

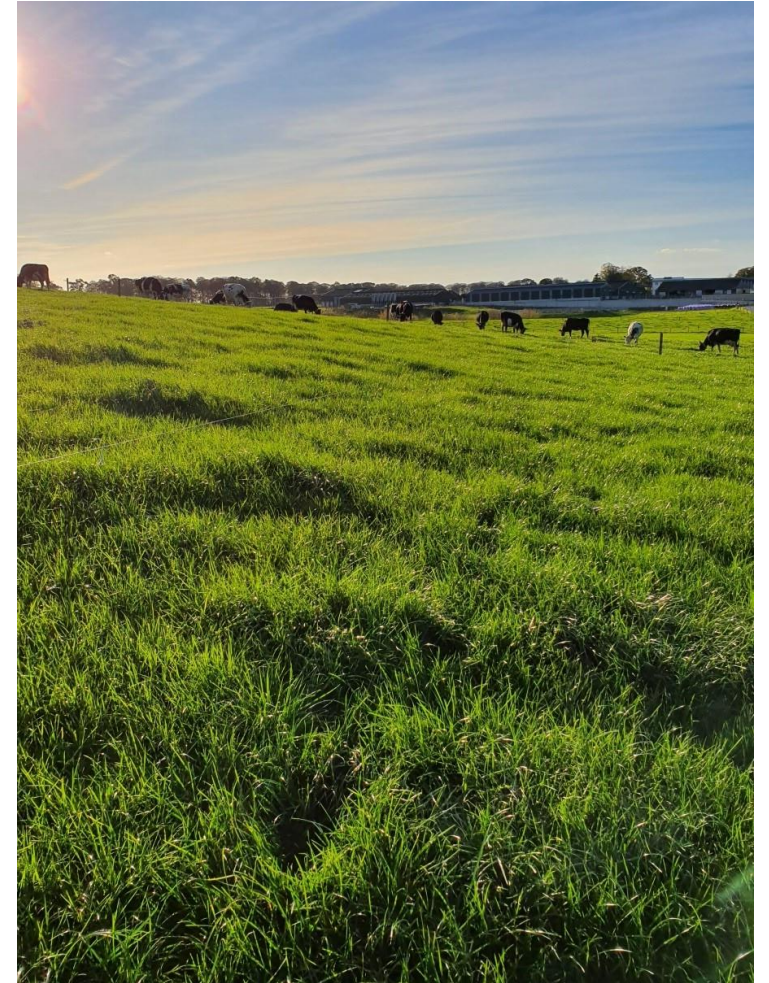
New phenotypes for grass utilization and persistence under grazing to improve grass breeding

Tomás Tubritt, Laurence Shalloo and Michael O'Donovan

*Teagasc, Animal and Grassland Research and Innovation
Centre, Moorepark, Co. Cork, Ireland*

Irish Dairy System

- Grass based, spring calving
 - 300 day grazing season
 - Maximising grazed grass in cow diet
- Grass Sward
 - Pre-dominantly perennial ryegrass
 - Large output (up to 15 t DM/ha/year)
 - High quality
- Reseeding
 - 7 % of available grassland reseeded per year
 - Increases perennial ryegrass content, increasing sward performance



Pasture Profit Index (PPI)

Variety Name	Ploidy	Heading Date	Pasture Profit Index Values € / Ha / Year								¹ Teagasc Grazing Utilisation
			Total	Sub-Indices						Trait	
			PPI	Spring Growth	Summer Growth	Autumn Growth	Quality	Silage	Persist.	Rating 1 - 5 star	
Aberchyde	T	25-May	225	42	62	48	41	31	0	****	
Gracehill	T	4-Jun	222	35	57	61	12	56	0	*	
Abergain	T	4-Jun	212	18	56	54	52	32	0	***	
Nashota	T	3-Jun	200	37	51	45	32	36	0	-	
Abermagic	D	28-May	199	24	63	81	17	14	0	**	
Astonconqueror	D	27-May	195	70	50	52	-7	30	0	****	
Glenfield	T	3-Jun	188	48	60	44	5	31	0	-	
Moira	D	26-May	187	97	36	61	-33	25	0	****	
Aberplentiful	T	8-Jun	186	42	60	54	13	16	0	**	
Aberchoice	D	11-Jun	182	9	62	60	43	8	0	**	
Meiduno	T	3-Jun	180	34	53	50	30	13	0	***	
Aberwolf	D	30-May	179	44	49	50	10	26	0	***	

**Seasonal yield
(kg DM/ha)**

**Midseason quality
(g/kg DM)**

**Silage yield
(kg DM/ha)**

**Persistency
(years)**

**Utilisation
(%)**

Δ kg DM yield
Spring: €0.17
Summer: €0.04
Autumn: €0.11

Δ DMD / kg DM
April: -€0.001
May: -€0.009
June: -€0.011
July: -€0.010

Δ kg DM yield
1st cut: €0.04
2nd cut: €0.03

Δ GS -12 year
base
= -€67 / year

Δ utilisation
€0.04 / kg DM
utilised

**Pasture Profit Index
€ per ha/year**

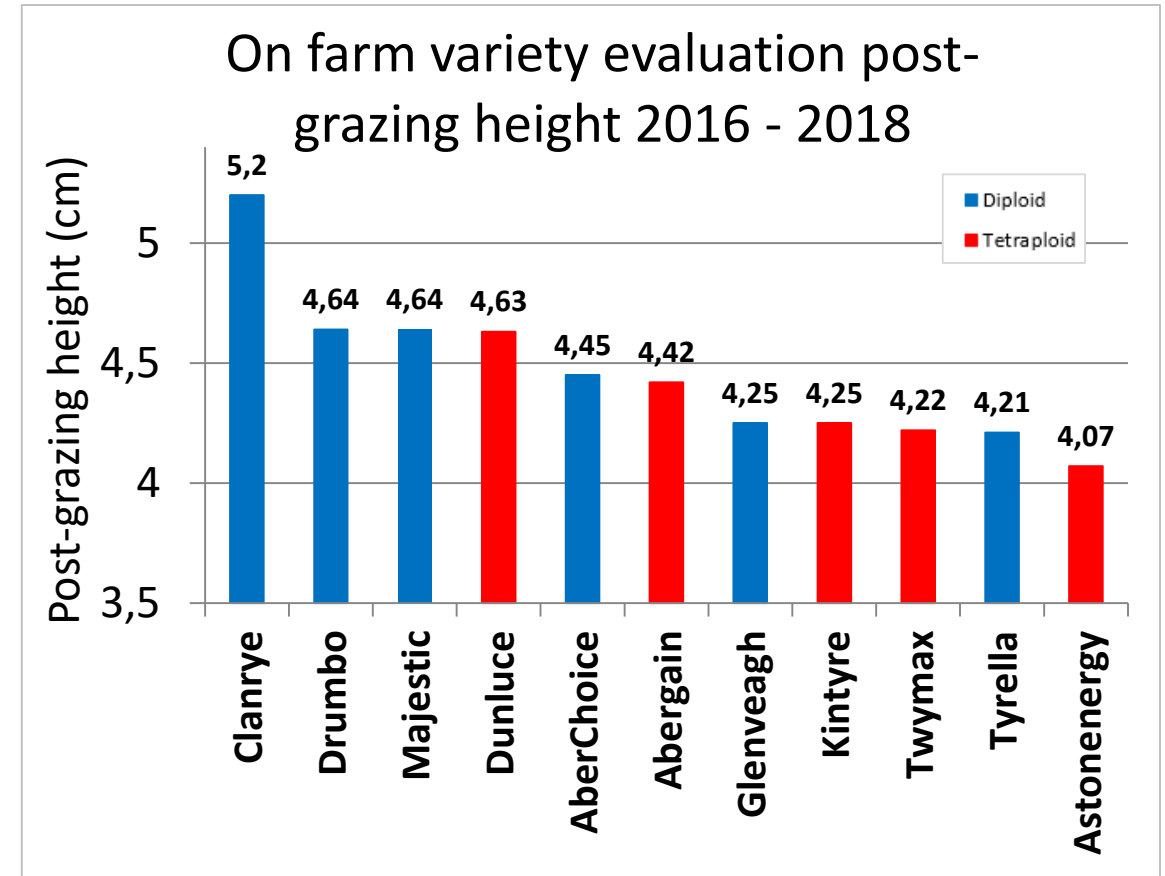
Grazing Utilisation sub-index - Background

- Grazing to low post-grazing height key grazing management strategy
- High post-grazing sward height = reduced grass quality (McDonald et al., 2008)
- Management decisions
 - Return cows to paddock (time lost moving cows)
 - Top the ungrazed grass (labour cost and loss of grass)
 - Surplus bales in following rotation (not all paddocks can be cut for silage)



Teagasc on-farm variety evaluation trial

- Trial set up:
 - 100 farms across Ireland
 - >500 individual paddocks
 - Pasturebase Ireland
- Perennial ryegrass varieties influence grazing management
- No indication of grazing suitability within PPI

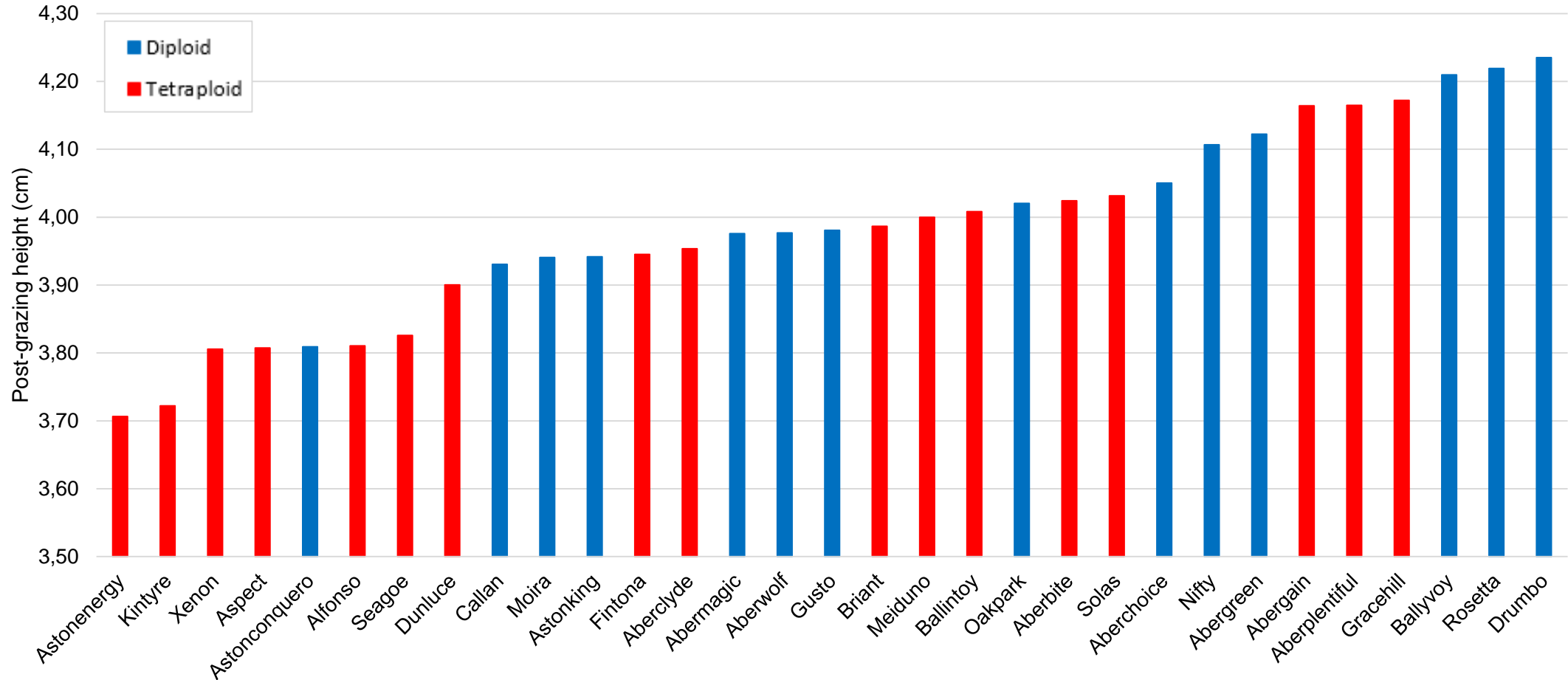


Variety grazing efficiency evaluation

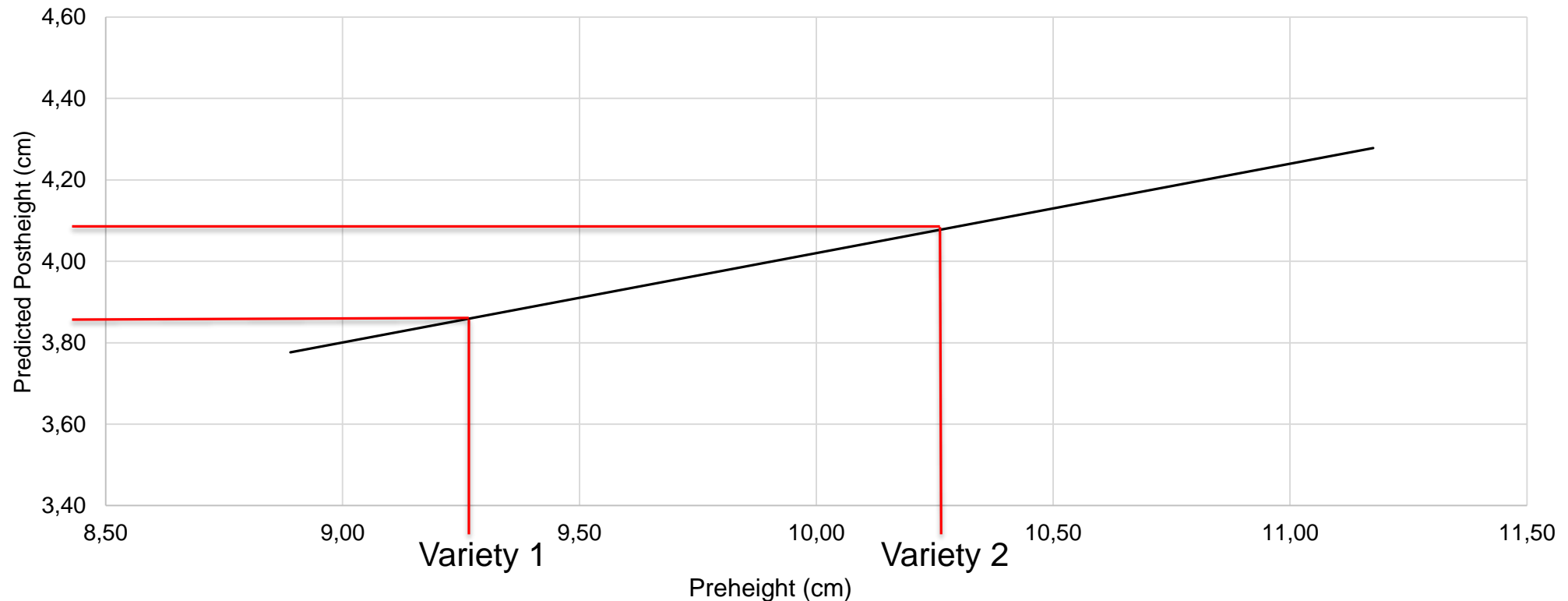
- Individual variety plots, sown in randomised block design (3 blocks)
- Plots grazed concurrently in rotational grazing system (8 – 10 grazing rotations per year)
- Measurements:
 - Herbage yield
 - Quality (NIRS)
 - Pre-grazing height
 - Post-grazing height
 - Morphology



Post-grazing height of varieties

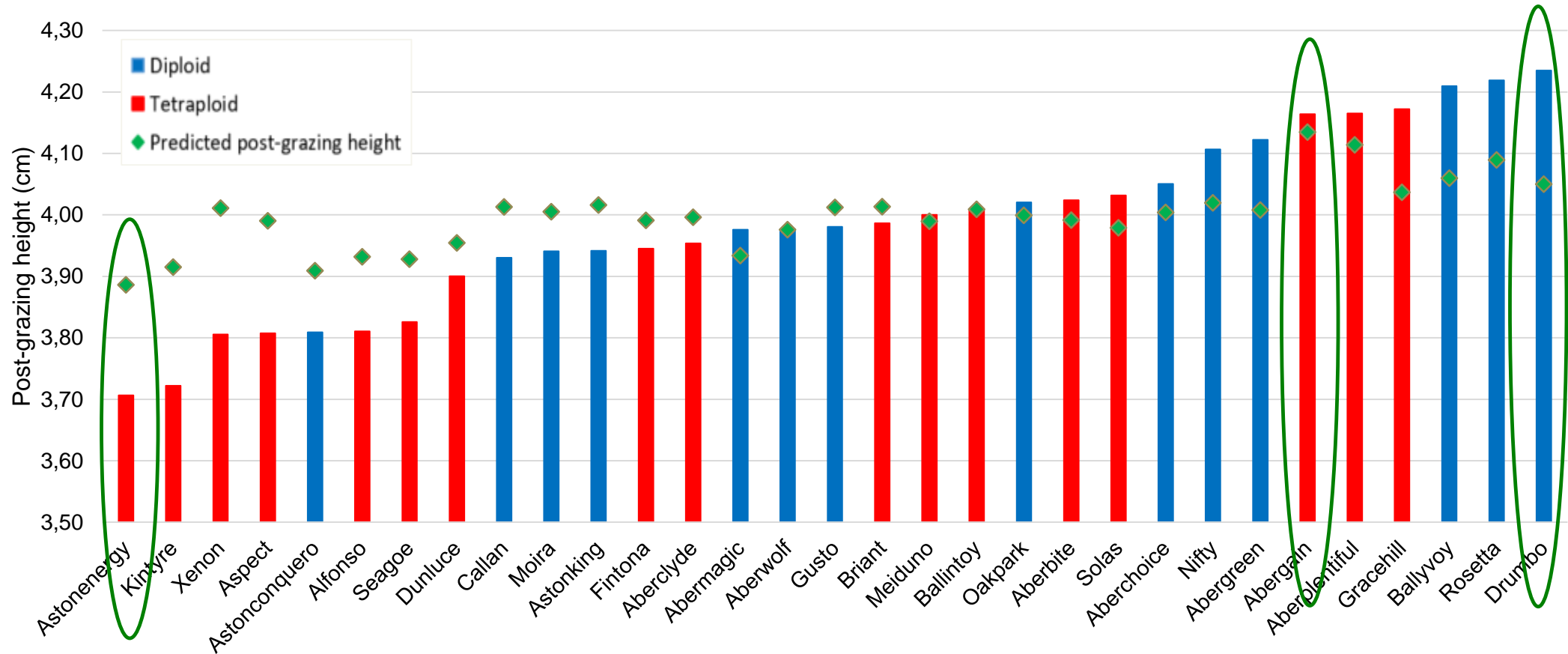


Regression model deriving predicted post-grazing sward height

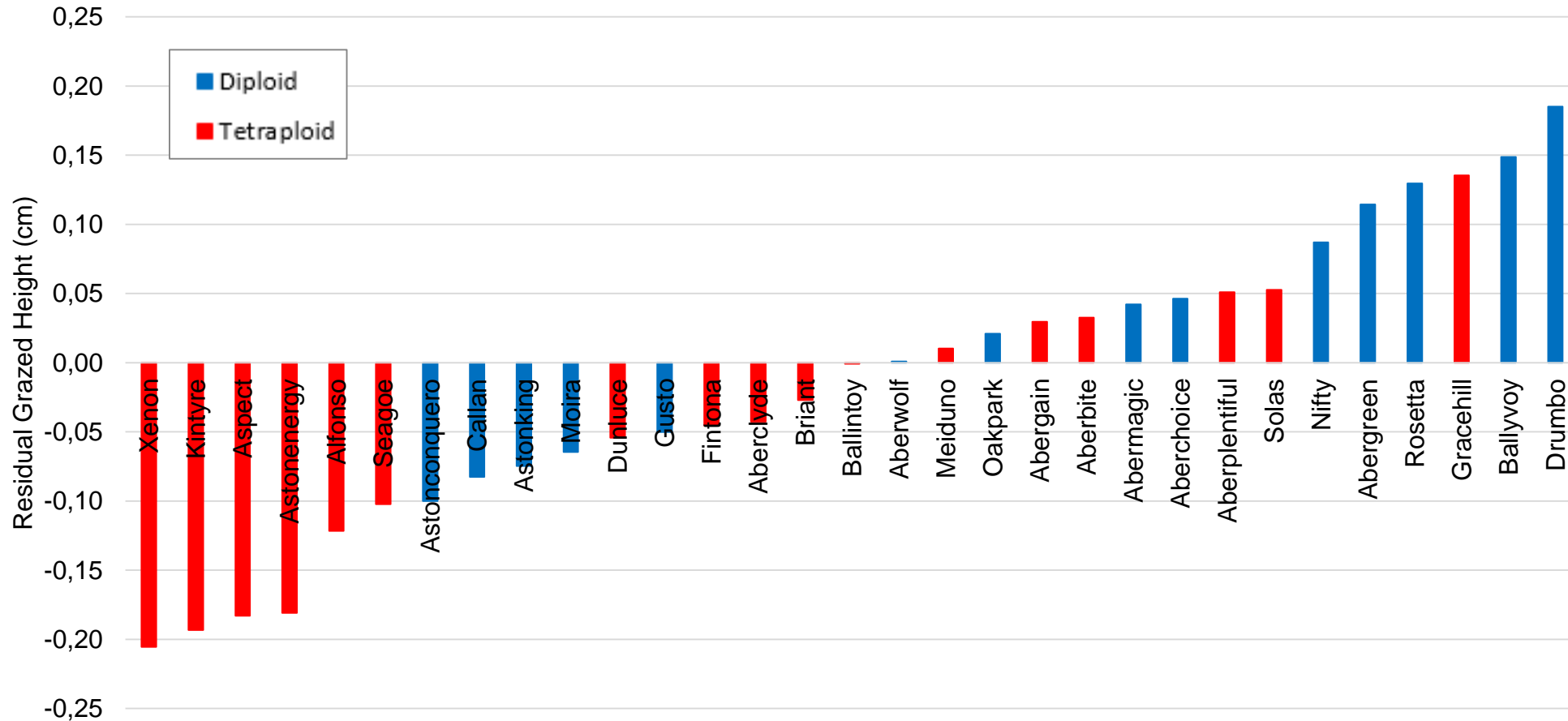


Model: Postheight = Trial + year + grazing event + block + pregrazing height

Achieved and predicted post-grazing height of varieties



Residual Grazed Height of perennial ryegrass varieties



Utilisation within the PPI

Variety	Annual RGH (cm)	Herbage density (kg DM/cm)	Additional/Reduced herbage yield per grazing (kg DM/ha)	Number of grazing rotations	Total difference in annual herbage yield (kg DM/ha)	Economic value per Kg DM (€)	Utilisation (€)
Variety 1	-0.21	250	53	8	420	€0.04	€17
Base	0.00	250	0	8	0	€0.04	0
Variety 2	0.14	250	-35	8	-280	€0.04	-€11

- ❑ Average herbage density from plot trial, correlates with previous research (Kennedy et al., 2009)
- ❑ Irish average of 8 grazing rotations (Maher et al., 2021)
- ❑ Economic value of €0.04 to match PPI Summer sub-index economic value

Utilisation star rating

Utilisation star rating	Grazing Utilisation € range
*	-€15 to -€9
**	-€8 to -€3
***	-€2 to +€2
****	+€3 to €8
*****	+€9 to +€16

Recommended Intermediate & Late Perennial Ryegrass Varieties 2021

Variety Name	Ploidy	Heading Date	Pasture Profit Index Values € / Ha / Year							¹ Teagasc Grazing Utilisation	Spring	Summer	Autumn	Total Yield	Mean DMD	1st Cut Silage	2nd Cut Silage	Ground Cover
			Total PPI	Sub-Indices					Trait	(t DM/ha)	(t DM/ha)	(t DM/ha)	(t DM/ha)	(g/kg)	(t DM/ha)	(t DM/ha)	Score	
				Spring Growth	Summer Growth	Autumn Growth	Quality	Silage	Persist.	Rating 1 - 5 star	<i>1.07</i>	<i>7.53</i>	<i>2.48</i>	<i>11.10</i>	<i>844.8</i>	<i>4.43</i>	<i>4.08</i>	<i>5.8</i>
Aberclyde	T	25-May	225	42	62	48	41	31	0	****	1.26	7.65	2.35	11.25	852.1	5.14	3.66	5.6
Gracehill	T	4-Jun	222	35	57	61	12	56	0	*	1.21	7.52	2.47	11.23	841.4	5.45	4.08	5.7
Abergain	T	4-Jun	212	18	56	54	52	32	0	***	1.11	7.50	2.40	11.04	854.3	4.88	4.05	5.6
Nashota	T	3-Jun	200	37	51	45	32	36	0	-	1.22	7.36	2.32	10.91	846.8	4.84	4.22	6.1
Abermagic	D	28-May	199	24	63	81	17	14	0	**	1.15	7.68	2.65	11.50	845.1	4.70	3.69	6.2
Astonconqueror	D	27-May	195	70	50	52	-7	30	0	****	1.42	7.35	2.39	11.15	837.6	5.31	3.38	6.1
Glenfield	T	3-Jun	188	48	60	44	5	31	0	-	1.29	7.60	2.31	11.23	841.7	4.84	4.07	5.7
Moira	D	26-May	187	97	36	61	-33	25	0	****	1.59	6.99	2.46	11.05	827.3	4.99	3.67	6.1
Aberplentiful	T	8-Jun	186	42	60	54	13	16	0	**	1.26	7.61	2.40	11.30	843.2	4.41	4.15	5.4
Aberchoice	D	11-Jun	182	9	62	60	43	8	0	**	1.05	7.65	2.46	11.18	849.5	4.17	4.23	6.0
Meiduno	T	3-Jun	180	34	53	50	30	13	0	***	1.21	7.42	2.37	11.03	849.3	4.54	3.87	5.2
Aberwolf	D	30-May	179	44	49	50	10	26	0	***	1.27	7.32	2.37	10.95	841.7	4.88	3.85	6.8
AberGreen	D	31-May	169	23	68	74	0	4	0	*	1.14	7.80	2.58	11.56	840.6	4.39	3.79	6.6
Fintona	T	24-May	168	38	50	53	-9	36	0	****	1.23	7.34	2.40	11.00	837.6	5.32	3.58	5.4
Ballyvoy	D	3-Jun	167	54	42	50	21	-1	0	*	1.33	7.16	2.37	10.89	843.7	4.24	3.84	6.3
Dunluce	T	29-May	161	10	54	54	20	22	0	****	1.06	7.45	2.41	10.95	844.7	4.55	4.17	5.4
Ballintoy	T	4-Jun	159	19	55	47	19	19	0	***	1.12	7.47	2.34	10.98	845.7	4.65	3.93	5.5
Elysium	T	27-May	157	38	46	36	13	24	0	-	1.23	7.26	2.24	10.75	844.3	4.86	3.79	6.0
AberBite	T	1-Jun	156	-13	52	56	35	26	0	**	0.93	7.41	2.42	10.80	849.2	4.66	4.15	5.8
Bowie	D	16-Jun	152	9	50	57	31	5	0	-	1.05	7.34	2.43	10.85	839.3	3.73	4.73	6.5
Gusto	D	31-May	149	31	46	64	11	-4	0	****	1.19	7.25	2.49	10.96	842.0	4.36	3.54	5.7
AstonEnergy	T	1-Jun	138	-7	45	48	51	0	0	*****	0.96	7.23	2.35	10.57	854.6	4.47	3.55	5.5
Briant	T	3-Jun	137	-1	55	49	15	19	0	***	1.00	7.46	2.36	10.85	841.7	4.60	3.98	5.5
Oakpark	D	2-Jun	132	21	49	55	-10	16	0	***	1.13	7.32	2.41	10.89	833.7	4.45	4.10	6.6
Drumbo	D	5-Jun	129	12	40	45	27	4	0	*	1.08	7.11	2.32	10.53	843.2	4.30	3.91	6.2
Solas	T	10-Jun	129	-2	46	61	6	19	0	**	0.99	7.24	2.46	10.72	838.8	4.38	4.29	5.8
Xenon	T	7-Jun	128	2	46	40	31	9	0	*****	1.01	7.24	2.27	10.57	846.6	4.10	4.34	6.2
Nifty	D	28-May	127	28	57	61	-34	15	0	**	1.17	7.53	2.46	11.19	831.8	4.75	3.65	6.4
Callan	D	3-Jun	123	59	38	41	-25	11	0	****	1.36	7.04	2.28	10.74	832.1	4.71	3.58	6.2
Aspect	T	3-Jun	122	1	47	34	29	12	0	*****	1.01	7.28	2.22	10.53	849.0	4.33	4.12	6.1
Triwarwic	T	2-Jun	122	9	50	33	9	21	0	-	1.06	7.34	2.21	10.64	843.0	4.73	3.91	5.8
AstonKing	D	5-Jun	115	52	42	36	-19	4	0	****	1.32	7.14	2.24	10.72	832.6	4.43	3.73	5.8
Smile	D	4-Jun	68	-8	35	48	-9	0	0	-	0.95	6.98	2.35	10.33	834.5	4.16	3.97	6.3

Notes: D - Diploid, T = Tetraploid

¹Teagasc Grazing Utilisation Trait is a provisional trait - see Appendix 1

Values in italics above denote the mean of the control varieties in Appendix 2

Experimental measurements

- Nutritive quality: scanned for OMD, CP, NDF, ADF and Ash by NIRS
- Morphology: 20 individual tillers from each plot obtained and separated into relative leaf, pseudostem, true stem and dead proportions

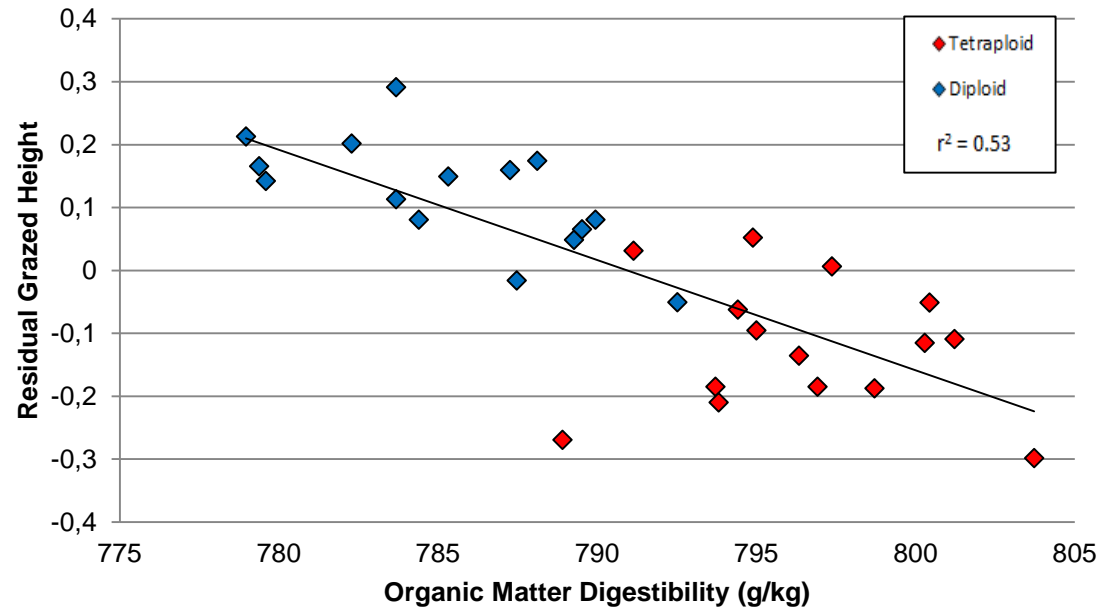


Nutritive and morphological performance of ploidy

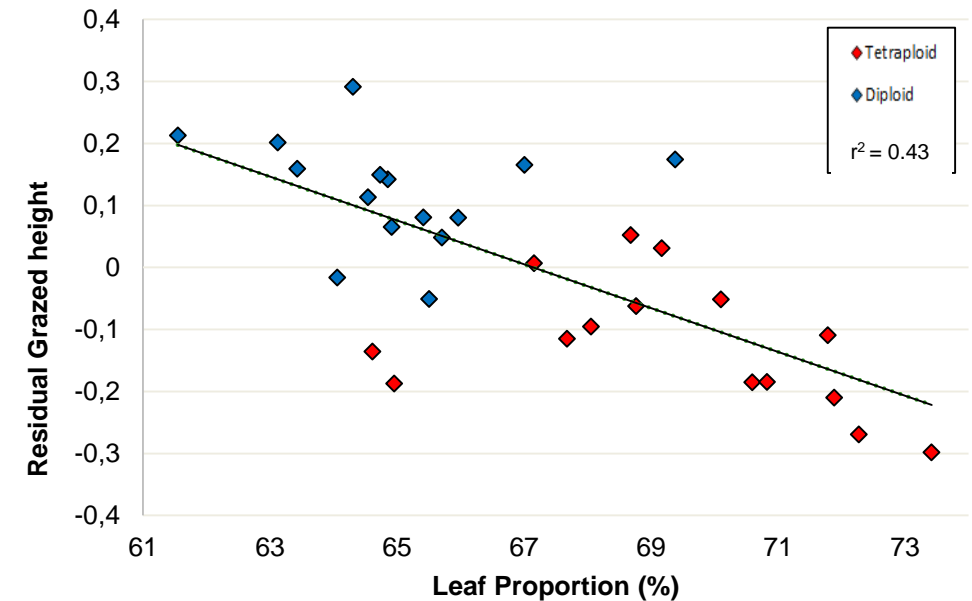
	Diploid	Tetraploid	S.E	Variety	Ploidy
<i>Nutritive quality traits</i>					
OMD (g/kg)	781	794	1	***	***
Crude Protein (g/kg DM)	207	211	2	**	*
ADF (g/kg DM)	326	304	2	***	***
NDF (g/kg DM)	492	462	2	***	***
Ash (g/kg DM)	138	126	1	NS	***
<i>Morphological traits</i>					
Leaf proportion	0.70	0.74	0.01	NS	***
Pseudo-stem proportion	0.21	0.19	0.01	**	***
True stem proportion	0.13	0.10	0.01	NS	*
Dead leaf proportion	0.05	0.04	0.01	NS	*

Relationship between nutritive quality and RGH

Organic matter digestibility



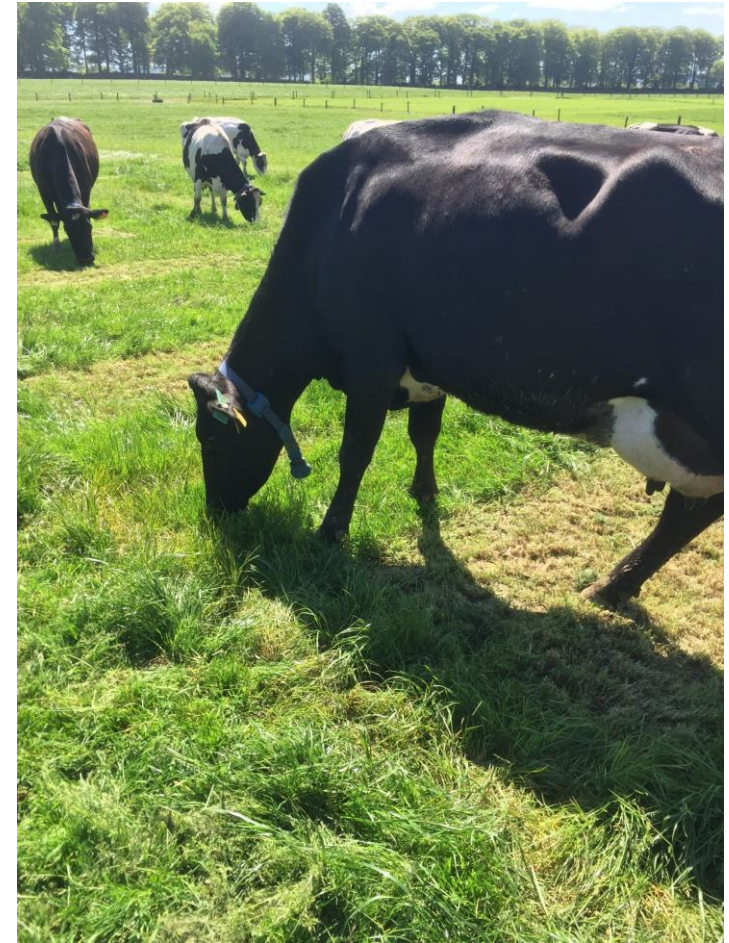
Leaf Proportion



- Increasing OMD by 10 g/kg, decreased RGH by 0.07
- Leaf proportion was also negatively correlated with RGH. A 1% increase in leaf proportion reduced RGH by 0.01

Summary

- Residual Grazed Height:
 - measure of variety grazing efficiency
- New grass utilisation trait within the PPI
 - First animal measured trait in variety selection index
- Plant traits influencing grazing efficiency
 - proxies for grazing efficiency improvement
- Continued PPI development planned
 - environmental traits, etc.
 - Clover profit index





Thank you for your attention