

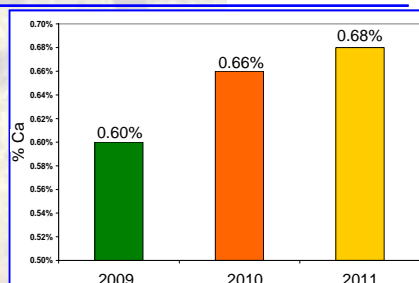


- **CALCIUM CONTINUES TO RISE**
- **PHOSPHORUS UP BY 12% DUE TO SPRING WEATHER**
- **POTASSIUM REMAINS HIGH AT 2.76%**
- **SODIUM INCREASES BY 16% PROBABLY REFLECTING SLURRY TARGETED AT SILAGE FIELDS**
- **CAB GOES BACK OVER+400meq/kg MARK**
- **IRON AND ALUMINIUM RISE BY 25% & 36% RESPECTIVELY DUE TO A COMBINATION OF SOIL CONTAMINATION AND DETERIORATING SOIL FERTILITY**
- **TRACE ELEMENTS GENERALLY STABLE**
- **MOLYBDENUM SIMILAR TO 2010**
- **COPPER ANTAGONISM FROM IRON, SULPHUR AND MOLYBDENUM MARGINALLY HIGHER THIS YEAR**
- **SOIL CONTAMINATION SIMILAR FOR THE PAST 3 YEARS**

Mean mineral data from the 2011 grass silage crop analysed between June and September 2011, has reported some interesting differences and similarities to the mean analysis of 2009 and 2010 grass silage. Weather patterns during the preceding winter and spring had a profound influence on the uptake of some elements, whereas the 2009/10 winter only really got going in January with low temperatures continuing through to April, the 2010/11 winter was largely experienced before New Year. Thereafter, spring temperatures were above average and were associated with an unusually dry period from February through to April. This pattern of warm, dry spring weather is undoubtedly responsible for the marked increase in Phosphorus. It would have been expected that, in contrast to Phosphorus, values would have fallen for Iron, Aluminium and Molybdenum. The fact that they have all increased may be related to the onset of wet weather during May when grass was being harvested. Against this background the following key features were seen:

CALCIUM—CONTINUING TO RISE

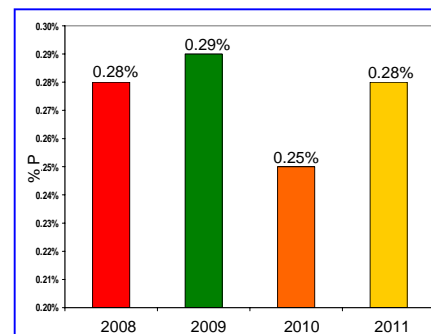
- Grass is a high CALCIUM crop.
- CALCIUM levels are influenced by:
 - (a) soil pH
 - (b) soil Calcium
 - (c) fibre (ADF)
- More emphasis on soil improvement, which inevitably involves liming, may be on the increase, as dairy farmers attempt to increase milk from forage.
- CALCIUM is a key component of cell walls, where it has a similar role to supporting the skeleton in animals. If higher CALCIUM levels are related to an increased ADF fraction, then a decrease in D value would be expected. There appears to be no evidence this is the case for 2011 grass silage.
- So, if the increasing CALCIUM trend is confirmed, then it



may well be related to more attention being directed at soil improvement.

PHOSPHORUS BOUNCES BACK

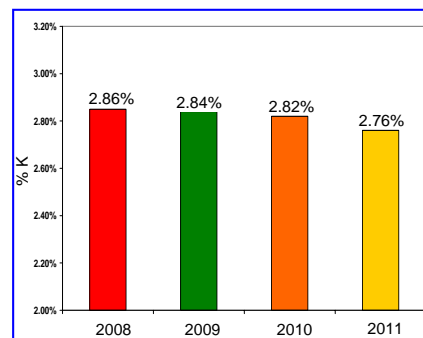
- Long term trend of PHOSPHORUS is 0.28-0.30%, as reflected in the 2008 and 2009 mean values.
- In 2010 PHOSPHORUS fell by 14% to 0.25%. The lowest mean value for 20 years, due to the prolonged cold spring



- Of all the minerals, PHOSPHORUS is the most sensitive to soil temperature, where there is a positive association between temperature and plant uptake.
- The warm, dry spring of 2011 has resulted in PHOSPHORUS bouncing back to the long term trend of 0.28-0.30% DM.
- With supplementary PHOSPHORUS costs remaining high, this marked average increase in grass silage PHOSPHORUS concentration is very welcome. For a dairy herd feeding grass silage as the sole forage, this year's increase in PHOSPHORUS is equivalent to an extra 4g PHOSPHORUS per cow per day.
- Consequently supplementary PHOSPHORUS levels should be able to be reduced by 3%, worth £60—£70 per tonne of mineral.

POTASSIUM MAINTAINS HIGH VALUE—BUT EVIDENCE OF A DECLINE?

- Excessive POTASSIUM levels remain a key feature of grass silage, when it is reckoned that the requirement for grass growth is around 2% DM and the cow requirement is about 1% DM.
- POTASSIUM peaked in 2008, having steadily increased since the early 1990s.

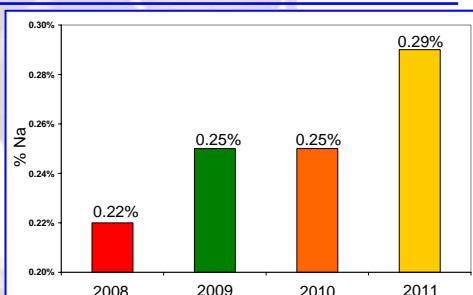


- Over the past four seasons, POTASSIUM has, on average, started to decline. Since 2008, POTASSIUM levels have fallen by 3%. This is not very marked, but it may be part of a long term trend which is related to dairy farmers reducing or even abandoning bagged POTASH applications and depending solely on the contribution from slurry and manures.
- A recent survey of soil nutrient values by NRM reports that about 60% of soil samples show a replete or excessive POTASH index. Consequently, it could take several years for the high soil POTASH reserves on some farms to become exhausted, particularly as slurry is a generally good source of POTASH.

- Such excessive POTASSIUM levels in grass silage represent a significant risk factor for HYPOCALCAEMIA and HYPOMAGNESAEMIA. For dairy cows, POTASSIUM is the single most important mineral involved in sub-clinical Milk Fever and Ketosis at calving.

SODIUM CONTINUES TO CLIMB

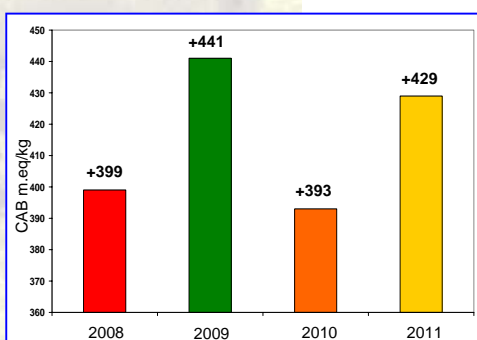
- SODIUM is the junior cation electrolyte partner of POTASSIUM.
- An inverse linear relationship exists between forage SODIUM and POTASSIUM values.



- SODIUM generally only represents 10% of the grass POTASSIUM value.
- SODIUM is essential for water intake and balance in the cow.
- SODIUM improves grass palatability and is an important rumen buffer.
- Over the past four years, SODIUM has on average increased by around 30%. Some of this increase is undoubtedly related to a slightly declining POTASSIUM. However, the most important driver is likely to be the increased targeting of slurry at silage ground.
- Slurry generally contains a reasonable level of SODIUM because of the increased practice of feeding salt licks or rocks to milking cows on a free choice basis.
- The practice of applying salt to pasture in early spring to improve grass palatability and grazing activity is increasing and is also likely to be a contributory factor to the higher forage value.
- A higher SODIUM concentration in grass silage is generally a positive feature, as it keeps POTASSIUM in check and improves forage intake and digestibility.

CATION-ANION BALANCE (CAB) REMAINS HIGH

- CAB has fluctuated around +400 meq/kg over the past four years, having steadily increased since the 1990s.



- Reason for the 2011 increase relates to a changing POTASSIUM—SODIUM balance and a lower CHLORIDE value.
- High CAB as reported here has no adverse effects on lactating cows. However, a high CAB in a Transition diet prior to calving will increase the alkalinity of body fluids (blood, cell, tissue, urine).
- A physiological alkaline state depresses CALCIUM utilisation at calving by blocking CALCIUM release from bone and depressing CALCIUM absorption in the gut.
- A reduced supply of CALCIUM at a time when the cow's requirement is exploding, will increase the incidence of:

- * Retained cleansings
- * Metritis
- * Poor milk initiation
- * Displaced abomasum
- * Reduced dry matter intake
- * Ketosis
- * Milk Fever

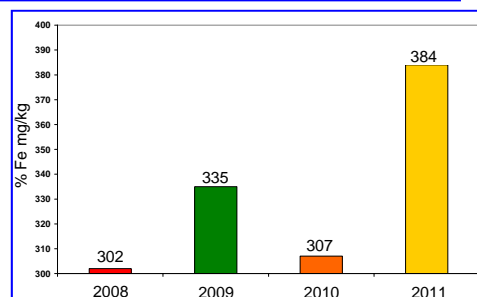
- Having an effective Transition diet which substantially reduces the adverse effect of a high CAB on cow health is a pre-requisite to subsequent cow health, fertility and productivity.

MACRO MINERAL SUMMARY

- **CALCIUM** continues to rise—is soil improvement responsible?
- **PHOSPHORUS** bounces back 14% due to warm spring temperatures.
- **MAGNESIUM** remains constant.
- **POTASSIUM** maintains a high value, but has it peaked?
- **SODIUM** continues to climb—is slurry implicated?
- **CHLORIDE** values fluctuate widely within a 1.0-1.2% range.
- **SULPHUR** remains constant.
- **CATION-ANION BALANCE** remains high and potentially damaging to cows at calving.

IRON - HIGHEST VALUE FOR 4 YEARS

- IRON increased by 25% compared to 2010.
- Highest IRON value for four years.
- IRON has more than doubled over 20 years.



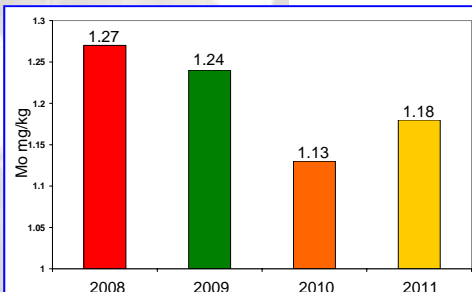
- 5 year average IRON value is 345 mg/kg DM.
- IRON is contributed by:
 - (a) Soil contamination
 - (b) Increased plant uptake
- Soil contamination, as estimated from the TITANIUM analysis, has increased by 4%, which is a relatively minor increase. ALUMINIUM, which is also an indicator of soil contamination, is up by 36%, although this element can also be absorbed through the roots.
- Dry, warm spring weather would have been expected to decrease soil contamination, however, wetter weather in May might have been the influencing factor.
- IRON is also an indicator of soil health, as compacted anaerobic soil increases the solubility of IRON which results in plant uptake. This feature is exacerbated by high applications of slurry, which in the raw state is extremely anaerobic.
- Soil improvement practices as defined by ensuring soils are aerobic will oxidise IRON, thereby reducing its solubility. As a result plant uptake decreases.
- Converting soils to an aerobic state involves reducing compaction, stabilising soil structure, aeration and composting slurry.
- At more than x3 animal requirement, IRON will exert

strong, competitive pressure on the absorption of related trace elements, MANGANESE, COPPER and ZINC.

- IRON derived from soil contamination is likely to be very oxidative on cow physiology, which will increase the requirement for anti-oxidants VITAMIN E, SELENIUM and COPPER.
- At the reported excessive level, IRON represents a significant challenge to cow health and productivity.

MOLYBDENUM REMAINS STEADY

- Long term mean MOLYBDENUM levels fluctuate between 1.1-1.3 mg/kg DM.
- MOLYBDENUM level is influenced by weather and soil conditions.
- MOLYBDENUM levels tend to be lower when soils are drier and more aerobic.
- MOLYBDENUM, in combination with SULPHUR and IRON, is antagonistic towards COPPER absorption. With both MOLYBDENUM and SULPHUR reporting similar values to 2010, it will be IRON which represents the increased antagonistic pressure in 2011 grass silage.
- RELATIVE COPPER ANTAGONISM remains "Moderate" for 2011 silage, which is also the case for 2009 and 2010



grass silage. It would be expected that alternative forages such as Maize Silage and Whole Crop Silage would report a "Very Low" to "Low" RELATIVE COPPER ANTAGONISM.

- In addition to locking up COPPER, MOLYBDENUM is also oxidative in nature, which will increase the dietary requirement for the key anti-oxidants—VITAMIN E, SELENIUM and COPPER.
- Improving soil fertility will result in a reduced MOLYBDENUM concentration. Any actions which increase air penetration to soils will oxidise MOLYBDENUM which effectively precipitates this element and reduces plant uptake.

TRACE ELEMENT SUMMARY

- **IRON** is at its highest value for four years.
- **MANGANESE** levels show no change, mean values are similar to previous years.
- **IODINE** shows a reduced mean value for 2011, but within the long term range of 0.75-1.00 mg/kg DM.
- **SELENIUM** mean value increased but the level remains extremely low at 0.05 mg/kg DM.
- **MOLYBDENUM** remains steady within the long term range of 1.1-1.3 mg/kg DM.
- **RELATIVE COPPER ANTAGONISM** is "Moderate" which indicates no change from 2009 and 2010.
- **SOIL CONTAMINATION INDEX** has increased slightly, but does not explain the substantial increase in both IRON and ALUMINIUM.

RISK FACTORS FOR MINERAL RELATED DISEASE IN 2011/12

POTASSIUM — HYPOCALCAEMIA

IRON — COPPER DEFICIENCY & OXIDATIVE STRESS

MINERAL ACTION PLAN

To ensure cow health, fertility and production is not compromised by identified Mineral Risk Factors use:

- ▶ **T&J Forage Mineral Analysis Service**
- ▶ **T&J Mineral Check to formulate balanced supplements**
- ▶ **T&J Soil Action Plan to improve soil fertility and forage mineral balance**

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Forage Mineral Report

SAMPLE TYPE	Grass Silage	FARMER	Mean 285 Samples
SAMPLE REF	2011	FIELD ID	01/06/11-01/09/11
DISTRIBUTOR	Thomson & Joseph Ltd.	POSTCODE	
DISTRIBUTOR'S REF		DATE	9 September 2011

MINERAL ELEMENT (DM BASIS)	ASSAY	VERY LOW	LOW	MEAN	HIGH	VERY HIGH	
Calcium	Ca %	0.68	0.30	0.50	0.60	0.70	0.90
Phosphorus	P %	0.28	0.20	0.30	0.35	0.40	0.55
Magnesium	Mg %	0.19	0.10	0.15	0.20	0.25	0.40
Potassium	K %	2.76	0.50	1.00	2.00	3.00	5.00
Sodium	Na %	0.29	0.10	0.20	0.25	0.30	0.40
Chloride	Cl %	1.01	0.30	0.60	1.00	1.40	2.00
Sulphur	S %	0.19	0.10	0.15	0.20	0.25	0.40
Cation-Anion Balance CAB	meq/kg	429	50	100	200	300	500
Iron	Fe mg/kg	384	50	100	150	200	350
Aluminium	Al mg/kg	173	25	50	100	150	300
Manganese	Mn mg/kg	112	50	75	100	125	200
Copper	Cu mg/kg	6.9	5	8	10	12	15
Zinc	Zn mg/kg	31.2	25	40	60	80	130
Cobalt	Co mg/kg	0.14	0.10	0.20	0.25	0.30	0.40
Iodine	I mg/kg	0.74	0.25	0.50	1.00	1.50	2.00
Selenium	Se mg/kg	0.05	0.05	0.10	0.15	0.20	0.25
Molybdenum	Mo mg/kg	1.18	0.10	0.35	0.80	1.25	2.00
Relative Copper Antagonism							
Soil Contamination Index							

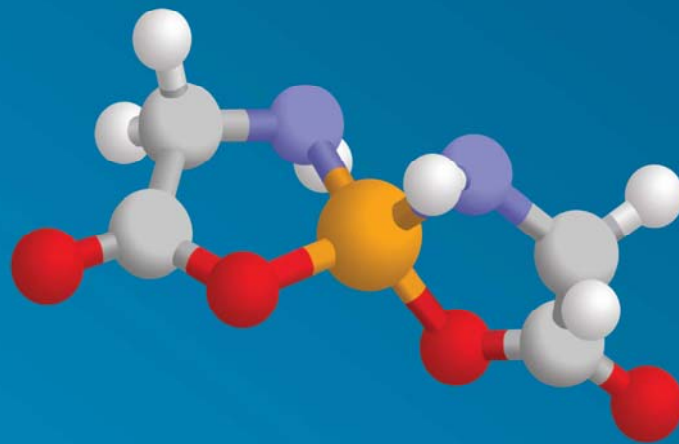
Forage Year		2009	2010	2011	% Difference 2011 v 2010
No. of Samples		214	268	285	
Calcium	%	0.60	0.66	0.68	+3
Phosphorus	%	0.29	0.25	0.28	+12
Magnesium	%	0.18	0.19	0.19	No change
Potassium	%	2.84	2.82	2.76	-2
Sodium	%	0.25	0.25	0.29	+16
Chloride	%	1.00	1.16	1.01	-13
Sulphur	%	0.18	0.18	0.19	No change
CAB meq/kg		+441	+393	+429	+9
Iron	mg/kg	335	307	384	+25
Aluminium	mg/kg	134	127	173	+36
Manganese	mg/kg	116	114	112	No change
Copper	mg/kg	6.5	6.8	6.9	No change
Zinc	mg/kg	30.2	33.1	31.2	-6
Cobalt	mg/kg	0.12	0.13	0.14	No change
Iodine	mg/kg	0.80	0.95	0.74	-22
Selenium	mg/kg	0.03	0.03	0.05	+66
Molybdenum	mg/kg	1.24	1.13	1.18	+4
Relative Copper Antagonism		Moderate	Moderate	Moderate	—
Soil Contamination—Titanium mg/kg		11.9	11.1	11.5	+4

Data covers the period 1st June to 1st September and relates to 1st Cut silage.

Results are expressed on a Dry Matter Basis.



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- Reduced mineral excretion
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