

Dairy cows reduce free water intake when offered different fresh-cut pasture species

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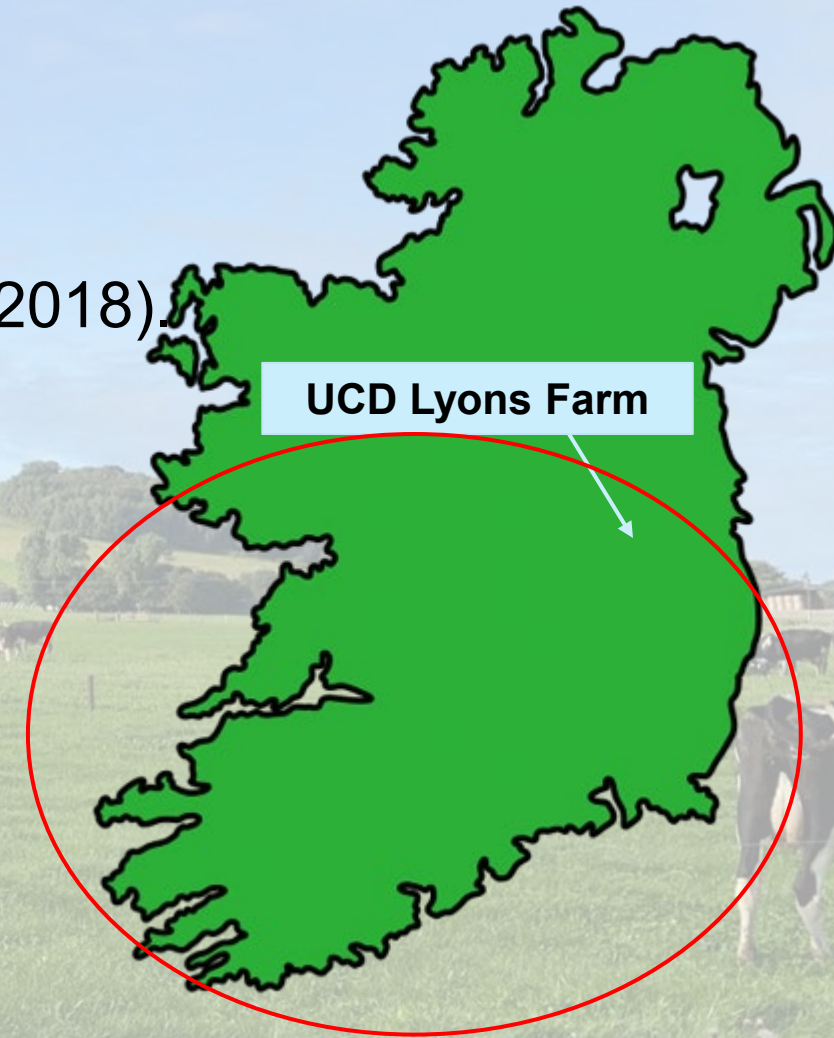
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Agriculture in Ireland

- **17,000** dairy farms – an average of 91 cows on 55 ha.
- Predominantly spring calving system.
- Grazed grass – **60%** of the dairy cow diet (O'Brien et al., 2018).

Environmental targets

- A **25%** reduction in GHG emissions by 2030.
- Reduce NH_3 emissions by **1%** by 2029.
- **50%** reduction in nutrient losses by 2030.
- **'Good status'** in all water bodies by 2027.



Plantago lanceolata

- Offering dairy cows forage plantain (*Plantago lanceolata*; **PL**) has resulted in:
 - Greater forage and total water intakes (**TWI**).
 - Increased urine volumes.
 - Lower urinary N concentration.
 - Similar/greater levels of milk production.(Box et al., 2017; Minnée et al., 2020)
- Urinary N in the environment - volatile.
 - N_2O
 - NH_3
 - NO_3^-



Plantago lanceolata

- Plantain compared to perennial ryegrass (*Lolium perenne*; **PRG**):
 - Lower dry matter (**DM**) content.
 - Lower soluble N content.
 - Lower fibre content.
 - Greater mineral content.(Minnée et al., 2020; Hearn et al., 2022)
- Limited research on dairy cows' pattern of free water intake (**FrWI**) when offered a lower DM forage.
- A paucity of information on water partitioning in dairy cows when offered forages of different DM content.

Research objective

- To determine the TWI and urinary N concentration produced by lactating dairy cows offered fresh-cut forages containing PL.
- To better understand the pattern of FrWI and partitioning of water in lactating dairy cows offered fresh-cut forages containing PL.



Hypothesis

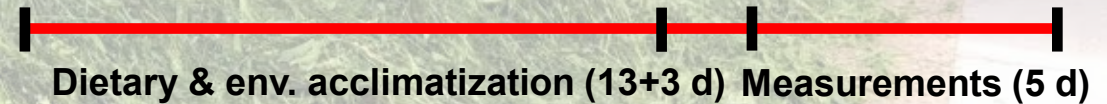
- Lactating dairy cows offered forage containing PL would have an altered FrWI pattern and greater TWI.
- Nitrogen concentration in the urine would be reduced in cows offered the forage containing PL.

Methodology

- Eight multiparous, mid-lactation dairy cows were assigned to 2 treatments in a 2x2 crossover design (**n = 8**).
- The 2 treatments were a fresh-cut PRG and white clover forage mixture (**PRG**), and a PRG, white clover, and PL forage mixture (**PLA**).

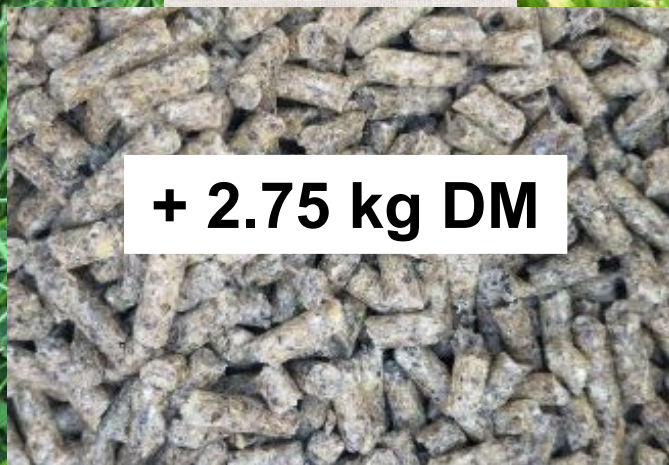
- Each period was 21 days in duration:

- 13 days of dietary acclimatization indoors.
- 3 days of environmental acclimatization.
- 5 days of measurements in individual tie stalls.





PRG



+ 2.75 kg DM



PLA

Methodology (continued)

- Water intake was recorded over the 5 days and individual FrWI was recorded using the Terra NutriTECH Opis mineral system.
- Feed water intake was calculated by measuring the fresh weight intake of forage and concentrate and correcting them for DM content.
- Data was analyzed using the MIXED procedure of SAS® Studio.
- Fixed effects included treatment, hour, period, and appropriate interactions.
- Cow within sequence was considered the random effect.



Results

Table 1. Pre-cutting herbage yield and botanical composition of the forages.

Item	Treatment ¹	
	PRG	PLA
Pre-cutting herbage yield (kg DM/ha)	1405	1389
Botanical composition (% species on a DM basis)		
PRG	80	23
White clover	15	7
Plantain stem	-	9
Plantain leaf	-	59
Unsown	5	2

¹ Treatment: **PRG** = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

Table 2. Chemical composition of the forages offered to lactating dairy cows.

Forage Chemical Composition	Treatment ¹	
g/kg DM unless otherwise stated	PRG	PLA
Dry matter (%)	17.1	16.2
Ash	98	129
Crude Protein	164	159
Neutral Detergent Fibre	450	374
Acid Detergent Fibre	247	230
Neutral Detergent Insoluble Crude Protein	56	66
Water Soluble Carbohydrates	69	51
Non-Fibre Carbohydrates	320	385

¹ Treatment: **PRG** = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

Table 3. The effect of treatment on dry matter intake (**DMI**) and milk production in lactating dairy cows.

	Treatment ¹			P - value	
	PRG	PLA	SEM	Treatment	Treatment × Period
DMI, kg/d					
Forage	18.7	20.1	0.36	0.005	NS
Concentrate	2.75	2.75			
Total	21.4	+1.5 kg 22.9	0.36	0.005	NS
Milk					
Yield, kg/d	24.9	25.8	0.88	0.06	NS
Fat, %	4.92	4.60	0.124	0.003	NS
Protein, %	3.73	3.72	0.056	0.48	NS

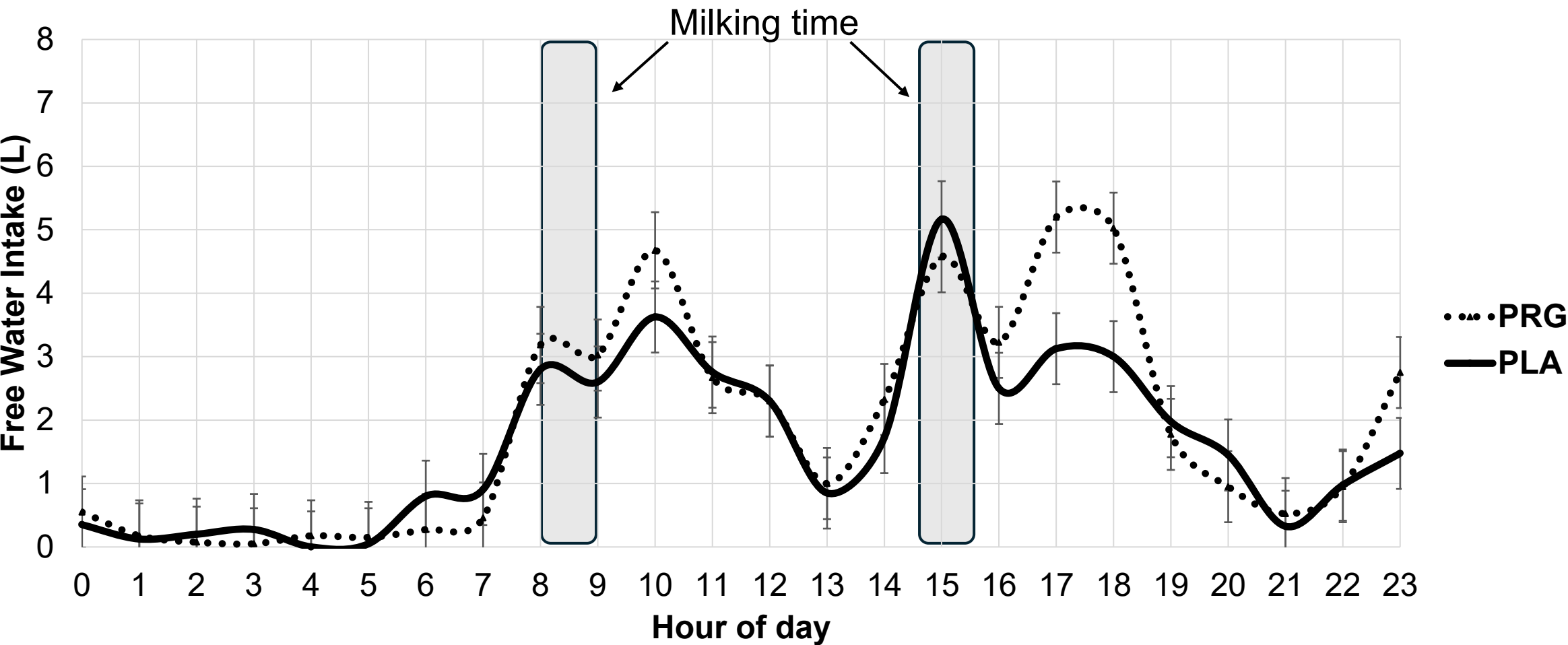
¹ Treatment: **PRG** = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

Table 4. The effect of treatment on water intake and urinary N concentration in lactating dairy cows.

	Treatment ¹			P - value	
Water intake (L/d)	PRG	PLA	SEM	Treatment	Treatment × Period
Feed	93.1	106.3	1.61	<.0001	NS
Free	46.1	37.4	4.37	0.03	NS
Total	139.2	143.7	4.72	0.25	NS
Urine					
N (%)	0.45	- 20% 0.36	0.018	<.0001	NS

¹ Treatment: **PRG** = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

Figure 1. Mean hourly FrWI of lactating dairy cows.



PRG = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

No significant difference in FrWI between treatments at any hour of the day ($\alpha = 0.05$).

A positive correlation existed with forage DM % and FrWI ($r = 0.75$, $P < 0.0001$; $n = 80$).

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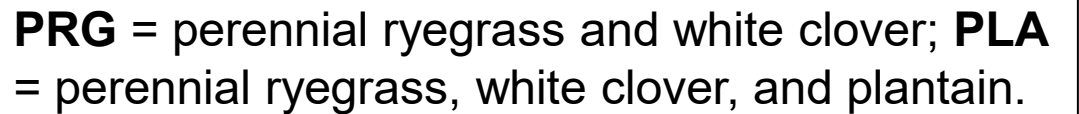


Table 5. The effect of treatment on the water balance of lactating dairy cows.

	Treatment ¹			<i>P</i> - value	
Item	PRG	PLA	SEM	Treatment	Treatment × Period
Water excreted, L/d					
Milk	21.7	22.6	0.84	0.02	NS
Feces	53.5	47.6	3.06	0.08	NS
Urine	38.3	43.8	2.48	0.04	NS
Water balance	25.6	29.6	2.02	0.19	NS

¹ Treatment: **PRG** = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

Table 6. The effect of treatment on water partitioning in lactating dairy cows.

Item	Treatment ¹		SEM	P - value	
	PRG	PLA		Treatment	Treatment × Period
Water partitioning					
Milk	0.16	0.16	0.008	0.78	NS
Feces	0.38	0.33	0.013	0.03	NS
Urine	0.28	0.31	0.009	0.03	0.05
Water accounted	0.81	0.79	0.012	0.26	NS

¹ Treatment: **PRG** = perennial ryegrass and white clover; **PLA** = perennial ryegrass, white clover, and plantain.

Conclusions

- Free water intake was significantly influenced by forage DM %.
 - Cows offered the lower DM forage had a reduced FrWI.
 - However, due to minimal difference in forage DM % between the treatments the pattern of FrWI and TWI were not impacted.
- The higher urine production for cows offered PLA reduced the concentration of N in urine.
- The different sources of water intake between the treatments may have contributed to the differences observed in water partitioning.
- Farms employing water-based delivery methods of supplements should consider the effect of pasture DM content on the total FrWI of lactating dairy cows.

Thank you for your attention

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