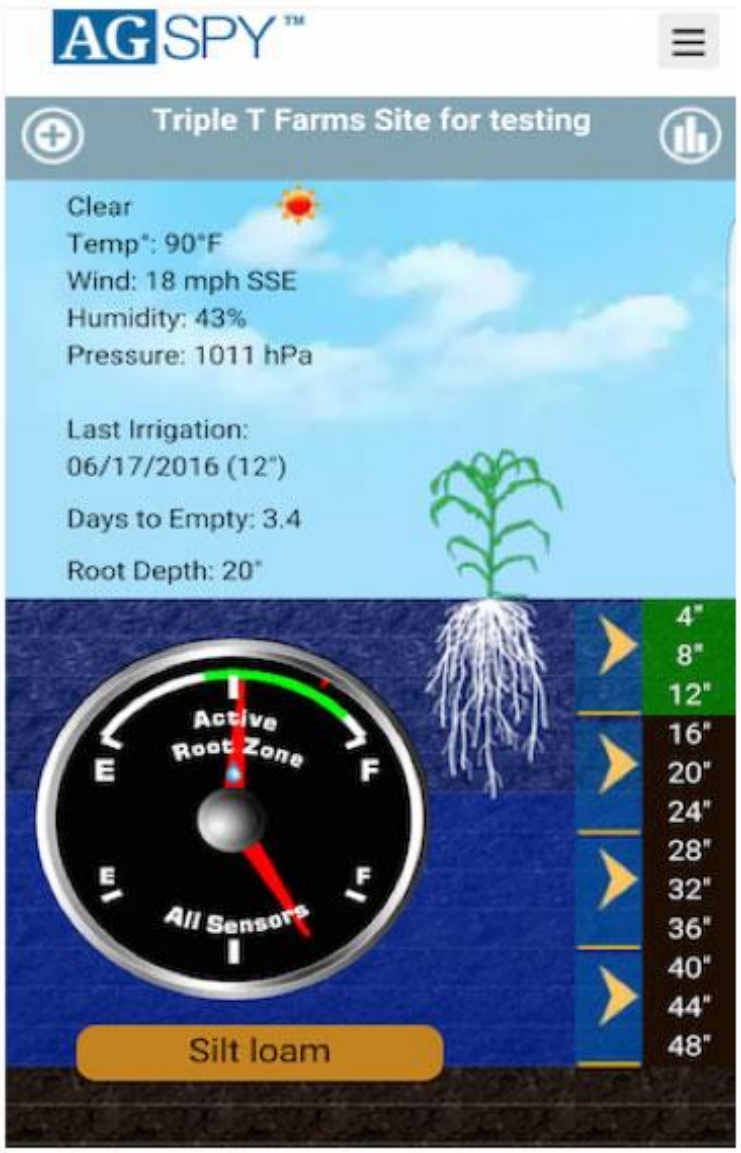


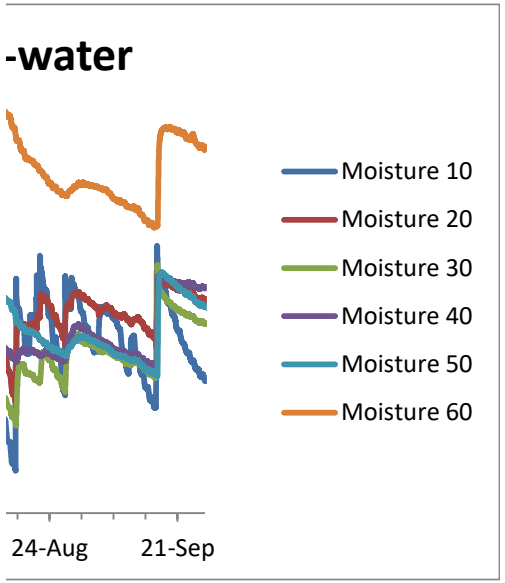


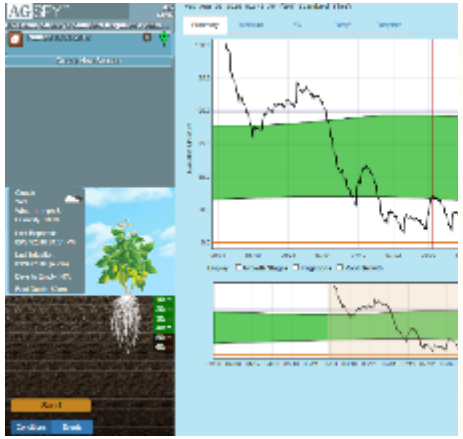


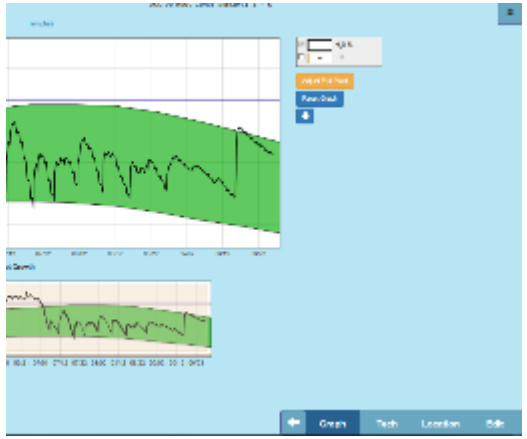
Aquaspy Soil Water Sensor Data





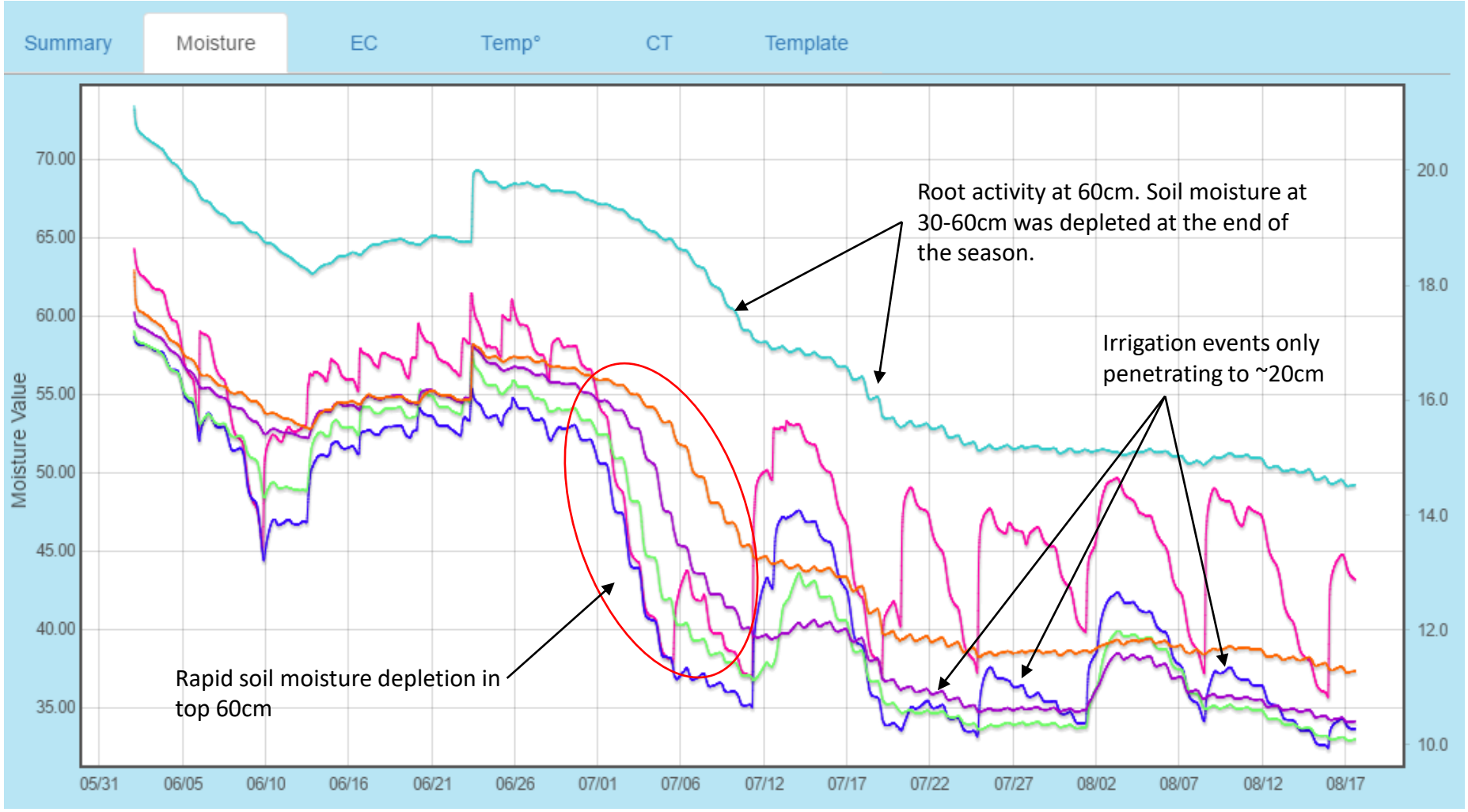




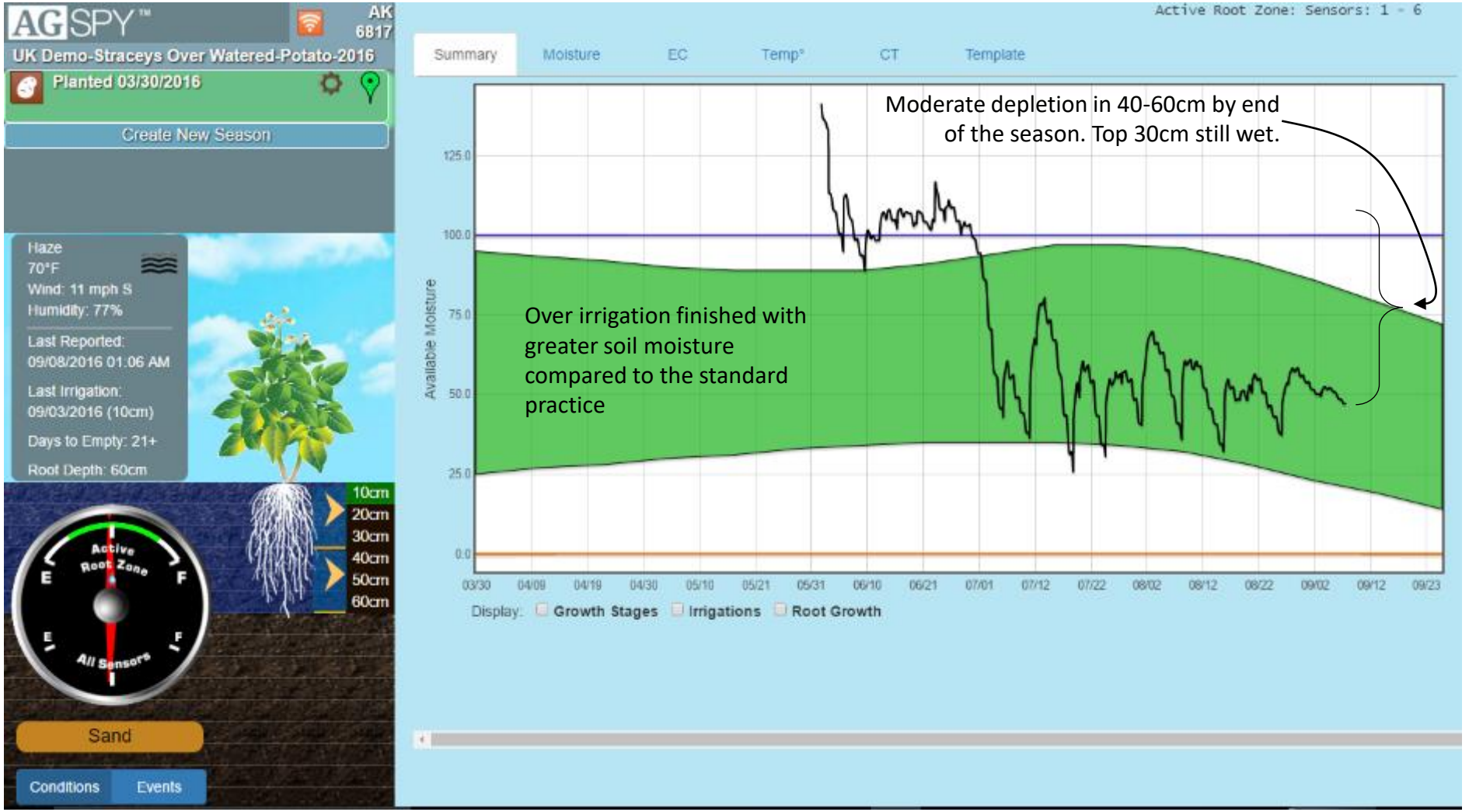


Standard irrigation

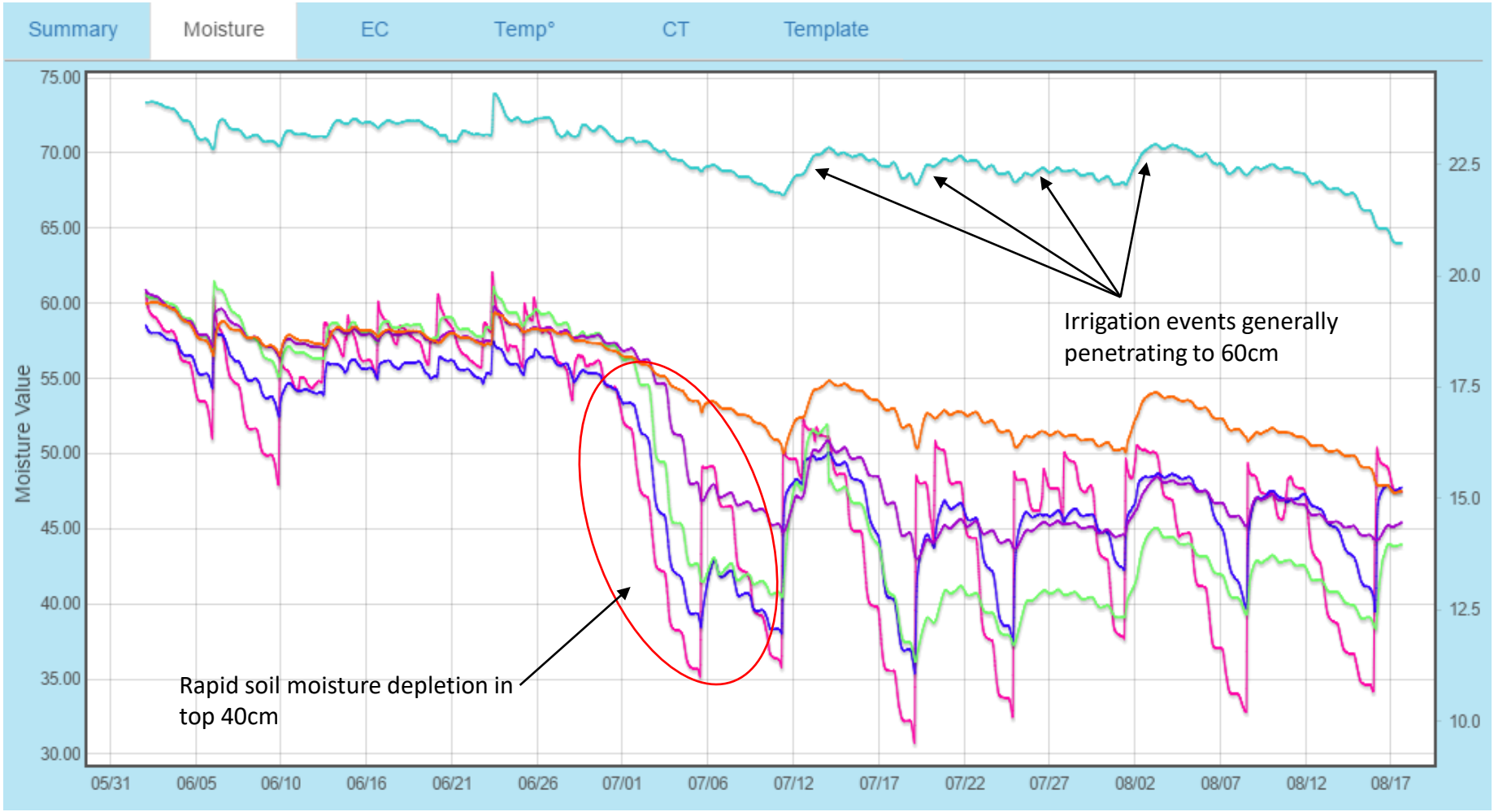
Standard irrigation



Over irrigation

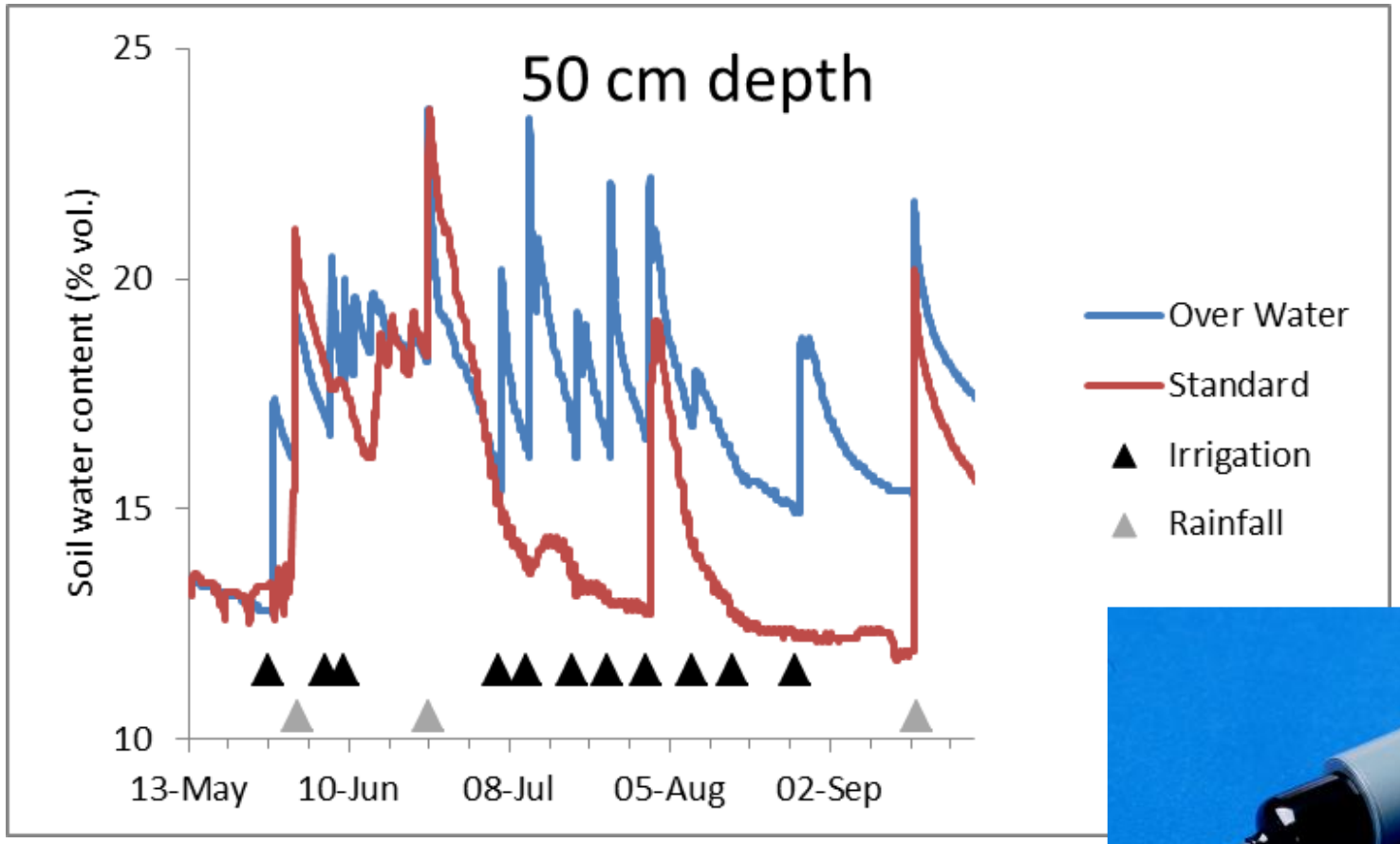


Over irrigation



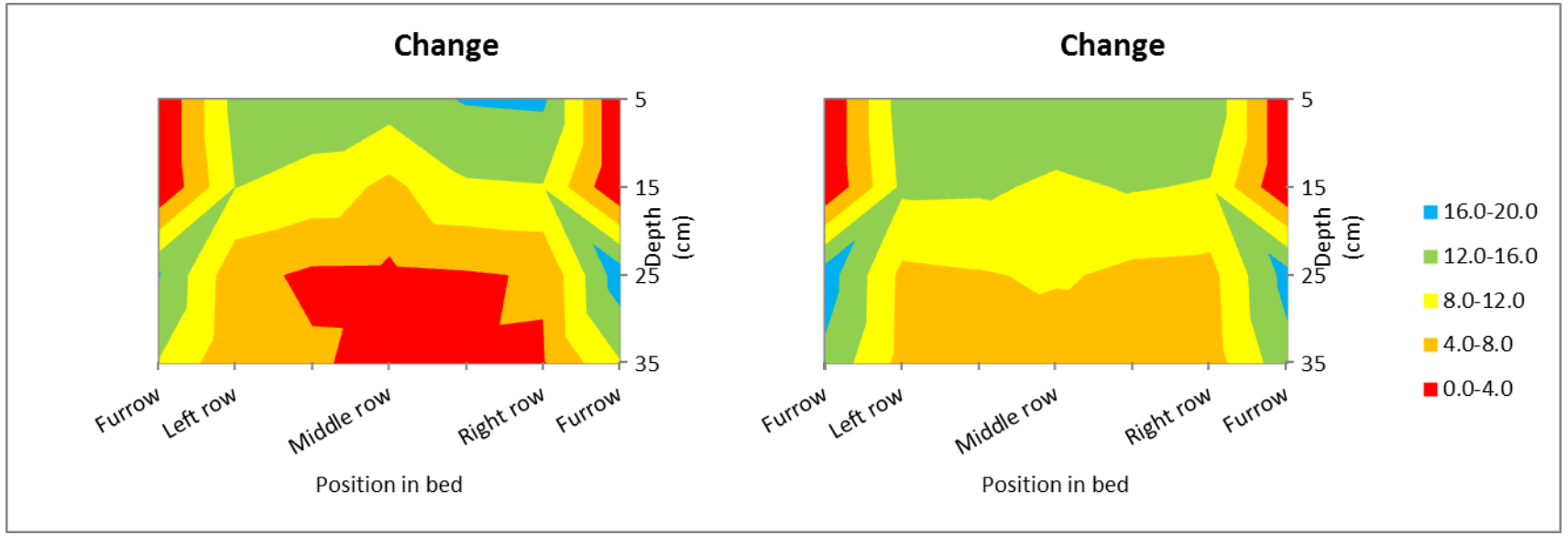
Drainage events recorded by Theta Probe

Over Water recorded rapid wetting at every irrigation.
Nothing in Standard except on 1 August but model also showed this.



Infiltration across bed after 2 hours:

Application 18 mm 27 mm



N * Irrig: yield (irrigation means)

Irrig	N	Stems (000/ha)	Tubers >10 mm (000/ha)	Tubers <40 mm (000/ha)	Yield >40 mm (t/ha)	>90 mm length (%)	DM (%)	DM yield (t/ha)
Std		76 (± 7.0)	405 (± 34.5)	89 (± 19.9)	68.7 (± 4.62)	94 (± 1.4)	22.3 (± 0.41)	15.8 (± 1.29)
Freq		64 (± 5.5)	319 (± 41.6)	37 (± 11.9)	70.8 (± 5.57)	92 (± 3.1)	22.3 (± 0.41)	16.1 (± 1.42)
O-water		76 (± 15.6)	426 (± 102.0)	90 (± 51.5)	67.4 (± 5.52)	91 (± 6.4)	21.5 (± 0.81)	14.5 (± 1.87)

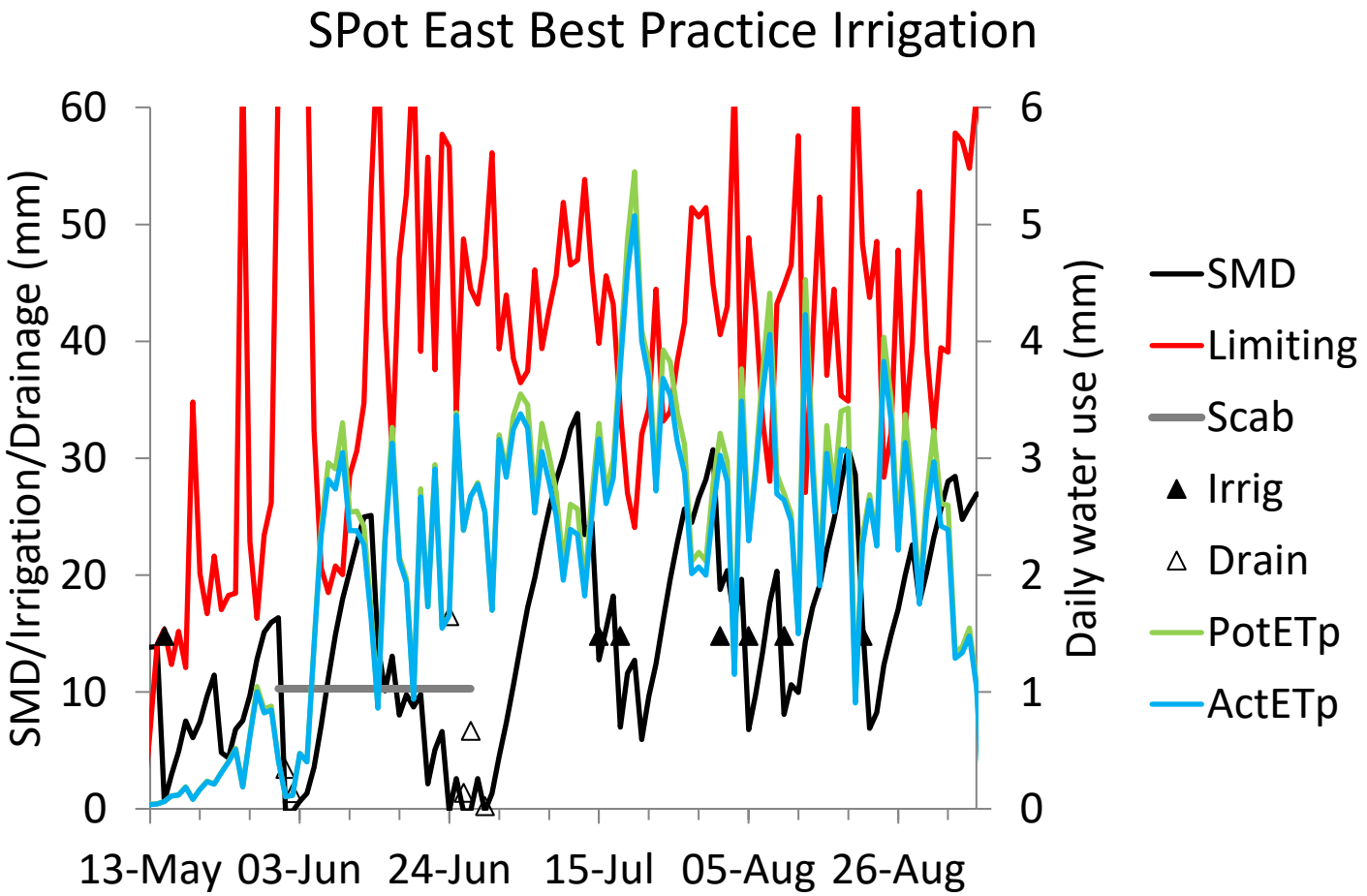
Irrig		Stems (000/ha)	Tubers >10 mm (000/ha)	Tubers <40 mm (000/ha)	Yield >40 mm (t/ha)	>90 mm length (%)	DM (%)	DM yield (t/ha)
Std		82 (± 9.9)	385 (± 46.3)	67 (± 19.2)	70.9 (± 1.79)	93 (± 3.4)	22.3 (± 1.56)	16.2 (± 1.56)
Delayed start		86 (± 4.2)	397 (± 13.8)	67 (± 5.7)	75.5 (± 2.23)	89 (± 0.4)	22.8 (± 0.86)	17.2 (± 0.77)

N * Irrigation: quality
Worst dolling/cracking in over-water

N * Irrigation: quality
Worst brown centre/hollow heart in frequent regime

Best practice schedule:

Rules:
1. Have to irrigate 3 days ahead of limiting SMD trigger to complete field
2. No knowledge of future rainfall
3. Have long-term ET as prediction



Comparisons:

Standard, Best Practice, Optimised

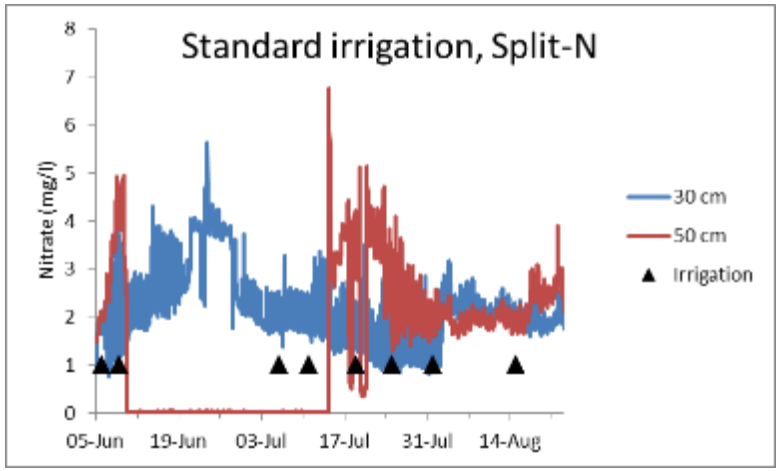
	Irrigation (mm)	Drainage (mm)	Water use (mm)	Efficiency† (%)	Modelled yield (t/ha)
Standard	160	96	258	97.8	65.4
Best Practice	105	41	251	95.3	63.7
Optimised	165	79	259	98.3	65.7

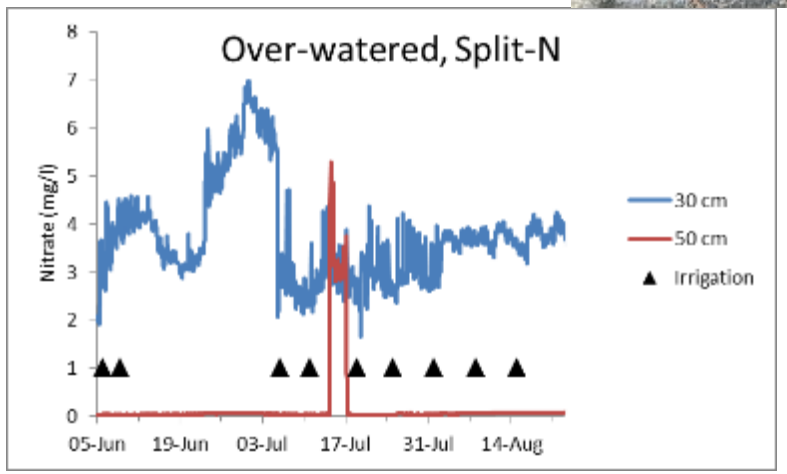
†Efficiency in meeting water requirement of canopy and ET demand

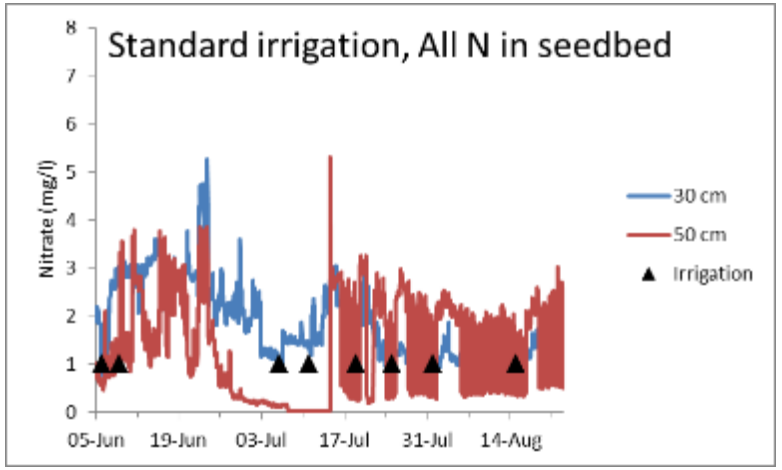
Summary

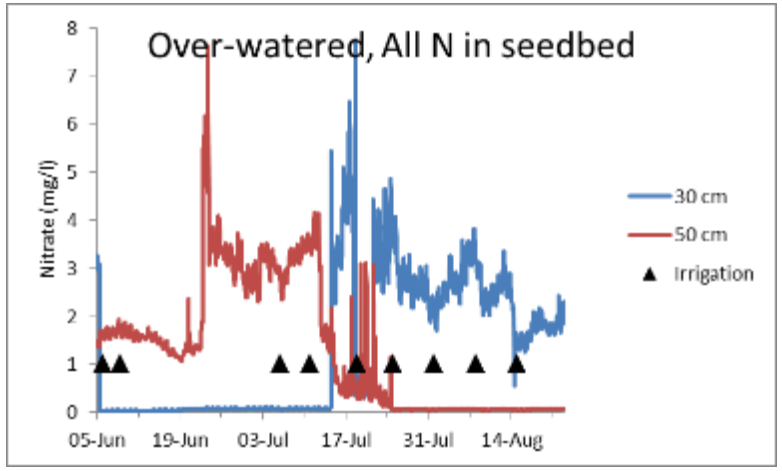
- No effect of irrigation regime (rate or timing) on ground cover development or duration
- No effect of irrigation regime on yield or quality
- Twice frequency irrigation: no effect
- Delayed start: no effect
- Over watering did not advance canopy senescence or increase internal defects or misshapes, but did decrease [DM]

Soil NO_3 sensors (Tony Miller, JIC + Agrii)

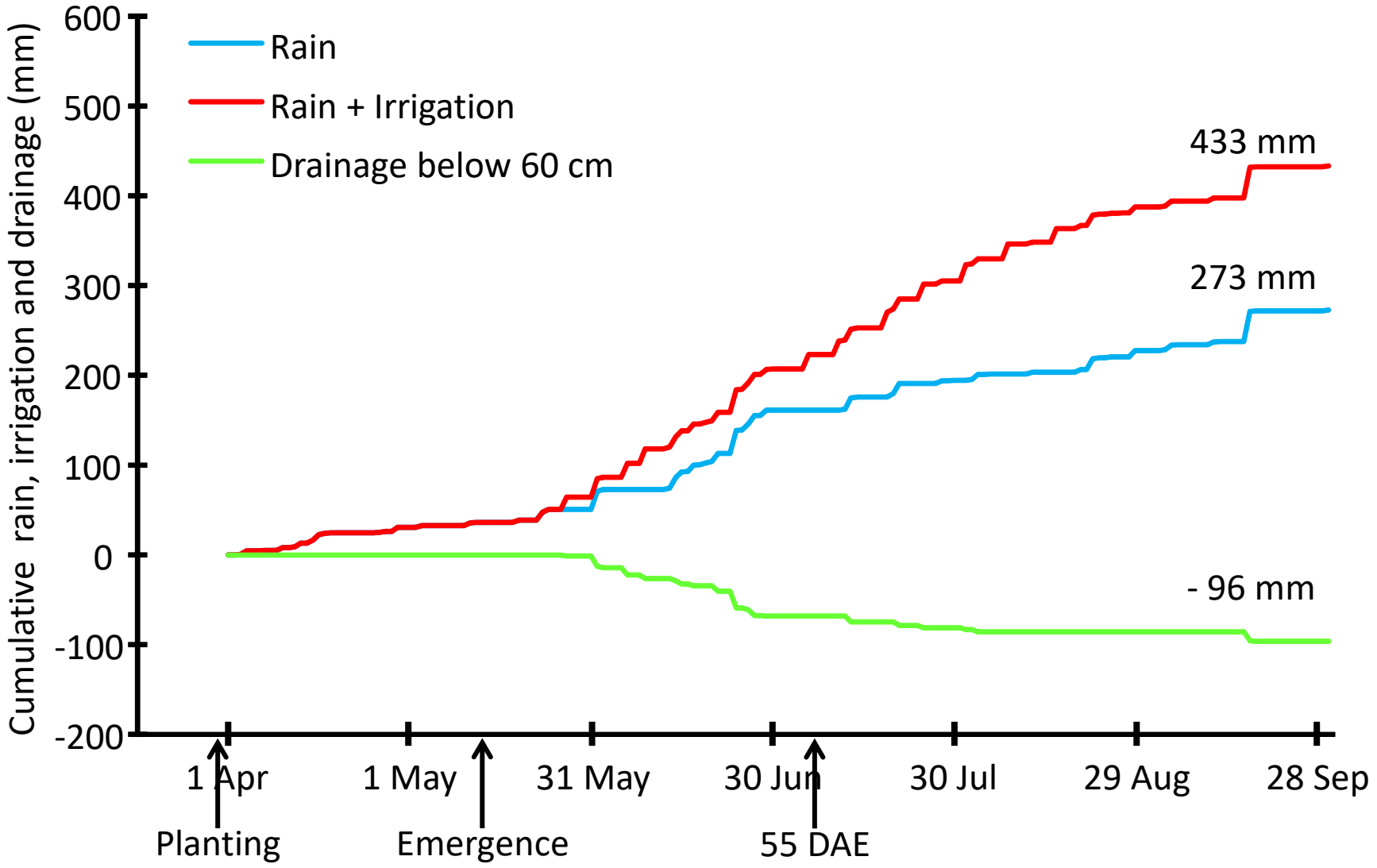




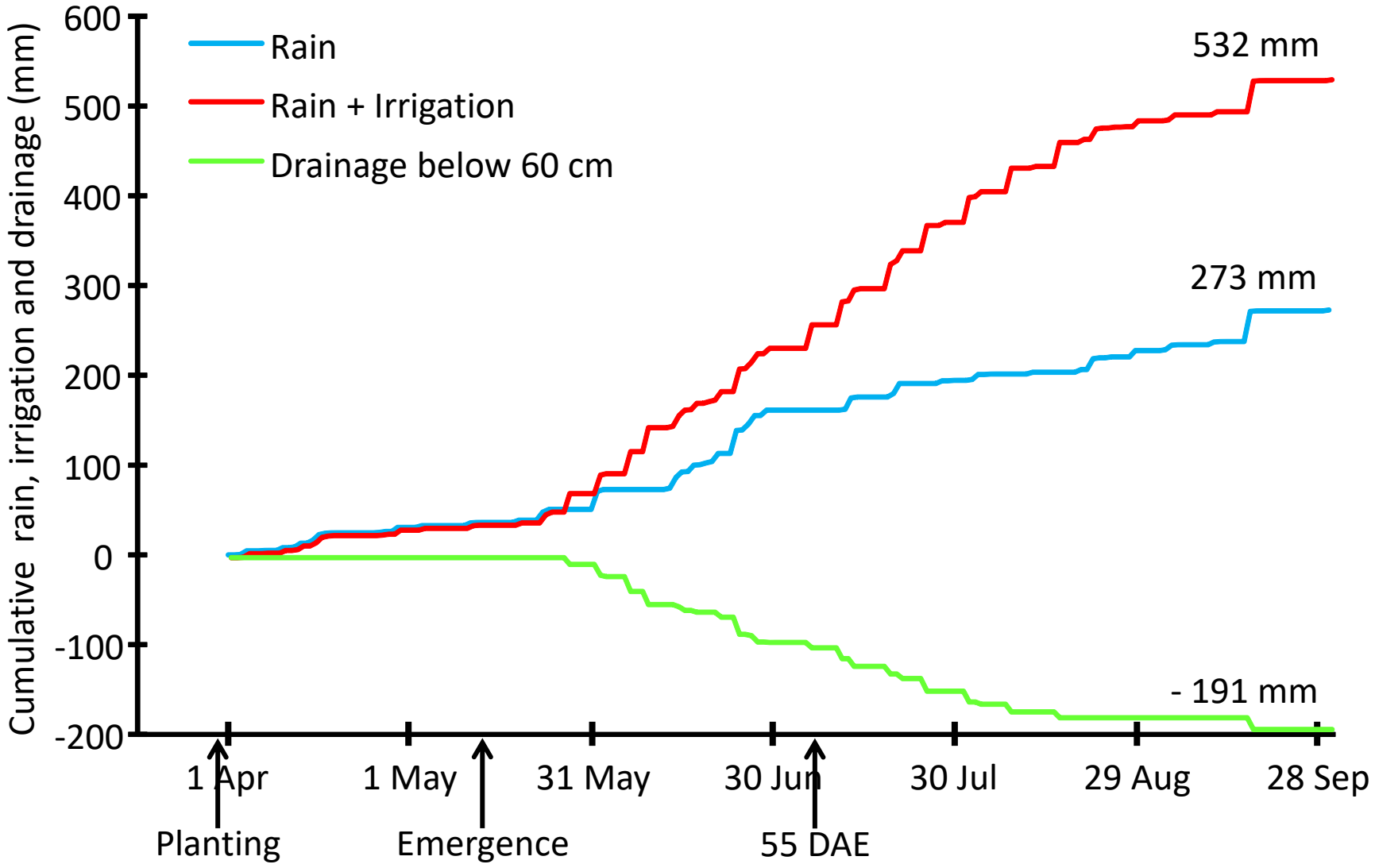




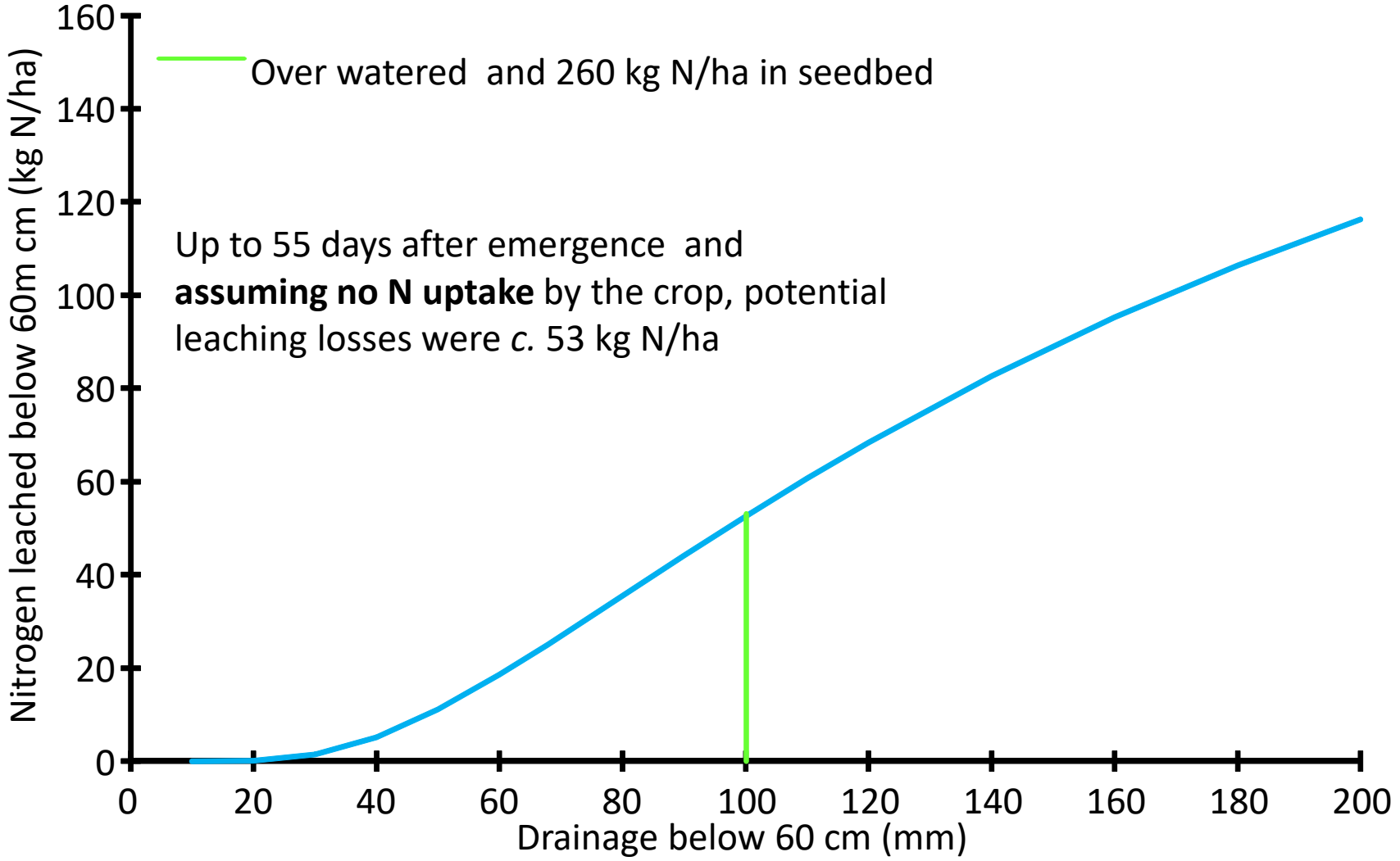
Water input and drainage SPot Farm East Elveden
Standard irrigation and standard N application



Water input and drainage SPot Farm East Elveden Over-watered and all N in seedbed



Effect of rainfall and irrigation strategy on estimates of N leaching at SPot Farm East



SPot Farm East Results 2018
Nitrogen and Irrigation

Marc Allison & Mark Stalham

NIAB CUF

N x irrigation experiment conducted by NIAB CUF

- Variety: Brooke (crisping)
- Nitrogen
  - Standard Split N
  - All N applied to top of bed pre-planting
  - All N placed on-planter
- Irrigation
  - Standard (18 mm @ 18 mm SMD)
  - Over-water (27 mm @ 18 mm SMD)
- Sand (91 % S, 5 % Z, 4 % C, 1.9 % OM)
- Destoned: 3 April Planted: 24 April Emerged: 24 May

Comparisons:

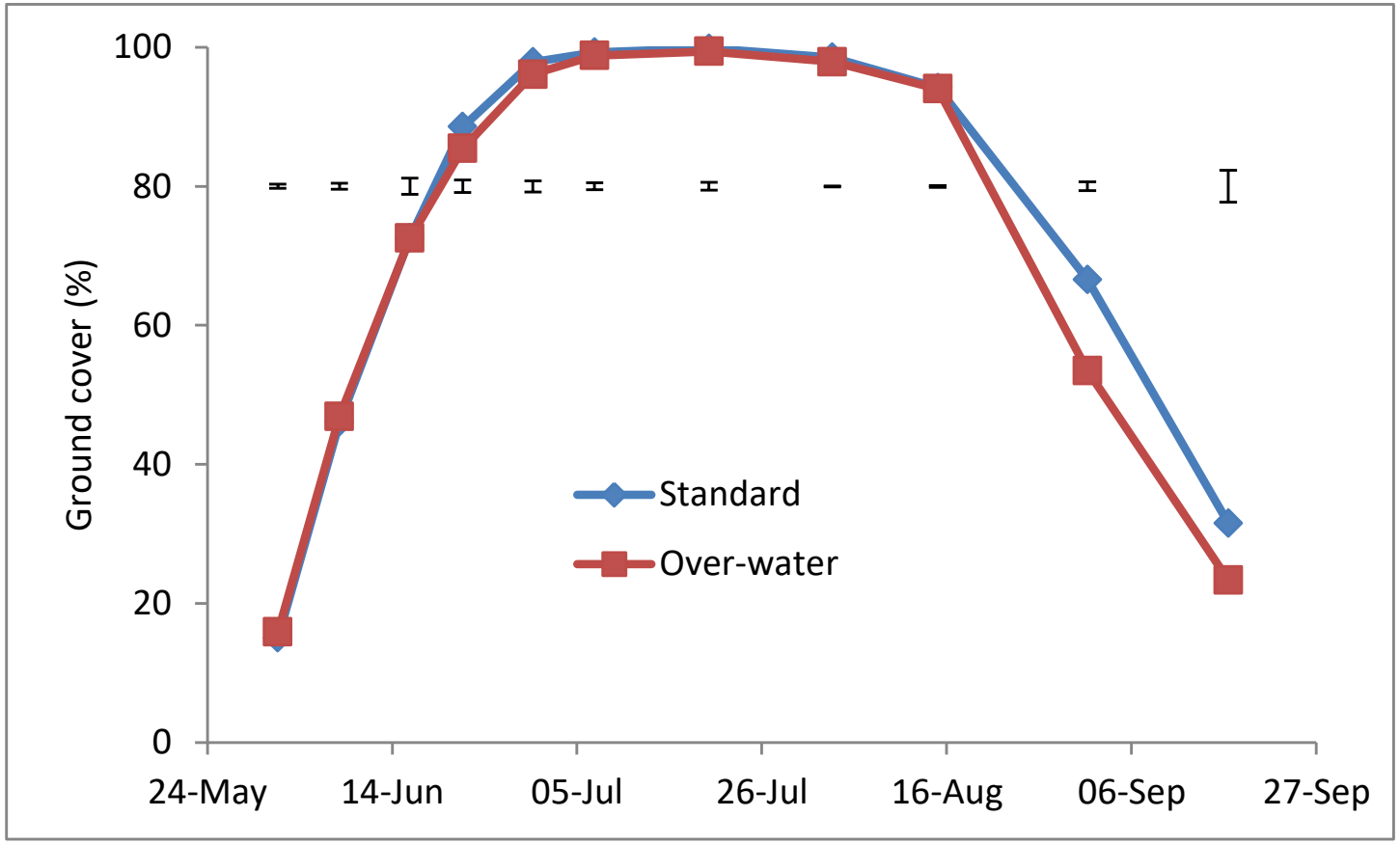
Standard, Over-water, Best Practice

	Irrigation (mm)	Drainage (mm)	Water use (mm)	Efficiency† (%)	Modelled yield (t/ha)
Standard	199	182	232	98.0	61.2
Over-water	296	278	229	98.2	60.4
Best Practice	127	115	230	97.2	60.7

Best Practice: yield reduced, but drainage and irrigation reduced by *c*. 70 mm

†Efficiency in meeting water requirement of canopy and ET demand

Nitrogen x Irrigation: ground covers
a) Irrigation



Nitrogen x Irrigation: yield

Irrigation	Nitrogen	Stems (000/ha)	Tubers >10 mm (000/ha)	Total yield (t/ha)	Yield >40 mm (t/ha)	Tuber DM (%)	DM yield (t/ha)
Standard	Split	91	442	65.0	63.5	24.4	15.9
	Seedbed	84	395	63.1	61.9	24.3	15.3
	Placed	77	334	59.8	58.7	25.0	15.0
Over water	Split	86	399	60.0	58.5	24.5	14.7
	Seedbed	77	376	61.3	60.2	25.2	15.4
	Placed	67	357	53.9	52.7	24.9	13.4
S.E. (12 D.F.)		6.8	35.4	4.13	4.04	0.29	1.00
S.E. (12 D.F.; same Irrig)		7.3	31.7	3.58	3.46	0.35	0.84

No effect of N or irrigation on fry quality

			Defects (% w/w)			
Irrigation	Nitrogen	Hunter Lab L value	Bruise	Internal sugar	External sugar	Total
Standard	Split	75.0	1.3	0.7	2.0	5.3
	Seedbed	73.3	0.0	0.0	0.9	2.1
	Placed	72.6	0.0	0.0	4.0	4.0
Over water	Split	73.4	0.0	0.3	2.7	3.1
	Seedbed	72.7	0.8	0.0	1.2	4.2
	Placed	73.8	0.0	0.7	0.5	0.5
S.E. (12 D.F.)		0.99	0.53	0.46	1.05	1.91
S.E. (12 D.F.; same Irrig)		0.93	0.63	0.45	1.14	1.96

Summary: yield and quality

- No effect of irrigation regime on early ground cover development, but overwatering caused earlier senescence and reduced GC duration (but only by 3.5 days at 100 % GC)
- Overwatering reduced yield
- No effect of irrigation on fry quality

SPot Farm East Results, 2016-2017 Common scab irrigation

Key questions under investigation:

- What is the best irrigation regime to control common scab on different soil types for varieties differing in susceptibility to scab?
- How does a grower identify the ideal scab control period for maincrop and salad varieties?
- When is the scab control period over?

Maximum SMD (mm) for common scab control in different varietal scheduling groups (AHDB R448)

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.

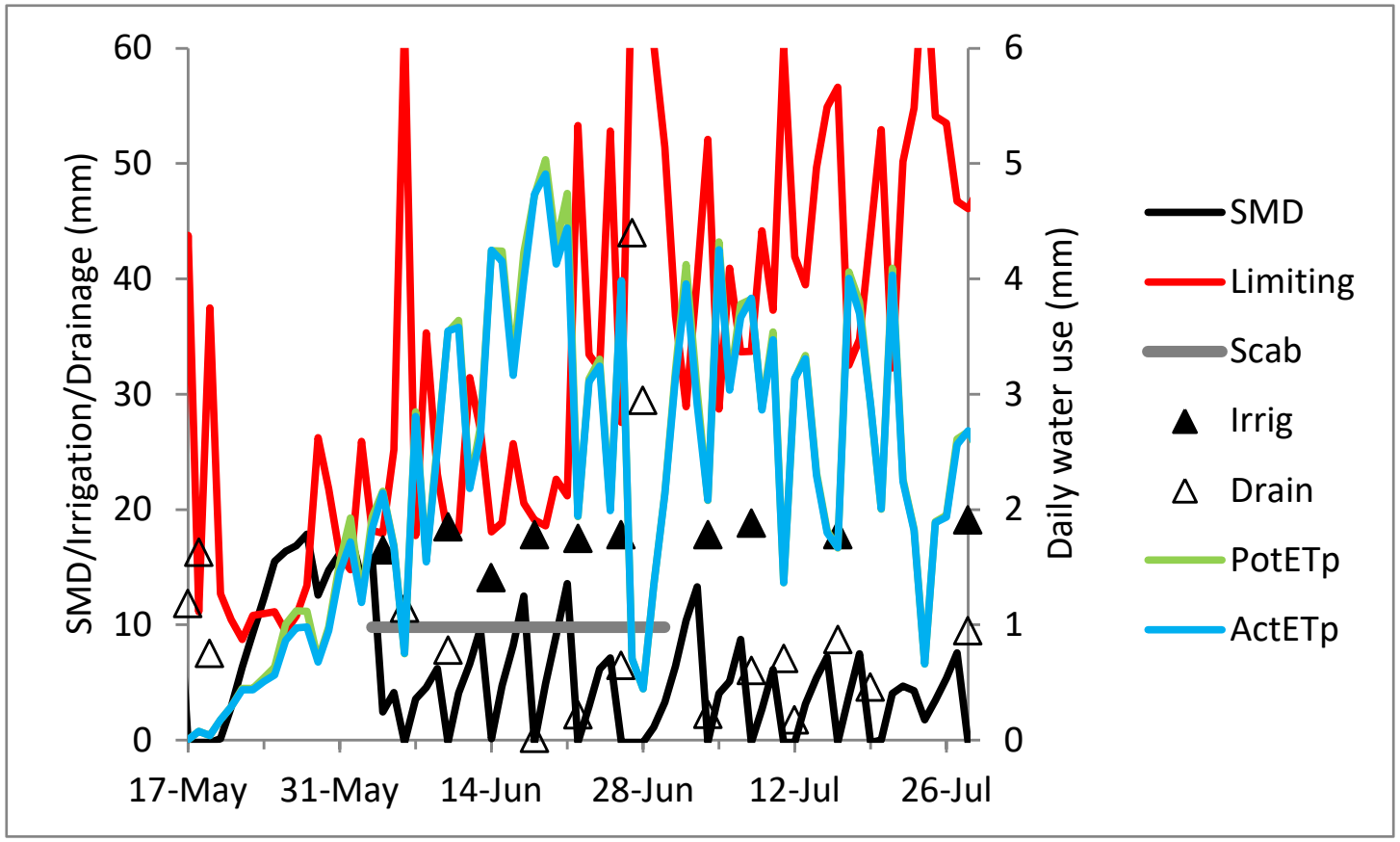
	Group	1. Susceptible	2. Intermediate	3. Resistant
		Maris Piper(1) Maris Peer (5)	Charlotte (4) Desiree (4) Estima (6) Exquisa Flair King Edward (7) Marabel† Melody (7) Nectar (6) Rooster (6) Sylvana (7) Safari† (4) Venezia Vivaldi (5)	Bute (4) Electra (8) Elfe Jelly (6) Lanorma (7) Orchestra (8) Perline Regina Vales Sovereign (7) Volare (5)
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**

Timings 2016/2017

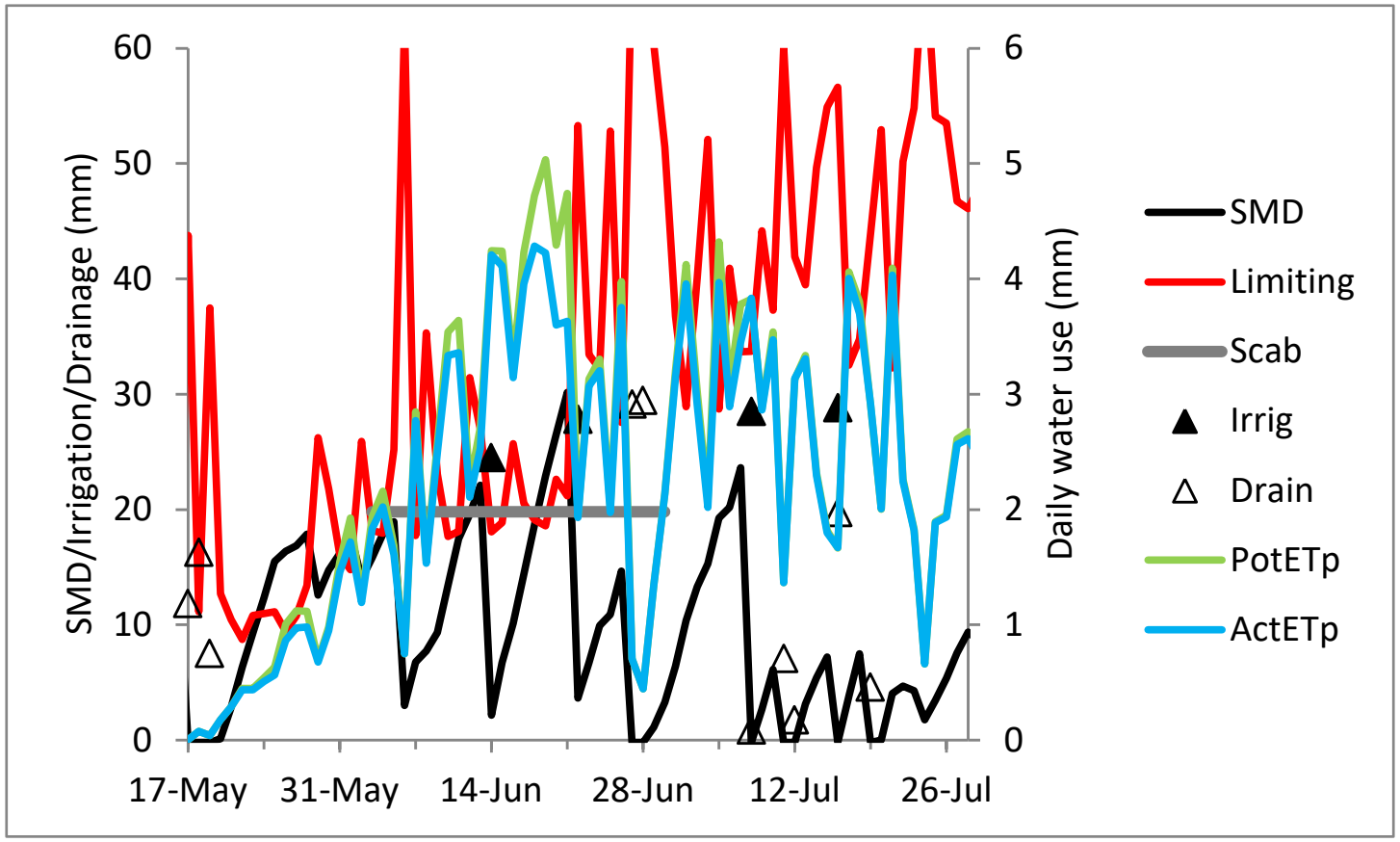
	Emer First-50 %	Emer First-90%	Emer-TI 50%
Bute	4	6	19
Estima	3	5	17
Jelly	3	5	19
Juliette	4	7	19
Lanorma	4	7	15
Leontine	4	8	13
Maris Peer	4	7	18
Maris Piper	4	7	19
Melody	2	5	19
Nectar	3	5	19
Red Fantasy	4	7	21
Rooster	3	6	18
Saxon	4	6	16
Soraya	3	5	17
Vales Sovereign	5	16	18
Mean	**3**	**7**	**18**

- Key is to know what time lapse is between emergence and TI: 18 ± 2 days
- Varieties with a short period are at a greater risk from delayed start and failure to wet up ridge

Scab 2017: soil moisture deficits
a) Standard 18 mm
Earliest TI: 4 June. First irrigations: 4, 10 & 14 June



Scab 2017: soil moisture deficits
b) Infrequent 27 mm
Earliest TI: 4 June. First irrigation: 14 June



Common scab data

Treatment	Variety	Proportion packable (%)	Severity (% SA)	Cracking (%)	Powdery scab (%)
Standard	Bute (7)	71	4.4	10	0
Infrequent	Bute	94	2.0	0	0
Standard	Estima (3)	97	1.8	9	58
Infrequent	Estima	97	1.6	8	47
Standard	Jelly (5)	93	1.3	1	63
Infrequent	Jelly	100	0.8	0	54
Standard	Juliette (6)	88	3.0	2	0
Infrequent	Juliette	99	1.2	2	0
Standard	Lanorma (4)	96	1.2	0	17
Infrequent	Lanorma	99	1.1	1	4
Standard	Leontine (8)	93	2.4	0	29
Infrequent	Leontine	74	4.1	0	22
Standard	M Peer (6)	82	2.9	0	7
Infrequent	M Peer	78	4.1	0	8
Standard	M Piper (3)	80	4.9	0	0
Infrequent	M Piper	21	18.1	0	0
Standard	Melody (5)	97	1.7	0	0
Infrequent	Melody	96	1.5	3	0
Standard	Nectar (4)	87	2.6	0	75
Infrequent	Nectar	70	4.7	1	45
Standard	R Fantasy (6)	99	1.0	0	2
Infrequent	R Fantasy	80	3.6	1	2
Standard	Rooster (6)	90	2.4	1	2
Infrequent	Rooster	87	2.9	1	2
Standard	Saxon (6)	95	1.7	0	1
Infrequent	Saxon	55	7.7	1	0
Standard	Soraya (7)	90	2.7	0	0
Infrequent	Soraya	96	1.7	2	0
Standard	V Sovereign (3)	100	0.9	0	4
Infrequent	V Sovereign	94	2.0	0	1
Standard		**91**	**2.3**	**1**	**17**
Infrequent		**83**	**3.8**	**1**	**12**

Maris Piper

10 mm SMD

20 mm SMD

Maris Peer

10 mm SMD

20 mm SMD

Red Fantasy

10 mm SMD

20 mm SMD

Soraya

10 mm SMD

20 mm SMD

Summary

- Incidence of common scab much worse in 2017 than 2016
- Maris Piper bad common scab with infrequent irrigation
- Why was scab bad if initial irrigation timing correct? Very dry soil at TI?
- Infrequent regime: worse scab in Leontine, Maris Peer, Nectar, Red Fantasy and Saxon
- Powdery scab increased with Standard (frequent) irrigation, but confined to certain varieties (seed or soil inoculum?)

Common scab control in different varietal scheduling groups (revised table)

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

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

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

Varietal scheduling group			
1. V. Susceptible	2. Susceptible	3. Intermediate	4. Resistant
Maris Piper(1)	Charlotte (4)	Bute (4)	Electra (8)
Maris Peer (5)	Desiree (4)	Estima (6)	Elfe
	Leontine	Exquisa	Jelly (6)
	Marabel	Flair	Lanorma (7)
	Nectar (4)	Juliette (7)	Orchestra (8)
	Red Fantasy	King Edward (7)	Perline
	Rooster (6)	Melody (7)	Regina
	Safari (4)	Soraya	Vales Sovereign (7)
	Saxon (5)	Sylvana (7)	Volare (5)
	Venezia (3)		
	Vivaldi (5)		

Soil texture	Maximum soil moisture deficit (mm)			
Sand	9.8	12.7	15.6	18.8
Loamy Sand	12.0	15.9	19.3	23.1
Sandy Loam	13.4	17.8	21.5	25.8
Sandy Silt Loam	14.4	19.0	23.0	27.7
Silt Loam	16.3	21.5	26.2	31.4
Clay Loam/Clay†	14.4	19.0	23.1	27.7

Planning for 2021 Discussion?

POTATOES

SPot Farm Results 20 January, 2021

Which approach to potato irrigation? Findings from SPot Farm Trials

Mark Stalham (Coordinator)

With contributions from Will Gagg