Trial system design and results to date

Catherine Keeling
Warwick Crop Centre

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

N analysis

	Maize/Slurry (Separated)	Maize (Separated)	Potato (Whole)	Slurry (Whole)	Food (Whole)	Food (Separated)
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total N	**3620**	**3801**	**2914**	**4287**	**5876**	**4257**
Mineral N	**1489**	**1606**	**1933**	**3605**	**3738**	**2547**
Ammonium-N	1484	1602	1932	3603	3736	2543
Nitrate-N	5	5	1	2	2	4
Min. N excess	**12 x**	**13 x**	**16 x**	**30 x**	**31 x**	**21 x**

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Mineral N

In raw state digestates have:

- Between 10 and 30 times too much min. N

→ **Dilution required**

- 100% of min. N in the form of ammonium
    - Direct toxicity
    - Acidifcation of rootzone

→ **Nitrate amendment recommended**

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Mineral N

Dilution

Digestates diluted to achieve 120mg/l total min. N

Nitrate amendment

The 120 mg/l min. N is comprised of:

- 60% ammonium-N (from digestate)
- 40% nitrate-N (from amendment)

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

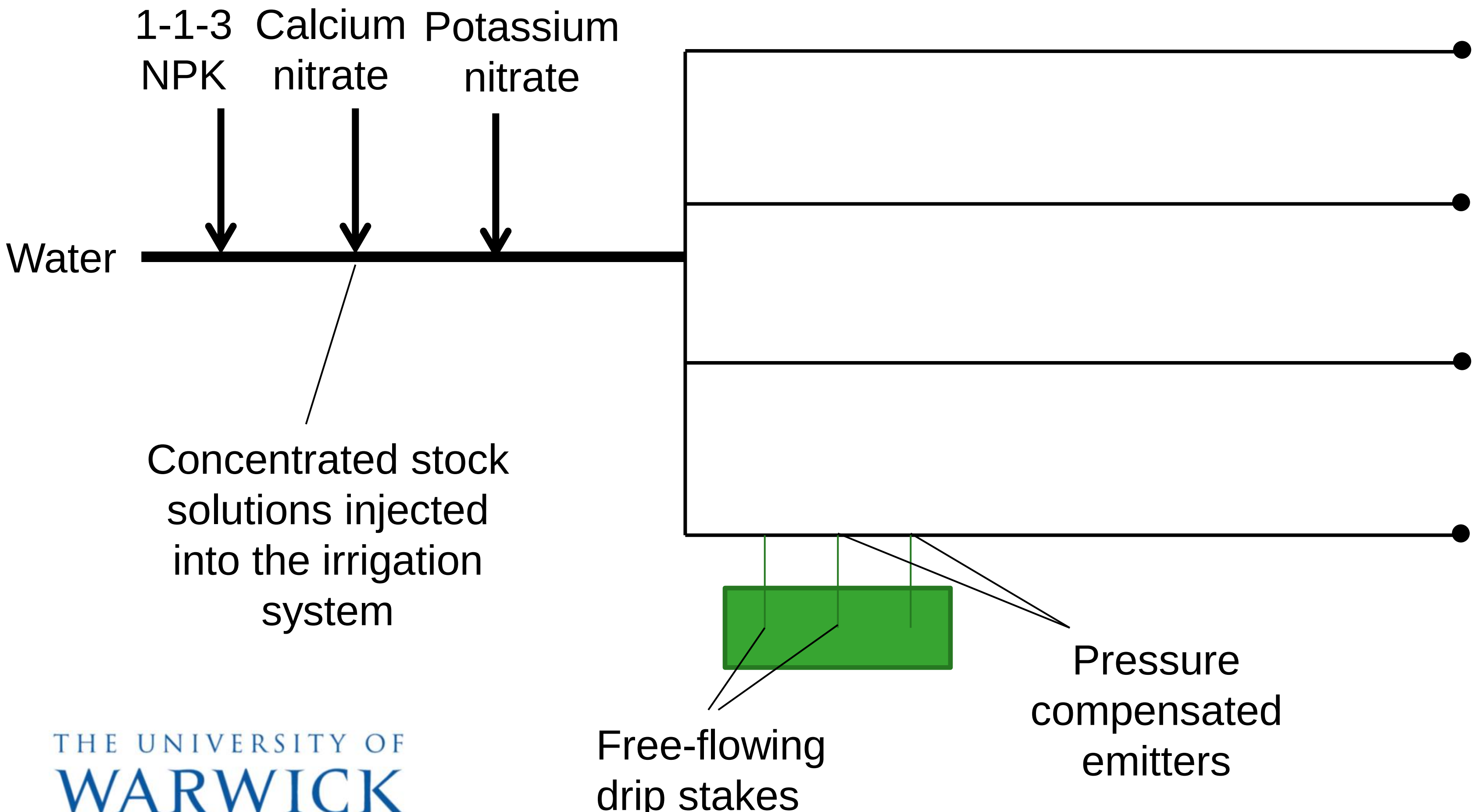
Diluted digestates

	Target	Maize/Slurry (Separated)	Maize (Separated)	Potato (Whole)	Slurry (Whole)	Food (Whole)	Food (Separated)	Amendment
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	(as KNO_3)
N	120-150	**71**	**71**	**71**	**71**	**71**	**71**	**+ 50**
Req. dilution factor		(21x)	(23x)	(27x)	(51x)	(53x)	(36x)	
								(as MKP)
P	40-55	11	8	4	4	4	3	**+ 45**
K	250-300	175	150	179	72	43	41	**+ 200**
Ca	100-120	52	43	29	33	29	33	(as KNO_3 & MKP)
Mg	25	12	9	6	8	6	6	
Fe	1200-1700	1897	767	176	446	138	240	**+1200**
Mn	500-800	164	107	30	86	25	36	**+ 500**
Mo	20-50	0	0	0	0	0	0	**+ 40**
Total solids (%)		0.26	0.22	0.08	0.10	0.05	0.08	
EC (dS m^{-1})	1.5-1.8	2.2	2.1	2.1	1.9	2.1	1.9	

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

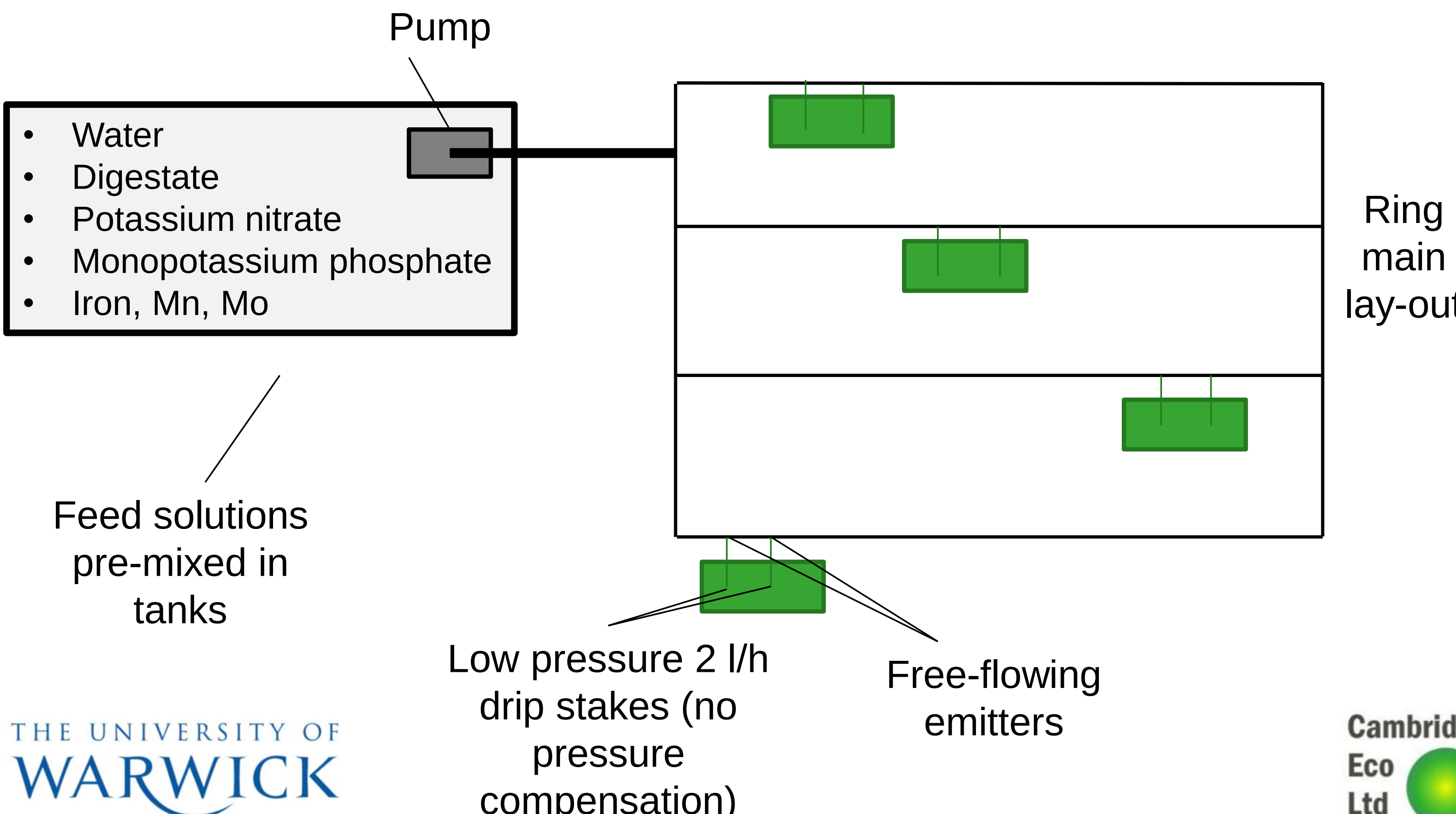
Typical commercial system



THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

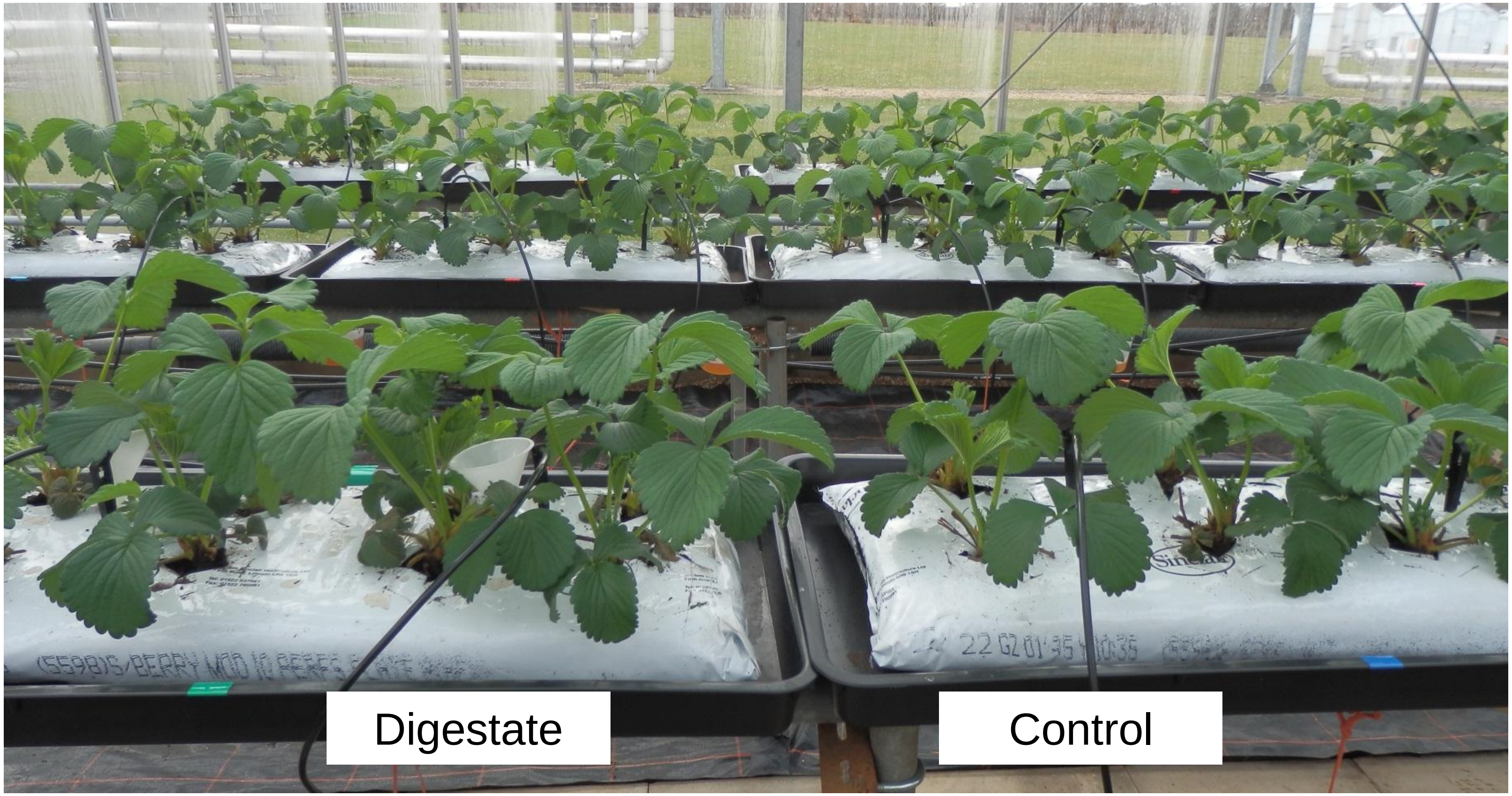
Experimental system



THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Day 18 (12 March)



Leaf growth (Day 18)
(length of largest terminal leaflet)

Treatment	Mean (mm)	5%*	(s.e.)
Food (whole)	**100**	a	(1.7)
Control	**99**	a	(2.6)
Maize (sep.)	**98**	a	(1.4)
Food (sep.)	**97**	a	(2.1)
Potato (whole)	**97**	a	(2.5)
Maize/Slurry (sep.)	**95**	a	(1.2)
Slurry (whole)	**95**	a	(2.9)

*Means followed by different letters would indicate significant difference at the 5% level

(GenStat: Anova and Tukey test)

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Initiation of flowering
(Day 20, 14 March)

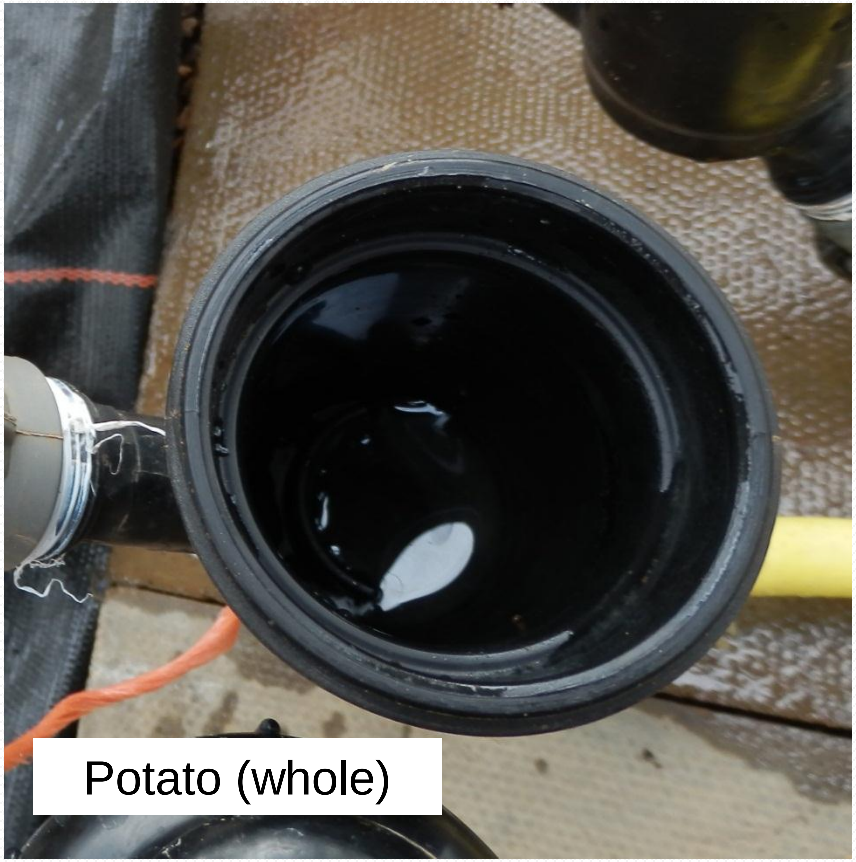
Treatment	Mean (per bag)	5%*	(s.e.)
Control	**9**	a	(2.0)
Potato (whole)	**8**	a	(1.3)
Food (whole)	**8**	a	(1.7)
Slurry (whole)	**8**	a	(0.6)
Food (sep.)	**6**	a	(0.7)
Maize/Slurry (sep.)	**6**	a	(2.0)
Maize (sep.)	**6**	a	(1.5)

*Means followed by different letters would indicate significant difference at the 5% level (GenStat: Anova and Tukey test)

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Sedimentation



Day 52

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Day 52: Calcium deficiency

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Day 59

Maize/Slurry (separated)

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Day 59

Maize (separated)

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Day 59

Potato (whole)

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

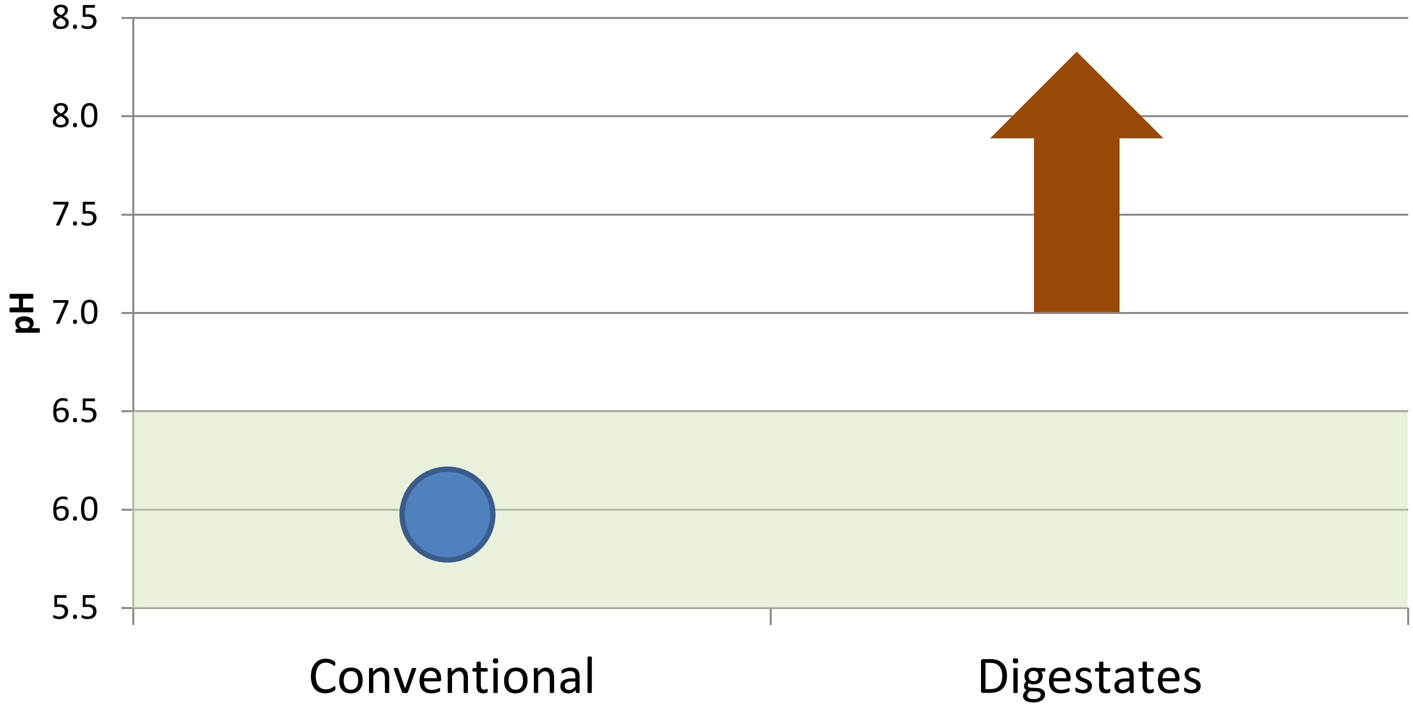
Diluted digestates

	Target	Maize/Slurry (Separated)	Maize (Separated)	Potato (Whole)	Slurry (Whole)	Food (Whole)	Food (Separated)	Amendment
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	(as KNO_3)
N	120-150	**71**	**71**	**71**	**71**	**71**	**71**	**+ 50**
Req. dilution factor		(21x)	(23x)	(27x)	(51x)	(53x)	(36x)	
								(as MKP)
P	40-55	11	8	4	4	4	3	**+ ~~45~~**
K	250-300	175	150	179	72	43	41	**+ 200** → 140
Ca	100-120	52	43	29	33	29	33	(as KNO_3 & MKP)
Mg	25	12	9	6	8	6	6	
Fe	1200-1700	1897	767	176	446	138	240	**+1200**
Mn	500-800	164	107	30	86	25	36	**+ 500**
Mo	20-50	0	0	0	0	0	0	**+ 40**
Total solids (%)		0.26	0.22	0.08	0.10	0.05	0.08	
EC (dS m^{-1})	1.5-1.8	2.2	2.1	2.1	1.9	2.1	1.9	

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

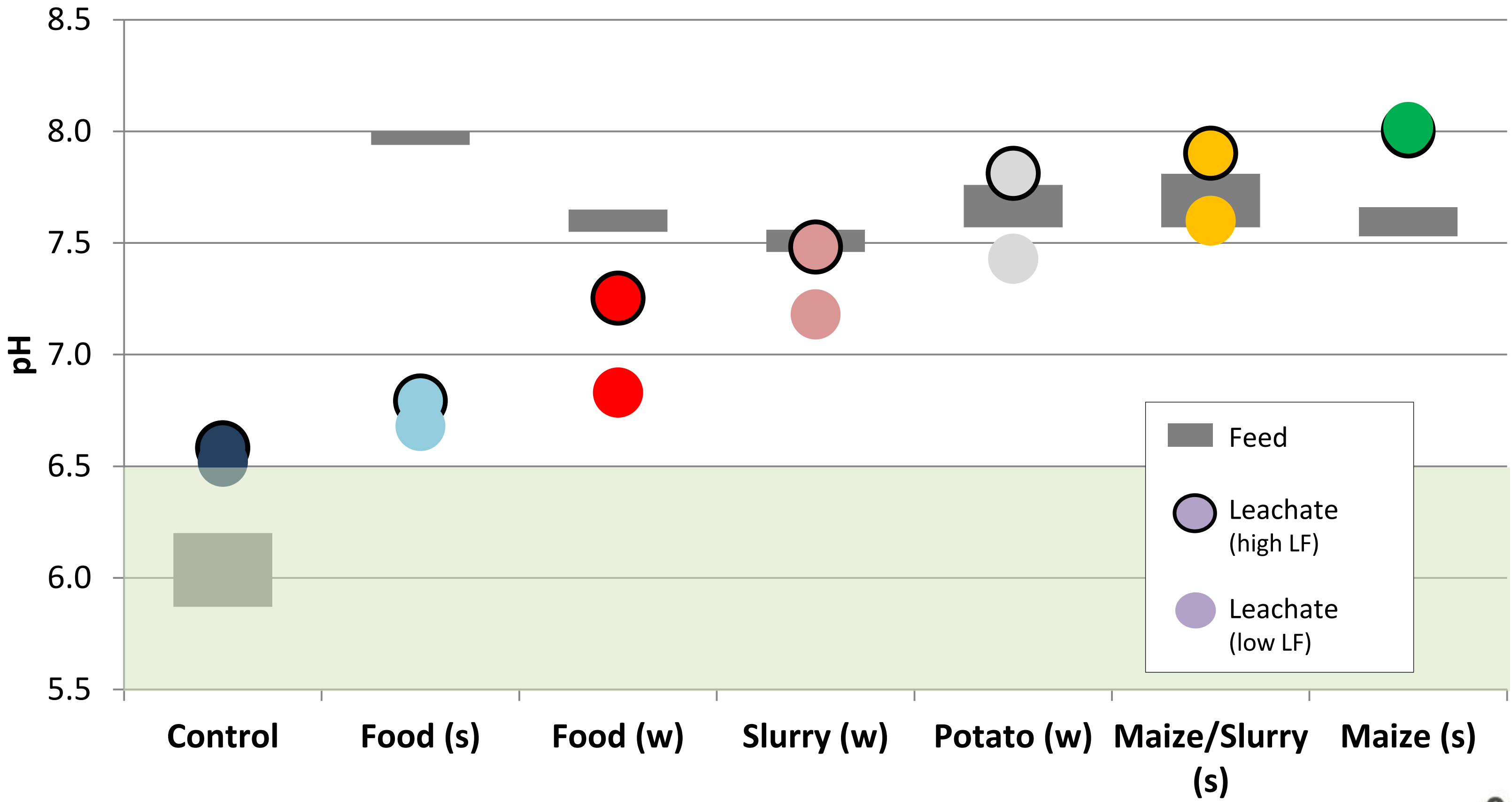
pH



THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

pH

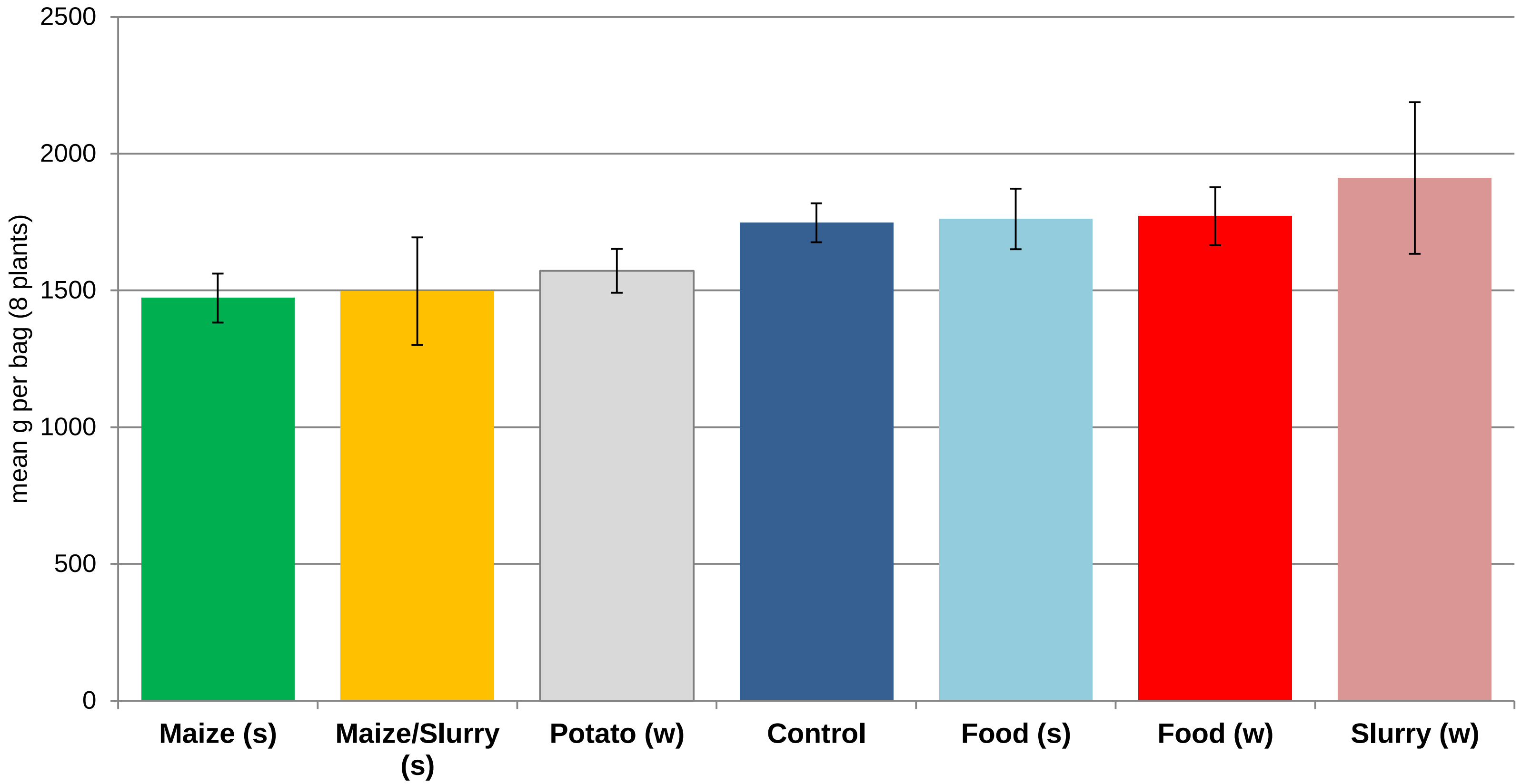


THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Total fruit weight

(up to 17 May)

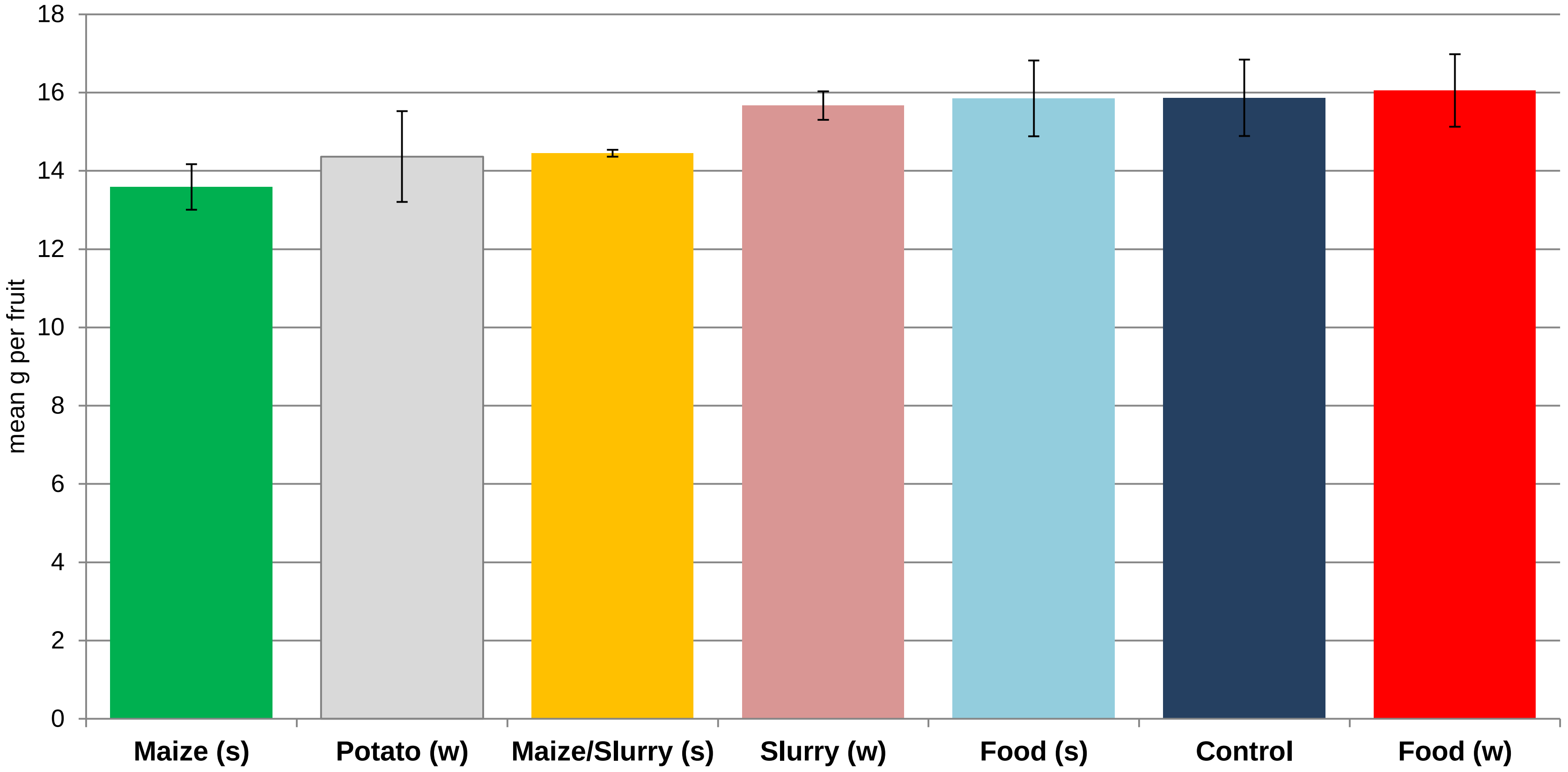


THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Average fruit weight

(up to 17 May)

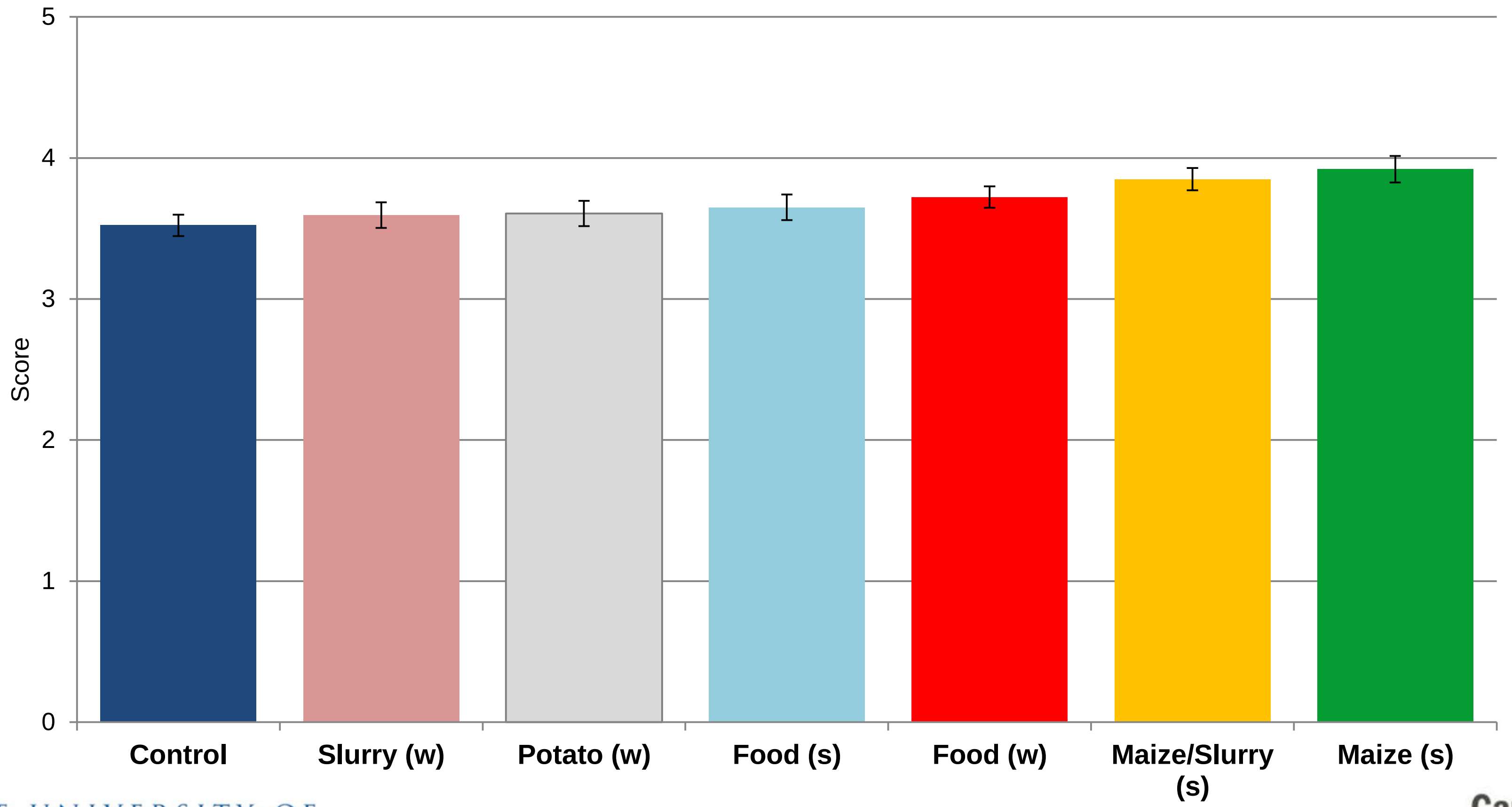


THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Taste testing:

Aggregated scores for aroma, texture, juciness and flavour



THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Conclusion

- Digestates can perform at least as well as conventional feeds in strawberry production, with respect to both yield and consumer acceptability

- Need to run system at a pH appropriate to the individual digestate
  - Need to understand the relationship between feed pH and rootzone pH

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd

Next steps…

- Test digestates using a conventional injection drip irrigation system
  - pH tailored to individual digestate
  - Do the emitters block?
- Experiment with nutrient/nitrate amendment

Maize (s)	Potato (w)	Maize/ Slurry (s)

  - Can the naturally high K, well buffered digestates be used unammended?

THE UNIVERSITY OF WARWICK

Cambridge Eco Ltd