

### HOW DOES THE MINERAL STATUS OF MAIZE & WHOLE CROP COMPARE TO GRASS SILAGE?

**I**ncreased use of alternative forages such as Maize and Whole Crop Silage at the expense of Grass Silage requires the effect on the mineral contribution from these forages to be established and appropriate changes in mineral supplement formulation to be introduced. It has been recognised for a long time that Maize and Whole Crop Silages have a generally lower mineral composition than Grass Silage. The data presented here confirms that view, and provides a useful comparison for both farm adviser and nutritionist.

#### Maize Silage

The mean mineral analysis of Maize Silage over the past 3 years is presented in Table 1. The immediate impression is that the mean composition is very consistent over this time period. This feature is very different for Grass Silage, which is much more variable in its mineral status. As a result of this consistency, the mean mineral analysis of 277 samples analysed between 2008-2010 is used as the reference for this forage.

#### Whole Crop Silage

Fewer samples of Whole Crop Silage have been analysed compared to Maize Silage over the period 2008-2010. However, consistency of analysis continues to be a feature and consequently the mean of 67 samples analysed over this 3 year period is used as the reference for this forage.

**Table 1**

**MAIZE SILAGE – MEAN MINERAL ANALYSIS DATA**

No. of Samples	Element	Year				
		72	106	99	277	
		2008	2009	2010	Mean	
	Calcium	0.27	0.27	0.28	0.27	
	Phosphorus	0.20	0.19	0.19	0.19	
	Magnesium	0.12	0.13	0.13	0.13	
	Potassium	1.25	1.27	1.27	1.26	
	Sodium	0.03	0.03	0.03	0.03	
	Chloride	0.32	0.32	0.35	0.33	
	Sulphur	0.09	0.09	0.09	0.09	
	Cation-Anion Balance	meq/kg	+187	+192	+171	+187
	Iron	mg/kg	228	170	162	187
	Aluminium	mg/kg	75	49	55	60
	Manganese	mg/kg	31.0	32.9	30.4	31.4
	Copper	mg/kg	4.1	4.6	4.5	4.4
	Zinc	mg/kg	23.8	23.7	26.3	24.6
	Cobalt	mg/kg	0.07	0.05	0.06	0.06
	Iodine	mg/kg	0.69	0.80	0.80	0.76
	Selenium	mg/kg	0.06	0.02	0.02	0.03
	Molybdenum	mg/kg	0.55	0.40	0.58	0.51

**Table 2**

**WHOLE CROP SILAGE – MEAN MINERAL ANALYSIS DATA**

No. of Samples	Element	Year				
		16	19	32	67	
		2008	2009	2010	Mean	
	Calcium	0.31	0.27	0.36	0.31	
	Phosphorus	0.23	0.22	0.22	0.22	
	Magnesium	0.11	0.12	0.14	0.12	
	Potassium	1.62	1.46	1.58	1.55	
	Sodium	0.03	0.06	0.07	0.05	
	Chloride	0.50	0.51	0.60	0.54	
	Sulphur	0.13	0.12	0.14	0.13	
	Cation-Anion Balance	meq/kg	+206	+182	+179	+186
	Iron	mg/kg	173	271	242	229
	Aluminium	mg/kg	68	117	91	92
	Manganese	mg/kg	60.0	63.9	77.6	67.2
	Copper	mg/kg	3.1	4.1	5.0	4.1
	Zinc	mg/kg	22.8	24.5	28.1	25.1
	Cobalt	mg/kg	0.05	0.09	0.10	0.08
	Iodine	mg/kg	0.45	0.57	0.78	0.60
	Selenium	mg/kg	0.03	0.02	0.02	0.02
	Molybdenum	mg/kg	0.76	0.66	0.78	0.73

### Grass–Maize–Whole Crop Comparisons

The mean mineral analysis of these three forages for the period 2008-2010 is presented in Table 3. It is immediately apparent that Grass Silage has a much higher mineral status compared to either Maize or Whole Crop Silage. For the majority of mineral elements the levels are very similar between Maize and Whole Crop. The main difference between these forages are the higher values for Potassium, Manganese and Molybdenum in Whole Crop. With these exceptions, the mineral composition of Maize and Whole Crop is very similar. In every case Grass Silage reports a higher value than the alternative forages. However, in contrast to the consistency of mineral analysis found over the years for

Maize and Whole Crop Silage, Grass Silage is very variable in its mineral composition. This feature reflects the ability of grass to take up from soil any element in a soluble state, whether it is required or not. As a consequence, the mineral analysis of grass provides useful information on soil chemistry and biological activity. This is not the case for Maize or Cereal crops, which only appear to actively seek those elements which are essential to support plant growth and development.

### Forage Major Mineral Comparisons

Figure 1 compares the average Major Mineral concentration in Maize and Whole Crop Silage to that found in Grass Silage. The comparative mineral contribution is variable, as illustrated by Phosphorus, where Maize and Whole Crop provide 70 and 81% of this element's concentration in grass. In contrast, the Sodium contribution from Maize and Whole Crop is only 11 and 19% respectively of that supplied by Grass Silage. In practical terms, the two mineral elements in Maize and Whole Crop which supply less than 50% of that provided by Grass Silage are:

#### 1. Calcium -

For every 1kg Dry Matter of Grass Silage which is replaced by Maize or Whole Crop Silage

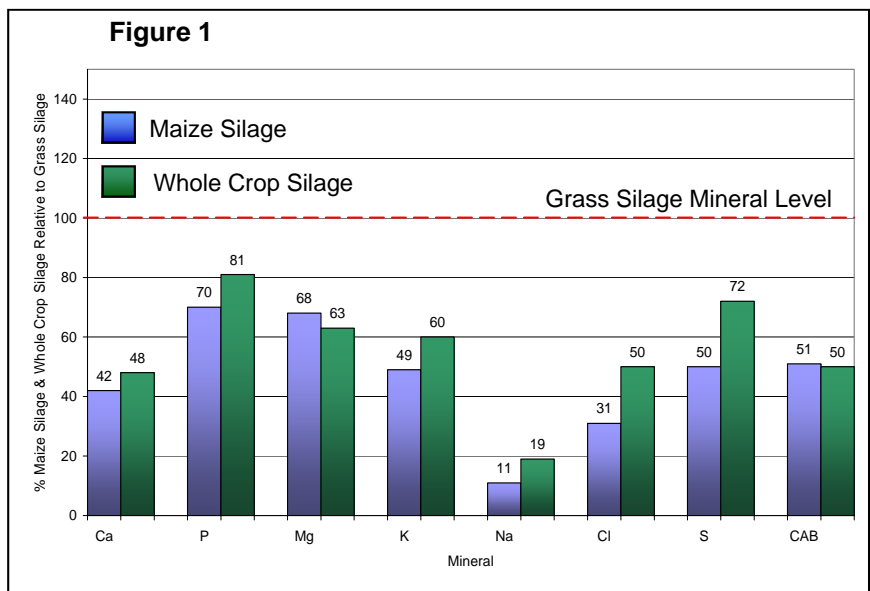
**ADD 10g Limestone Flour/COW/DAY**

So, if 12kg DM switched from Grass to Maize Silage add 120g Limestone Flour/cow/day.

**Table 3**

**COMPARISON OF MEAN MINERAL COMPOSITION OF GRASS, MAIZE & WHOLE CROP SILAGES**

Element (DM Basis)	Grass Silage	Maize Silage	Whole Crop Silage
No. of Samples	4048	277	67
Calcium %	0.64	0.27	0.31
Phosphorus %	0.27	0.19	0.22
Magnesium %	0.19	0.13	0.12
Potassium %	2.59	1.26	1.55
Sodium %	0.27	0.03	0.05
Chloride %	1.07	0.33	0.54
Sulphur %	0.18	0.09	0.13
Cation-Anion Balance meq/kg	+368	+187	+186
Iron mg/kg	384	187	229
Aluminium mg/kg	178	60	92
Manganese mg/kg	130.7	31.4	67.2
Copper mg/kg	7.2	4.4	4.1
Zinc mg/kg	30.8	24.6	25.1
Cobalt mg/kg	0.16	0.06	0.08
Iodine mg/kg	1.28	0.76	0.60
Selenium mg/kg	0.07	0.03	0.02
Molybdenum mg/kg	1.25	0.51	0.73
Relative Copper Antagonism	Mean	Very Low	Low



In practical terms, the two mineral elements in Maize and Whole Crop which supply less than 50% of that provided by Grass Silage are:

2. Salt (Sodium Chloride) -

For every 1kg Dry Matter of Grass Silage which is replaced by Maize or Whole Crop Silage

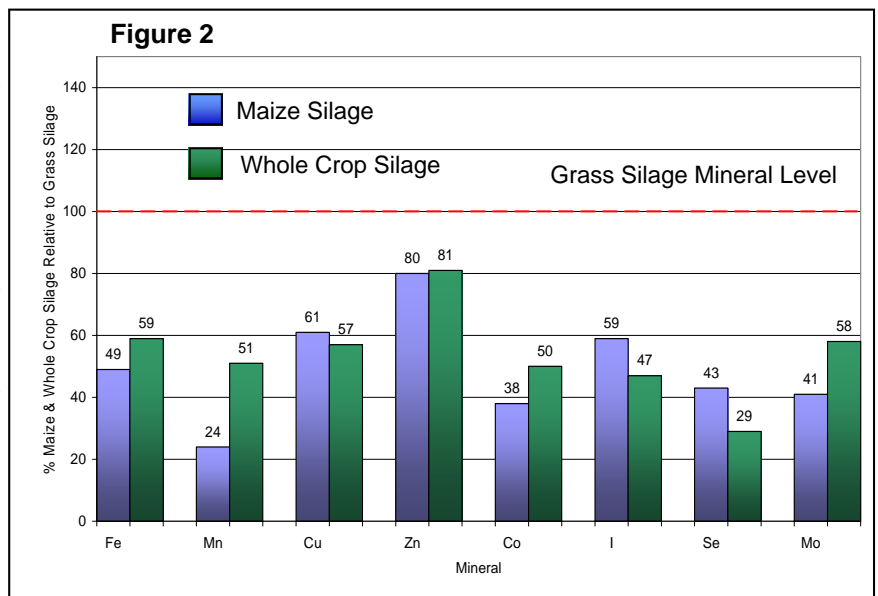
**ADD 7g SALT/COW/DAY**

So, if 12kg DM switched from Grass to Maize Silage add 84g Salt/cow/day.

Forage Minor Mineral Comparisons

The comparison of the trace element status of Maize and Whole Crop Silages to Grass Silage is shown in Figure 2. In general, while trace element levels of the alternative forages are closer than for the major minerals, there are some obvious differences.

These include:



1. Manganese -

On average Maize Silage only provides 24% of the level supplied by grass. Whole Crop Silage, in contrast, provides 51%. Grass is a Manganese rich plant and supplementation is not usually required for a grass dependent diet. However, this is not the case for the alternative forages where farm mineral supplementation needs to include **MANGANESE at between 3000-6000mg/kg**.

2. Cobalt, Iodine, Selenium -

Maize and Whole Crop silages are providing on average less than half the contribution from Grass Silage. Recognition of the much lower element levels needs to be made when formulating balancing mineral supplements.

3. Molybdenum -

This antagonistic element to **COPPER** absorption has a much lower concentration in alternative forages being 41% of grass for Maize and 58% for Whole Crop Silage. This substantially reduced antagonism to **COPPER** must be reflected in a **REDUCED COPPER DIETARY LEVEL** to avoid excess **COPPER** accumulation in the liver, which significantly increases the risk of **COPPER TOXICITY**. Typically for dairy diets totally dependent on Maize or Whole Crop silages, supplementary mineral levels of **COPPER should not exceed 1,500mg/kg**. At the other extreme of diets containing exclusively Grass Silage with a high **MOLYBDENUM** level, then supplementary **COPPER** levels may

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reach 4,000mg/kg. The most important action is to tailor **COPPER** supplementation to the identified threat from **MOLYBDENUM** antagonism. In the case of Maize and Whole Crop Silages, standard mineral values can be made. But due to the inherent variability in the mineral status of Grass Silage, checking the **MOLYBDENUM** status through the **T&J Forage Mineral Analysis Service** is essential.

### Summary

1. Alternative forages such as Maize and Whole Crop Silages provide lower levels of minerals compared to Grass Silage.
2. The mineral composition of Maize and Whole Crop Silage is consistent over time. Standard mineral values can be used for these forages when formulating supplements.
3. Grass Silage has a much more variable mineral content and a regular check of its mineral status is recommended.
4. Maize and Whole Crop Silages are very deficient in **CALCIUM** and **SALT** compared to Grass Silage. Additional supplementation is necessary when using these alternative forages.
5. For Trace Elements, take account of **MANGANESE**, **COBALT**, **IODINE**, **SELENIUM** and particularly **MOLYBDENUM** contribution from Maize and Whole Crop Silages which will be substantially lower than for Grass Silage. There are serious implications for **COPPER** supplementation when including alternative forages in dairy diets.
6. Use the **T&J Forage Mineral Analysis Service** and **Mineral Check** formulation service to ensure a balanced mineral supplement is provided every time.

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