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GRASS SILAGE 2019

EARLY SEASON MINERAL PROFILE

- MACRO-MINERALS UNCHANGED OVER PAST 3 SEASONS EXCEPT FOR ELECTROLYTES
- ELECTROLYTE ELEMENTS (POTASSIUM, SODIUM, CHLORIDE) HIGHER DUE TO WARMER SPRING
- CATION-ANION BALANCE RISES TO +423 meq/kg
- SOIL CONTAMINATION SUBSTANTIALLY LOWER, REFLECTING GOOD CONDITIONS AT GRASS HARVESTING
- MOLYBDENUM FALLS DRAMATICALLY (20%) AS MAY DRIER THAN AVERAGE
- HYPOCALCAEMIA RISK INCREASED, BUT ANTAGONISTIC CHALLENGE TO COW FERTILITY AND HEALTH REDUCED

BACKGROUND

Following the record breaking weather patterns in 2018, as reflected in spring floods and summer drought, it was important 2019 reverted to type for growing grass, and indeed it did. A warm early spring (February—April) and above average hours of sunshine provided an ideal launch pad for the grass growing season. Supported by 140% of average rainfall in the key month of March, reinforced this excellent start to the season. Conditions were so favourable that silage cuts started a month early in April. This pattern continued into May with average temperatures, but lower rainfall; ideal for silaging. The other factor which ensured a good start to the season was the carry over of soil nutrients from 2018 following a dry winter. Although these weather patterns were experienced across the region, inevitably regional variation was considerable.

Data obtained from Met Office, Weather Summaries In general terms the North and West was cooler and wetter compared to the South and East. This feature was particularly apparent in the first half of March with the arrival of Storm Freya and Storm Gareth, which dumped high rainfall on the uplands of the Northern part of Ireland. This was followed by drier and warmer weather in April, which culminated in a sunny Easter with temperatures well into the 20s C. To date, 2019 should be a record grass growing year in many parts of these islands. What a welcome contrast to the drought restricting season of 2018. The following comments report our initial findings on the mineral composition of 1st Cut Silage for this season.

MACRO MINERAL

Macro-minerals play an important role in bone development, energy utilisation and general physiology, which is creating the optimal conditions for metabolism to drive livestock productivity. For those elements essential for skeletal development and milk production (Calcium, Phosphorus), and energy utilisation (Phosphorus, Magnesium), mean values over the past three years have been very consistent. This pattern would suggest the concentration of these elements is independent of vegetative growth, being more dependent on soil nutrition chemistry. Furthermore, they would be less prone to leaching by high winter rainfall due to their relatively low solubility. In contrast, electrolyte elements (Potassium, Sodium, Chloride) are very soluble and are more likely to reflect available soil levels which would be a combination of spring applications from slurry and residual carry-over from the drought in 2018. The ideal grass growing conditions in the spring of this year would also drive vegetative growth and the uptake of these. electrolyte elements. Interestingly, Sulphur has remained unchanged over the past three years, which suggests Sulphur fertiliser applications have become routine, as this element also has a high solubility and will readily leach under the influence of winter rainfall. The fact that mean concentrations have remained constant indicates Sulphur applications are now a regular occurrence.

Mean Monthly Deviation from Long Term Average (1981-2010)

		Temperature °C	Rainfall %	Sunshine %
January 2019	Warm Spring			
February	Warm Spring	—-	52	101
March	Warm Spring	+2.4	82	144
April	Warm Spring	+1.3	140	114
May	Normal Temp	+1.0	71	114
June	Normal Temp	-0.3	93	101
July	Normal Temp	+0.2	152	95
	Normal Temp	+1.2	114	100

Data obtained from Met Office, Weather Summaries

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Mean Concentration (% DM)

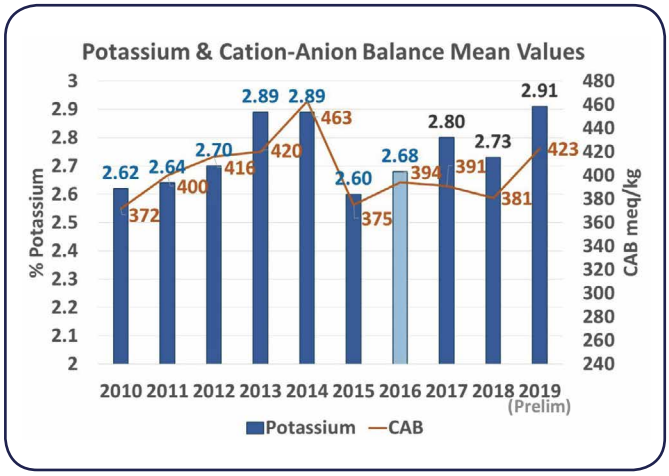
Element	2017	2018	2019	% Difference 2019 v 2018
Calcium	0.61	0.61	0.61	—-
Phosphorus	0.36	0.35	0.35	—-
Magnesium	0.19	0.19	0.18	+6
Potassium	2.80	2.73	2.91	+7
Sodium	0.29	0.25	0.28	+12
Chloride	1.06	0.98	1.04	+6
Sulphur	0.24	0.24	0.24	—-
CAB meq/kg	+391	+381	+423	+12

• Potassium and CAB

A mean Potassium level of 2.91% is the highest value over the past ten years and is 6% higher than the long-term average of 2.75%. The almost perfect growing conditions for grass this spring has already been referred to as the primary cause. Mean Potassium values have fluctuated widely in recent years, with a progressive increase evident between 2010 –2014, followed by a more variable pattern. These trends are due to three influencing factors

1. Potash fertiliser "holiday" adopted by many farms, as a cost cutting measure.
2. Volatile spring weather patterns have a direct impact on vegetative growth and soil solubility, which is highlighted this year.
3. Increased focus on re-seeding pastures to improve grassland productivity

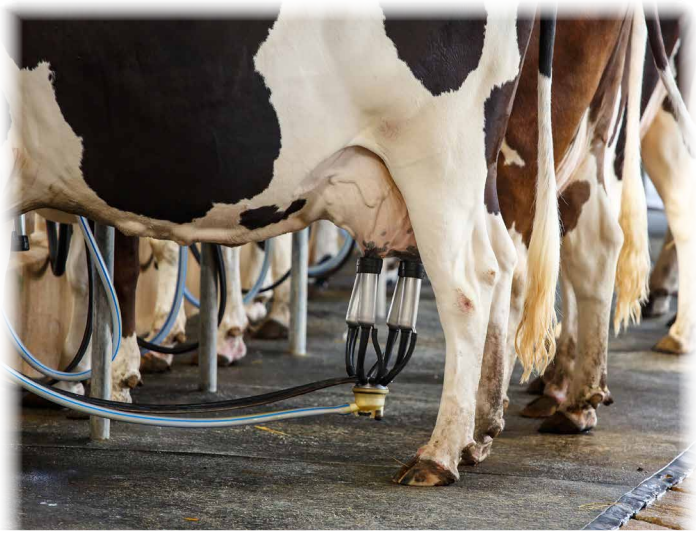
As new grasses have a "hunger" for Potassium, inevitably herbage levels rise in a newly established pasture.
Nutrient Management Planning based on soil analysis and grass production targets is an essential tool to developing a more balanced and sustainable



approach to Potassium supply from slurry and fertiliser. This year the average Potassium supply level of 2.91% is 16% above the 2.50% target for optimal grass vegetative growth. Excess Potassium has the potential to disrupt electrolyte balance, which will adversely impact water balance. In addition, increased pressure on Magnesium, which is essential for cow health occurs. These aspects are exaggerated in the dry cow, where excess Potassium increases metabolic alkalinity and the risk of hypocalcaemia.
Cation-Anion Balance (CAB) is highly influenced and dependent on Potassium. As a result, CAB follows the previously described Potassium trends. Not surprisingly this season's high Potassium value is translated into a corresponding high CAB value of +423 meq/kg, which reverts to the 2012-2014 levels, and is 10% above the last four years (2015-2018) trend of +385 meq/kg. Consequently, the risk of hypocalcaemia at calving will be higher.
Grass silage CAB values are the single largest contributor to the total dietary Cation-Anion Balance (DCAB). For lactating cow diets the majority of TMRS will be calculated within the target range of +200 to +400 meq/DM for a milking cow and the higher value in this season's silage crop will make it more difficult to achieve a DCAB of less than +100 meq/kg DM for dry cow diets: For close up or Transition diets for average to high yielding herds the challenge is greater to achieve a DCAB of around zero to –50 for a partial anionic diet and less than –100 meq/kg DM for a full anionic diet. Failure to achieve these DCAB targets will increase the risk of hypocalcaemia which includes:

- Retained cleansings
- Uterine infections
- Displaced abomasum
- Depressed Dry Matter intake
- Poor milk initiation
- Ketosis
- Milk Fever

The occurrence of Hypocalcaemia will inevitably depress milk production, fertility and health in the forthcoming lactation.
Consequently it is a key action point to analyse grass silage for minerals from which a Cation-Anion Balance can be calculated to be used in balancing pre-calver diets with the purpose of minimising hypocalcaemia.



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• Sulphur

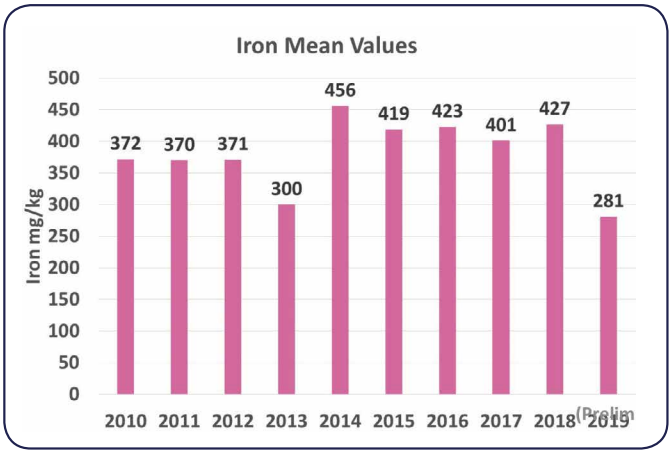
Sulphur is an essential macro-element for grass growth and in combination with Nitrogen is important for protein production. Like Nitrogen, Sulphur is mobile in soils, particularly light soils, and needs to be applied annually. The significant atmospheric deposition of Sulphur from coal fired industry has long gone, and the reliance of fertiliser inputs including slurry is critical. The fertiliser industry has long campaigned for Sulphur to be included in Nitrogen based fertilisers and this policy appears to be paying off, as since 2010 the mean grass silage Sulphur level has increased from 0.19% to 0.24% (a 26% increase). This rise in forage Sulphur levels is equivalent to a 4% unit increase in grass protein levels, which represents a significant reduction on the requirement for imported protein feeds.

Trace Elements Mean trace element values have drifted lower this year, due primarily to being diluted by increased grass growth. This trend is particularly noticeable by the decline in Manganese, Iodine and Boron levels. However, the headlines have been stolen by the dramatic reduction in Iron, Aluminium and Molybdenum mean values.

	Mean Trace Element Values (mg/kg DM)			% Difference 2018 v 2017
Element	2017	2018	2019	
Manganese	110	106	94	- 11
Copper	7.1	7.5	7.4	—-
Zinc	30.5	30.1	29.5	—-
Cobalt	0.23	0.25	0.23	—-
Iodine	0.43	0.49	0.24	- 51
Selenium	0.09	0.09	0.09	—-
Boron	5.2	7.5	6.2	- 17
Iron	401	427	281	- 34
Aluminium	175	156	119	- 24
Molybdenum	1.71	1.91	1.55	- 19
Lead	0.72	0.76	0.63	- 17

• Iron

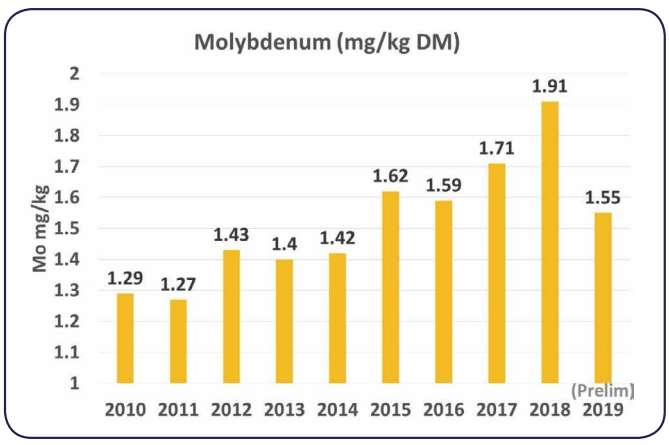
Iron has fluctuated widely over the past ten years, with mean annual values exceeding 400mg/kg in the past five years (2014-2018). The reported mean of 281 mg/kg for this year is the lowest this decade, being 34% below the 2018 mean. Silage Iron concentration is determined by a combination of soil contamination and root absorption. The extent of soil contamination is primarily weather related, as shown by the peak Iron level in 2014, which was a wet grass harvest year. In contrast, 2013 and April/May this year was dry and the opportunity for soil to be picked up with grass was reduced. However, a significant proportion of Iron occurs from root absorption, which is not influenced by soil contamination.



A key contributory factor is compaction, which renders soils anaerobic and increases the solubility of Iron, thereby raising root absorption. With livestock dietary Iron requirement reported at between 50-100mg/kg DM, the levels found in grass silage are clearly well in excess of animal needs. A combination of minimising soil contamination at harvest, and reducing soil compaction through the introduction of a soil improvement plan will help to arrest, and hopefully reduce, forage Iron concentration. High Iron intakes are a risk to the absorption of related cations (Manganese, Zinc and Copper) and consequently represents a risk to cow health and fertility. In addition, published research demonstrates that within silage clamps Iron contributed by soil contamination becomes solubilised which makes it more reactive and oxidative. In this highly active form, Iron will readily bind with Copper and Sulphur in the rumen to form insoluble Iron-Copper Sulphides, thereby reducing Copper availability and increasing the dietary requirement. In addition, reactive Iron will increase oxidative stress in cattle to the detriment of health and productivity.
To limit damage, check forage Iron levels and use the data to estimate total dietary levels, which can be used to determine the risk to cow health. To counter high Iron levels provide a balanced mineral supplement containing Novus MAAC chelates of Copper, Manganese and Zinc, which are well protected from Iron competitive pressures and absorbed at different gut sites.

• Molybdenum

The relentless rise in average grass silage Molybdenum levels since 2014 has been arrested by the dramatic decline of 19% in this season's early samples from 1.91mg/kg (2018) to 1.55mg/kg (2019). The excellent grass growing and harvesting conditions this spring is considered to be mainly responsible for this significant reduction in Molybdenum antagonism.
Of all the elements, Molybdenum is the most sensitive to anaerobic soil conditions. In well aerated soils Molybdenum is oxidised which renders it insoluble, thereby making it difficult for plants to absorb through the roots. Once air is excluded from soils by compaction, the chemistry of Molybdenum changes, which makes it more soluble and available for root absorption. In addition, soil pH and Sulphur also play a role in either stimulating or suppressing Molybdenum uptake by grass. Having a knowledge of the mineral composition of both soil and grass is a pre-requisite to developing a soil improvement programme designed to reduce forage Molybdenum levels. Molybdenum is well recognised as a Copper antagonist which reduces the availability of this essential element through the formation of insoluble compounds. An increased dietary Copper requirement results. The antagonism from Iron and Molybdenum on Copper availability requires additional Copper in a mineral supplement, to overcome the combined suppression of these antagonists. While recognition of the antagonistic challenge to Copper availability in the forthcoming winter season is important, the longer term strategy to reduce both Iron and Molybdenum lies in both soil improvement and practical actions at grass harvesting. Actions based on analytical information are also important to prevent both Copper toxicity and the more prevalent and economically damaging Copper deficiency diseases.



• Forage Mineral Reports

SAMPLE TYPE	Grass Silage	FARMER	Mean of 384 samples
SAMPLE REF	2019	FIELD ID	2019
DISTRIBUTOR	Thomson & Joseph Ltd.	POST CODE	
DISTRIBUTOR'S REF		DATE	9 September 2019

Dry Matter 33.0%

MINERAL ELEMENT (DM BASIS)			ASSAY	VERY LOW	LOW	MEAN	HIGH	VERY HIGH
Calcium	Ca	%	0.61	0.3	0.5	0.6	0.7	0.9
Phosphorus	P	%	0.35	0.2	0.3	0.35	0.4	0.55
Magnesium	Mg	%	0.18	0.1	0.15	0.2	0.25	0.4
Potassium	K	%	2.91	0.5	1.5	2	2.5	5
Sodium	Na	%	0.28	0.1	0.2	0.25	0.3	0.4
Chloride	Cl	%	1.04	0.3	0.6	1	1.4	2
Sulphur	S	%	0.24	0.1	0.15	0.2	0.25	0.4
Cation-Anion Balance		meq/kg	423	50	100	200	300	500
Manganese	Mn	mg/kg	94	50	75	100	125	200
Copper	Cu	mg/kg	7.4	5	8	10	12	15
Zinc	Zn	mg/kg	29.5	25	40	60	80	130
Cobalt	Co	mg/kg	0.23	0.1	0.2	0.25	0.3	0.4
Iodine	I	mg/kg	0.24	0.25	0.5	1	1.5	2
Selenium	Se	mg/kg	0.09	0.05	0.1	0.15	0.2	0.25
Boron	B	mg/kg	6.2	1	2	4	6	10
Iron	Fe	mg/kg	281	50	100	150	200	350
Aluminium	Al	mg/kg	119	25	50	100	150	300
Molybdenum	Mo	mg/kg	1.55	0.1	0.35	0.8	1.25	2
Lead	Pb	mg/kg	0.63	1	2	2.5	3	10
Relative Copper Antagonism								
Soil Contamination Index								

		Forage Year	2017	2018	2019	% Difference 2018 v 2019
		No. of Samples	431	319	384	
Dry Matter	%		31.2	33.3	33.0	—
Calcium	%		0.61	0.61	0.61	—
Phosphorus	%		0.36	0.35	0.35	—
Magnesium	%		0.19	0.19	0.18	—
Potassium	%		2.80	2.73	2.91	+7
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Molybdenum	mg/kg		1.71	1.91	1.55	- 19
Lead	mg/kg		0.72	0.76	0.63	—
Relative Copper Antagonism			High	High	High	—
Soil Contamination—Titanium	*mg/kg*		8.4	8.1	6.5	- 20

Data covers the period 1st June to 6th September.

Results are expressed on a Dry Matter basis.

IodEX PROTECTED

Based on Silage Analysis for 2019 silages, forage Iodine levels are down 50% on last year, there is a greater risk of Hypocalcaemia in 2019-2020 calving season leading to increase like hood of Milk fever, retained afterbirth and Ketosis.

For what is considered the most suitable Pre Calver mineral on the market to support the reduction of Hypocalcaemia - Contact the your local Inform Nutrition Representative below for further details on using Headstart Vet Tech and Headstart Pre Calver Elite Pre Calver minerals including protected iodine - Iodex

SUMMARY

The 3 key mineral risk factors to cow health and productivity are

Potassium, Iron and Molybdenum

Fe Iron · K Potassium · Mo Molybdenum

The 3 key mineral risk factors to cow health and productivity are Potassium, Iron and Molybdenum. While Potassium (+7%) has increased this season both Iron (- 34%)and Molybdenum (- 19%) are substantially reduced. The ideal nature of this season's grass growing and harvesting is considered to be responsible for these divergent trends. However, the risk of their involvement in Hypocalcaemia, Infertility and Oxidative Stress remains. Only through the regular analysis of grass silage can these risk factors be identified and a balanced mineral supplementation programme developed. In the longer term, forage mineral risk factors to cow health and productivity can be reduced through soil improvement and adopting an appropriate nutrient management plan for grassland. Having an integrated approach to the mineral nutrition of soils, grass and cows is the answer to improving grass and cow productivity in a sustainable and profitable manner. This review relates only to the mean of the first 384 Grass Silage samples analysed from this year's 1st Cut. The mineral status of silage is extremely variable and the only certain way of establishing the mineral content from an individual farm is by regular analysis.

Ask your local Inform Nutrition Ireland Nutritionist for further details

- **Kevin Conroy - Connacht** - 083 159 1892 - kevin@informnutrition.com
- **Liam Lacey - Leinster** - 086 770 2570 - liam@informnutrition.com
- **Howard Pearson - National** - 086 8550759 - howard@informnutrition.com
- **Sam Sweetnam - Munster** - 086 043 7153 - sam@mervuelab.com
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