

## UCD Lyons Systems Herd Annual Report 2022

### Project Title: Development of a Sustainable High-Output Grass-Based Spring Milk Production System

#### Summary of 2022 Findings:

- Average herd production was 7000kg milk and 562 kgs MS. Production was significantly lower in 2022 vs other years primarily due to drought conditions, lower grass intake and high silage intakes.
- 12tn grass DM was grown on the milking platform, the lowest grass growth figure since 2018.
- Fertility performance was excellent with 84% 6-week in calf rate and an empty rate of 10.5%.
- Financial simulations show the significant impact of a reduction in allowed organic nitrogen limits under derogation from 250kg to 220kg. The impact is similar between higher input systems and lower input systems.
- Preliminary results of the nutrition study show no significant differences between dietary treatments (Treatment 1: 14% crude protein (CP) supplement throughout the whole lactation vs Treatment 2 18% CP during the first and last rotations and 14% CP during the main grazing season).

#### Overall Project Objectives:

- To develop a profitable high-output grass-based spring milk production system
- To incorporate the most recent advances in grassland management for dairy farms into a high-output system
- Use a type of dairy cow that has good genetic indices for both milk production and fertility
- Employ the best practices from nutrition research and dairy cow husbandry
- Incorporate nutritional studies into a high-output system
- To incorporate management technologies and system attributes that enhance the sustainability of dairy production

#### System Targets and Genetics:

The system targets are presented in Table 1. The average genetic merit of the herd in January 2022 is presented in Table 2. In the January 2022 evaluation, the overall herd EBI was within the top 1% nationally, with milk sub-index (SI) in the top 1% and herd fertility SI in the top 5%. The feed budget is calculated on a days in milk (DIM) basis and is shown in Table 3.

**Table 1: System Targets**

Parameter	Target
Stocking rate on milking platform	3.27 LU/ha
Stocking rate whole farm	2.33 LU/ha
Milk yield kg/cow	7,500-8,000
Milk solids kg/cow	625
6-Week in calf rate	75%
Concentrate (kg/cow/year)	1,500
% diet as grazed grass	>51
% diet as grazed grass and grass silage	>75*

\*The annual feed budget contains >90% grazed grass + grass silage on an as-fed basis

**Table 2: Herd EBI (January 2022 evaluations)**

EBI	Milk	Fertility	Calving	Beef	Maint.	Health	Mgt
216 (Top 1%)	75 (Top 1%)	86 (Top 5%)	43	-11	12	8	3
Milk kg	Fat kg	Prot. Kg	Fat %	Prot. %	Calv int.	Surv %	
175	14	11	0.11	0.08	-4.3	2.6	

**Table 3: Feed budget for 2022 (target allowances and actual feed budget)**

Days in milk	0-20	21-60	61-90	91-120	121-180	181-240	241-270	271-305	306-343	344-365	Target annual amount	Actual annual amount
Silage kg DM/cow/day	5	0	0	0	0	0	5	15	10.7	8.5	1.3t DM	2.0 t DM
Grass kg DM/cow/day	10	15	15	15	15	14	7.5	0	0	0	3.5t DM	2.48 t DM
Concentrate kg/cow/day	8	8	7.5	6	3.5	3	3	3	0	0	1.5t as fed	1.56 t As fed

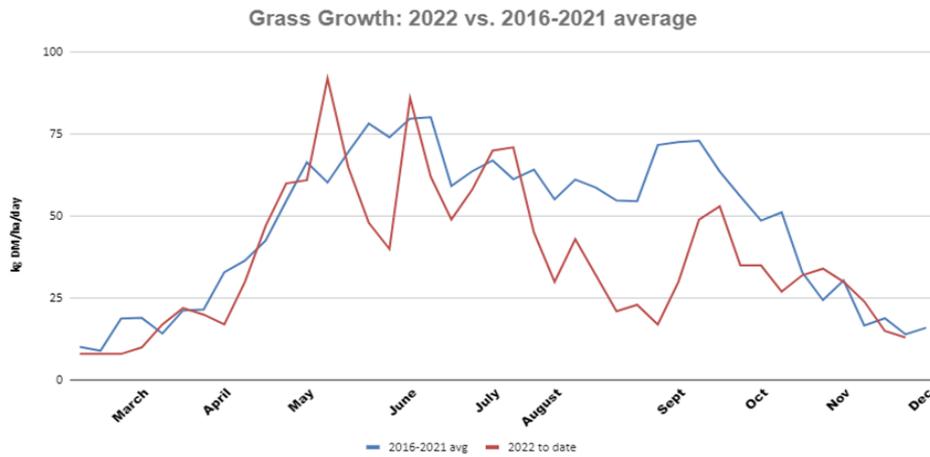
**Production Performance 2016-2022**

**Table 4: Herd Milk Production Performance 2016 -2022**

Parameter	Target	2016	2017	2018	2019	2020	2021	2022	7-year avg
Cow Numbers		58	60	59	58	57	57	57	58
MP ha		17.58	17.65	17.65	17.52	17.43	17.43	17.43	17.5
Silage ha		9	7	7	7	7	7	7	7.3
Whole Farm ha		26.58	24.65	24.65	24.52	24.43	24.43	24.43	24.8
SR on MP	3.27	3.3	3.4	3.34	3.31	3.27	3.27	3.27	3.3
SR Whole Farm	2.33	2.18	2.4	2.4	2.34	2.33	2.33	2.33	2.3
% Heifers	18-22	22.4	23.3	28	21	23	23	17.5	22.6
Average Lact Days	305	301	305	305	304	305	298	293	302
Average Protein %	3.6	3.56	3.66	3.62	3.6	3.59	3.64	3.62	3.61
Average Fat %	4.5	4.51	4.48	4.54	4.53	4.56	4.46	4.50	4.51
Average SCC	<120,000	111,000	91,500	154,000	56,000	58,000	50,000	73,000	84,786
Yield/cow kg (305d)	7750	7441	7548	6680	7541	7771	7744	7234	7423
MS/cow kg (305d)	625	592	602	558	597	621	630	580	597
Yield/cow kg (Actual)	7750	7407	7466	6790	7381	7503	7733	7010	7327
MS/cow kg (Actual)	625	588	595	544	586	606	629	562	587
MS/ha kg MP	2043	1953	2023	1850	1940	1980	2057	1838	1949
MS/ha kg WF	1456	1291	1428	1306	1371	1413	1468	1311	1370

**Table 5: 2022 Grassland Management**

Grass Production Parameter	
Opening cover on 12 <sup>th</sup> Jan 2022 (kg DM/ha)	993
Total grass grown (t/ha)	12.1
Total number of grazings	8.1
Closing cover on 1 <sup>st</sup> December 2021 (kg DM/ha)	654
Stocking rate on MP	3.27
Nitrogen (kg N/ha MP)	182
Phosphorus (kg P/ha MP)	0
Potassium (kg K/ha MP)	29
Turnout by day	10 <sup>th</sup> February
Turnout full time	2 <sup>nd</sup> March
Housed by night	2 <sup>nd</sup> November
Full time housing	18 <sup>th</sup> November
Total days at grass	268
Silage (bales) on MP (t/ha)	2.9
Herbage utilized t/ha	10.97
Grazed grass utilized t/cow	2.48
Grazed grass utilized t/ha	8.12
Milk from forage (kg)	3738
Average concentrates consumed (kg/cow as fed)	1565
Average silage consumed (kg/cow DM)	2030



**Figure 1.** Grass growth comparison between 2022 and average 2016-2021

**Table 6: Grassland Production Performance 2016-2022**

	2016	2017	2018	2019	2020	2021	2022	7-Yr Average
Grass grown kg/ha	13060	14000	11700	14535	13633	13807	12102	13262
Silage on MP (kg/ha)	1710	2000	1410	1979	1428	1421	2854	1829
Herbage utilized kg/ha	11417	12200	10030	13528	12122	11598	10977	11696
Grazed Grass utilized/ha	9,707	10200	8620	11549	10713	10177	8123	9897
Grazed Grass utilized/cow	2,942	3000	2535	3489	3243	3112	2484	2977
Milk from forage (kgs)	4400	4400	3548	4381	4612	4829	3860	4362
Nitrogen MP kg/ha	235	260	265	250	235	210	182	234
Nitrogen whole farm kg/ha	219	237	229	231	195	188	159	208
P MP kg/ha	9.3	8.6	8.9	10	14.6	25.3	0	11
K MP kg/ha	31.7	44	112	120	84.7	95.3	29	74

## Breeding 2022

The breeding season in 2022 began on the 3<sup>rd</sup> May and finished on 11<sup>th</sup> July (10 weeks). All cows were submitted within 26 days. This year, 56/57 cows were bred. One cow was omitted from breeding due to poor udder confirmation. The 21-day submission rate was 87.5% (49/56 cows in the breeding herd). The 6-week in calf rate was 84% (47/56 cows). A final scan on 13<sup>th</sup> October determined that 6/57 of submitted cows were empty. The calculated empty rate including the pre-breeding cull is 10.5%.

**Table 7: Fertility performance of the herd 2016-2022**

	2016	2017	2018	2019	2020	2021	2022
<b>Number of cows bred</b>	58 (of 58)	59 (of 60)	55 (of 60)	58 (56 sub)	57 (54 sub)	57(55 sub)	57 (56 sub)
<b>Submission rate 21 d%</b>	91	90	96	95	91	95	87.5
<b>First service conception rate %</b>	43	49	69	60	74	72	79
<b>6-week pregnancy rate %</b>	59	54	83	79	87	87	84
<b>Empty rate of total cows %*</b>	9 (5/58)	15 (9/59)	13 (7/55)	12 (7/58)	9 (5/54)	7 (4/57)	10.5 (6/57)

Breeding was all by A.I and was done twice daily. Bulls used were:

FR6217	PINE-TREE LAWSON LARRY-ET
FR5076	PEAK MOTION-ET
FR5857	OLDCASTLETOWNN TIERNAN
FR6139	LISDUFF PERCEPTION
FR5668	PEAK CHILTON-ET
FR6061	MUNTA MYSTIC
FR4573	VH PRASER
FR7533	BOMAZ EPISODE-ET
FR7359	MOORABBY NAVAJO
FR7923	TOBERMARTIN FRANCIS

**Table 8. The weighted EBI averages of these bulls used were as follows:**

EBI	Milk	Fert	Calv	Beef	Maint	Manag	Health	Milk	Fat	Prot	F+P	F	P
€	SI	SI	€	€	€	€	€	kg	kg	kg	kg	%	%
285	123	104	22	392	24	19	22	392	24	19	43	0.14	0.09

These bulls were selected for high milk fat and protein milk PTA to ensure the milk fat and protein % stay positive in addition to selecting for good health and high fertility sub-index values. Ten bulls were selected to increase bull team reliability. From the 7<sup>th</sup> week of breeding onwards, selected beef bulls were used for the remainder of the breeding season. The beef bulls being used are AA4235 (Gabriel Mossy), AU5506 (Whitestown Leyland), and LM2014 (Ewdenvale Ivor).

### Financial simulation

A financial simulation comparing the Lyons high-output grass-based spring milk production model and a very efficient low input model indicates that for 2022 a benefit of €36 per ha for Farm Profit and €67 per ha for Economic profit was realized in favor of the Lyons system. This simulation was done using the last three years performance data (595 kg of fat and protein output), currently allowable stocking rates introduced with 'Nitrates Banding' (January 1<sup>st</sup>, 2023) and relevant 2022 input and output prices. Further analysis of financial simulations indicates that a change on organic N excretion limits from 250 kg to 220 kg per ha whole farm will reduce Economic profit by €409 per ha for the Lyons system and €455 per ha for the very efficient low concentrate grazing system.

**Table 9. Financial Simulation 2022**

	Very efficient low concentrate system	UCD Lyons
Milk output (€/cow)	2,910	3,728
Milk output (€/ha)	7,843	8,697
Gross Margin (€/cow)	1,953	2,238
Gross Margin (€/ha)	5,264	5,221
Farm Profit ex. lab, rent, int (€/cow)	1,393	1,625
Farm Profit ex. lab, rent, int (€/ha)	3,754	3,790
Imputed labour (€/cow)	347	408
Imputed rent and interest (€/cow)	287	311
Economic Profit after lab, rent & int (€/cow)	759	906
Economic Profit after lab, rent & int (€/ha)	2,046	2,113
Reduction in Economic Profit if Organic N limit is 220 kg/ha	455	409

### Environmental metrics

Simulation of global warming potential was achieved by Life Cycle Assessment analysis in collaboration with the University of Nottingham. It was estimated that overall Global Warming Potential in 2020 equated to 0.95 kg of CO<sub>2</sub> equivalent per kg of FPCM (fat and protein corrected milk) (Table 10). This compares to a Teagasc National Average figure 1.13 kg of CO<sub>2</sub> equivalent per kg of FPCM and a future Target figure with a discount for grazing cow methane emissions of 0.86 kg of CO<sub>2</sub> equivalent per kg of FPCM published by Teagasc in 2022 (Herron et al in 2022). Interestingly, the 2020 data from Lyons indicates a very favorable figure of 0.81 kg of CO<sub>2</sub> equivalent per kg of FPCM when using Irish grown feed ingredients (without incorporating a reduced methane output for grazing cows). These simulations indicate the potential to reduce our carbon footprint by using production systems and practices which are part of the Systems project at Lyons. Farmgate Nitrogen Use Efficiency for the project equated to 40% (39.6%) in 2021, which compares favorably with other perennial ryegrass-based systems. It is anticipated that Farmgate Nitrogen Use Efficiency will improve further in the years ahead due to the increasing the use of clover on the milking platform and further reducing chemical N input.

**Table 10**

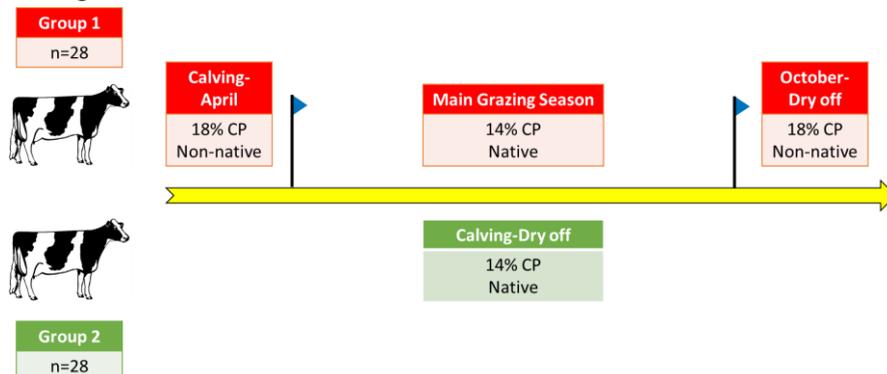
		Teagasc, National Average <sup>1</sup>	Herron et al. (2022), Current	UCD Lyons herd				Herron et al. (2022), Target	
				2016	2017	2018	2019		2020
Milk yield, kg <sup>-1</sup> cow <sup>-1</sup>		5,484	5,750	7,407	7,466	6,790	7,381	7,503	5,790
Milk solids produced, kg <sup>-1</sup> cow <sup>-1</sup>		417	439	588	595	544	586	606	481
Stocking rate, LU <sup>-1</sup> ha <sup>-1</sup>		2.10	2.06	2.18	2.43	2.39	2.37	2.33	2.74
Animal numbers	Cows	82 <sup>2</sup>	82	58	60	59	58	57	110
	Replacements	16 <sup>2</sup>	16	13	14	17	12	13	20
Herbage utilised, tonnes <sup>-1</sup> DM ha <sup>-1</sup>		7.8	8.12	11.1	11.0	11.6	12.2	11.6	12.3
Land area, ha		40 <sup>2</sup>	40	26.6	24.65	24.65	24.52	24.43	40
Concentrate per cow, kg <sup>-1</sup> DM		1,176	1,025	1,300	1,300	1,579	1,326	1,226	450
Fertiliser N usage, kg <sup>-1</sup> ha <sup>-1</sup>	MP <sup>3</sup>			235	260	265	250	235	
	Silage ground	184	185	167	166	127	170	85	150
Enteric emissions, kg CO <sub>2</sub> e <sup>4</sup>	Overall	291,983.96 <sup>5</sup>	333,239.18 <sup>6</sup>	256,585.96	245,086.29	270,303.33	255,792.35	245,235.70	299,544.77 <sup>7</sup>
	Per cow	2,979.43 <sup>5</sup>	3,400.40 <sup>6</sup>	3,613.89	3,311.98	3,556.62	3,654.18	3,503.37	2,304.19 <sup>7</sup>
	Per ha	7,299.60 <sup>5</sup>	8,330.98 <sup>6</sup>	9,646.09	9,942.65	10,965.65	10,431.99	10,038.30	7,488.62 <sup>7</sup>
Total emissions, kg CO <sub>2</sub> e <sup>4</sup>	Overall	521,399.93	595,069.97 <sup>6</sup>	422,408.75	414,117.20	441,980.41	481,789.35	437,377.06	599,089.54 <sup>7</sup>
	Per cow	5,320.41 <sup>5</sup>	6,072.14 <sup>6</sup>	5,949.42	5,596.18	5,815.53	6,882.71	6,248.24	4,608.38 <sup>7</sup>
	Per ha	13,035.0 <sup>5</sup>	14,876.75 <sup>6</sup>	15,880.03	16,799.89	17,930.24	19,648.83	17,903.28	14,977.24 <sup>7</sup>
GHG emissions, kg CO <sub>2</sub> e/kg FPCM <sup>8</sup>	Overall	1.13	1.23 (1.10 <sup>7</sup> )	0.91	0.86	1.03	1.07	0.95	0.86
	Allocation <sup>9</sup>	0.99	1.08 (0.97 <sup>7</sup> )	0.80	0.76	0.91	0.94	0.84	0.76

**Table 11**

		Teagasc, National Average <sup>1</sup>	Herron et al. (2022), Current	UCD Lyons herd				Herron et al. (2022), Target	
				2019 – 18%	2019 – 14%	2020 – 14%	2020 – 12% Non-native		2020 – 12% Native
Milk yield, kg <sup>-1</sup> cow <sup>-1</sup>		5,484	5,750	7,263	7,490	7,382	7,582	7,718	5,790
Milk solids produced, kg <sup>-1</sup> cow <sup>-1</sup>		417	439	574	589	607	608	609	481
Stocking rate, LU <sup>-1</sup> ha <sup>-1</sup>		2.10	2.06	2.37	2.37	2.33	2.33	2.33	2.74
Animal numbers	Cows	82 <sup>2</sup>	82	58	58	57	57	57	110
	Replacements	16 <sup>2</sup>	16	12	12	13	13	13	20
Herbage utilised, tonnes <sup>-1</sup> DM ha <sup>-1</sup>		7.8	8.12	12.2	12.2	11.6	11.6	11.6	12.3
Land area, ha		40 <sup>2</sup>	40	24.52	24.52	24.43	24.43	40	40
Concentrate per cow, kg <sup>-1</sup> DM		1,176	1,025	1,576	1,476	1,386	1,446	1,394	450
Fertiliser N usage, kg <sup>-1</sup> ha <sup>-1</sup>	MP <sup>3</sup>			250	250	235	235	235	
	Silage ground	184	185	170	170	85	85	85	150
Enteric emissions, kg CO <sub>2</sub> e <sup>4</sup>	Overall	291,983.96 <sup>5</sup>	333,239.18 <sup>6</sup>	257,934.26	254,890.39	244,557.36	246,364.43	245,169.55	299,544.77 <sup>7</sup>
	Per cow	2,979.43 <sup>5</sup>	3,400.40 <sup>6</sup>	3,684.78	3,641.29	3,493.68	3,519.49	3,502.42	2,304.19 <sup>7</sup>
	Per ha	7,299.60 <sup>5</sup>	8,330.98 <sup>6</sup>	10,519.34	10,395.20	10,010.53	10,084.50	10,035.59	7,488.62 <sup>7</sup>
Total emissions, kg CO <sub>2</sub> e <sup>4</sup>	Overall	521,399.93	595,069.97 <sup>6</sup>	488,395.72	471,256.44	442,322.63	448,957.04	386,444.57	599,089.54 <sup>7</sup>
	Per cow	5,320.41 <sup>5</sup>	6,072.14 <sup>6</sup>	6,977.08	6,732.24	6,318.90	6,413.67	5,520.64	4,608.38 <sup>7</sup>
	Per ha	13,035.0 <sup>5</sup>	14,876.75 <sup>6</sup>	19,918.26	19,219.27	18,105.72	18,377.28	15,818.44	14,977.24 <sup>7</sup>
GHG emissions, kg CO <sub>2</sub> e/kg FPCM <sup>8</sup>	Overall	1.13	1.23 (1.10 <sup>7</sup> )	1.10	1.04	0.98	0.98	0.81	0.86
	Allocation <sup>9</sup>	0.99	1.08 (0.97 <sup>7</sup> )	0.97	0.92	0.86	0.86	0.71	0.76

**2022 Nutrition study – Outline of dietary treatments**

Result Pending



## Dissemination in 2022

- Weekly notes and annual report published on the UCD Lyons Farm website (<https://www.ucd.ie/lyonsfarm/research/dairyresearch/lyonssystemresearchherdnotes/>)
- Twitter: @UCD\_SystemsHerd
- Industry and farmer groups were hosted throughout the year

## Research Team

Prof Karina Pierce, Prof Finbar Mulligan, Dr Zoe McKay, Prof Michael Wallace, Prof Alan Fahey, Mr Anthony Ryan, Mr Niall Walsh, Prof Emmet Kelly, Prof Eoin Ryan and Ms Mary Duane.



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