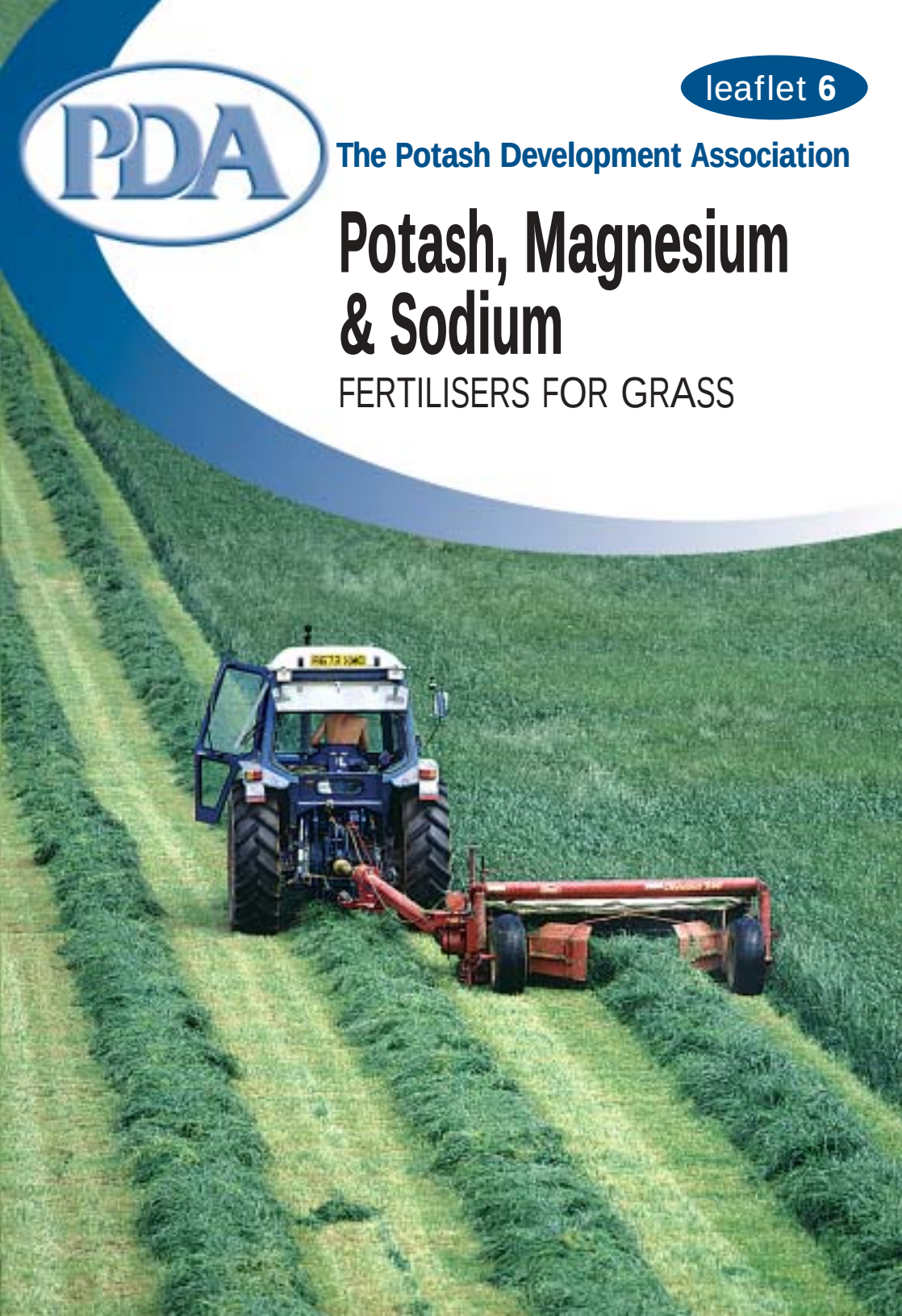
leaflet **6**

The Potash Development Association

Potash, Magnesium & Sodium

FERTILISERS FOR GRASS

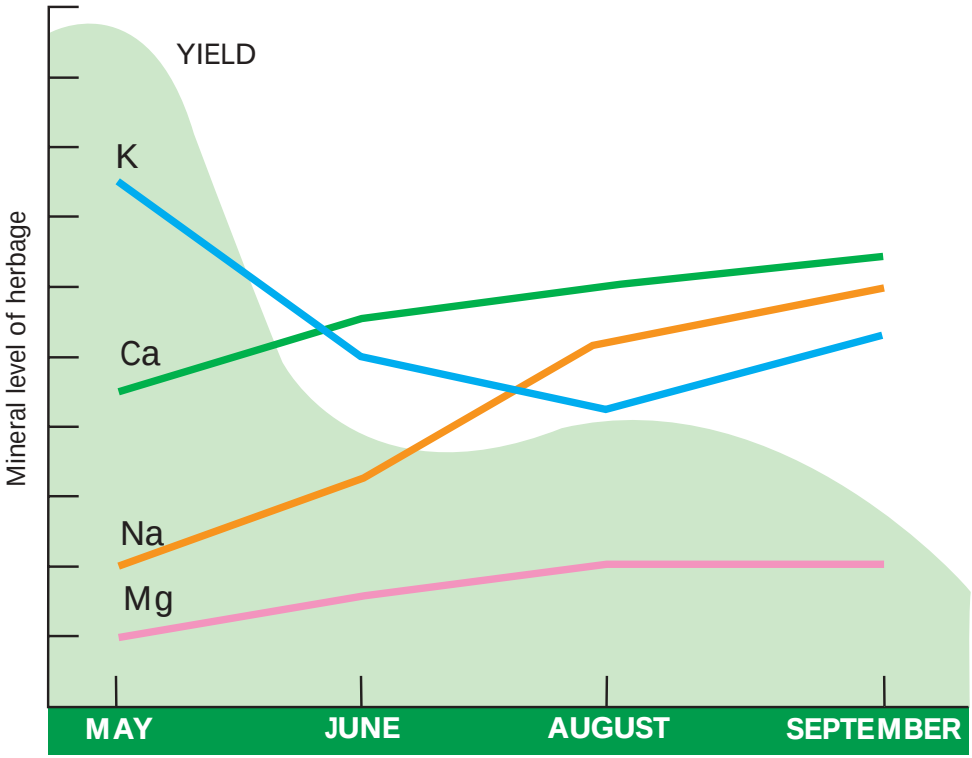


Potash use is linked to fears that so-called “luxury” uptake may cause staggers (hypomagnesaemia) and other mineral disorders. Metabolic problems can be costly but so is below-optimum use of potash. This leaflet reviews the facts.

Natural mineral content of grass

The natural pattern of uptake of minerals such as Potassium (K), Magnesium (Mg), Sodium (Na) and Calcium (Ca) varies during the course of the growing season. The dry matter of young rapidly growing grass, especially in the spring, has a high K content which declines as the season progresses, whilst the concentration of other minerals increases through the summer.

Seasonal pattern of mineral uptake in grass swards



Fertilisers and mineral uptake

The application of a correct balance of nitrogen, phosphate and potash is essential to obtain the best yields of low-cost on-farm forage. In addition to their effect upon yield, N and K fertilisers influence mineral content of grass, especially Mg, Na, and Ca. Adequate nitrogen will tend to stimulate the uptake of all minerals but the ease with which plant roots absorb different nutrients varies:

EASIER ← UPTAKE → LESS EASY

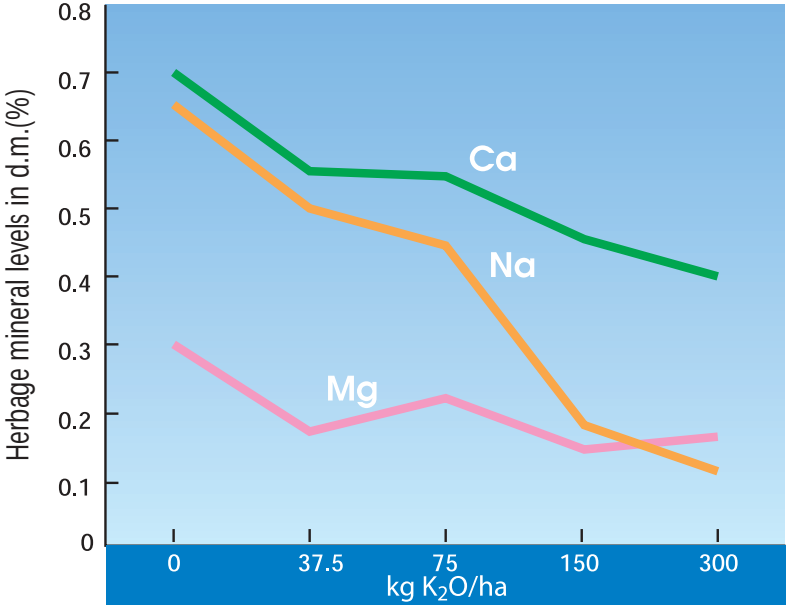
N as NO_3 : P : K : Na : Mg: Ca

This is in line with the needs of grass which for optimum growth requires large amounts of potassium and lesser amounts of magnesium and sodium. For animals however, the balance of requirements is for more magnesium and sodium and only modest potassium. An adequate supply and balance of these minerals is important to minimise the risk of metabolic disorders such as hypomagnesaemia (staggers or grass tetany) and milk fever and to ensure fertility.

Potash in perspective

Increasing uptake of one nutrient by the plant may affect the level of others, but it is quite wrong to assume that the application of potash automatically leads to mineral disorders. The effect of potash fertiliser on herbage mineral content will vary widely in different situations. The graph below shows how magnesium and sodium % may decrease as a result of potash application. However, this is not always the case and the application of potash may not have any effect on the sodium or magnesium %.

Effect of potash on the mineral content of ryegrass



Data from other trials show that soil type can be important:

Magnesium % in 1st cut herbage

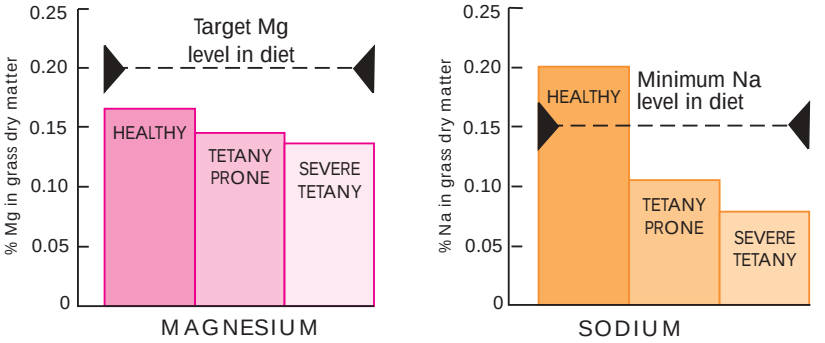
	Potash rate applied in March (kg/ha)					
	0	40	80	120	160	200
Clay loam soil	**0.15**	**0.15**	**0.17**	**0.15**	**0.14**	**0.15**
Sandy soil	**0.21**	**0.15**	**0.14**	**0.14**	**0.13**	**0.13**

Magnesium % in grass on the sandy soil was progressively reduced by higher spring potash applications whereas magnesium levels in grass on the clay loam were unchanged even up to 200 kg/ha K_2O.

Potassium, magnesium and sodium relationships

On farms where staggers is a recurring problem, attention should be given to the potassium, magnesium and sodium content of herbage.

The mineral content of healthy and tetany prone pasture

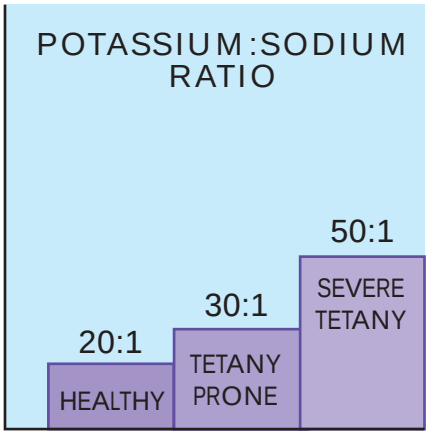


Normal magnesium concentrations in herbage are frequently below the minimum 0.20% suggested for animal diets. Magnesium % in plants is affected by a large number of factors and whilst the risk of magnesium disorders may increase with lower herbage magnesium, this is not a reliable measure of whether clinical mineral problems will occur in the animal.

The level of sodium should also be considered. The bar chart above shows that where herbage sodium levels are above the minimum dietary guide of 0.15% Na, the risk of staggers is low, but rises with lower sodium levels.

Nutrient balance

Nutrient balance is important in avoiding mineral disorders and experimental work has shown that there is less risk of staggers when potassium, magnesium and sodium levels in herbage result in K : Na and K : Mg ratios of between 10 and 20:1. The histogram indicates the greater risk of staggers at K : Na ratios greater than 20 : 1. Field trials and surveys have shown that maintaining a high level of sodium and magnesium in grass will reduce the risk of staggers.



The place for sodium

Sodium fertilisers will not normally give extra grass yield but they will increase the Na content of grass which will improve the palatability of herbage and may reduce the chance of grass staggers. Sodium is also associated with a greater % of live herbage, higher D values and sugar content of grass. Research from Bangor University indicates that these effects increase milk output and % butterfat and may also have a small benefit on somatic cell count. Grass palatability and milk output increase at herbage sodium levels up to 0.5% in the dry matter.

Grazing

Staggers is mainly associated with lush spring growth when magnesium and sodium % are low, potash application to grazed swards should be avoided at this time. Replacement K dressings should therefore either be made after the spring flush ie. June onwards, or applied in small more frequent applications. Potash requirements of grazed grass are small because most K is recycled back to the sward in the dung and particularly in the urine.

Staggers can occur at other times in the season when magnesium levels are inherently low, where over-dependence is placed on low dry matter grass and when animals are under other stress such as at calving. Close attention to the mineral nutrition of animals is required at these times and supplementation may be required.

Cut grass

Silage and hay crops remove large quantities of potash from the soil. These must be replaced to maintain soil fertility and protect future yields. Restricted use of potash will seriously reduce hay and silage yields and will not necessarily reduce the incidence of magnesium disorders.
So-called "luxury uptake" will not occur if the rate of fertiliser potash applied takes acount of:-

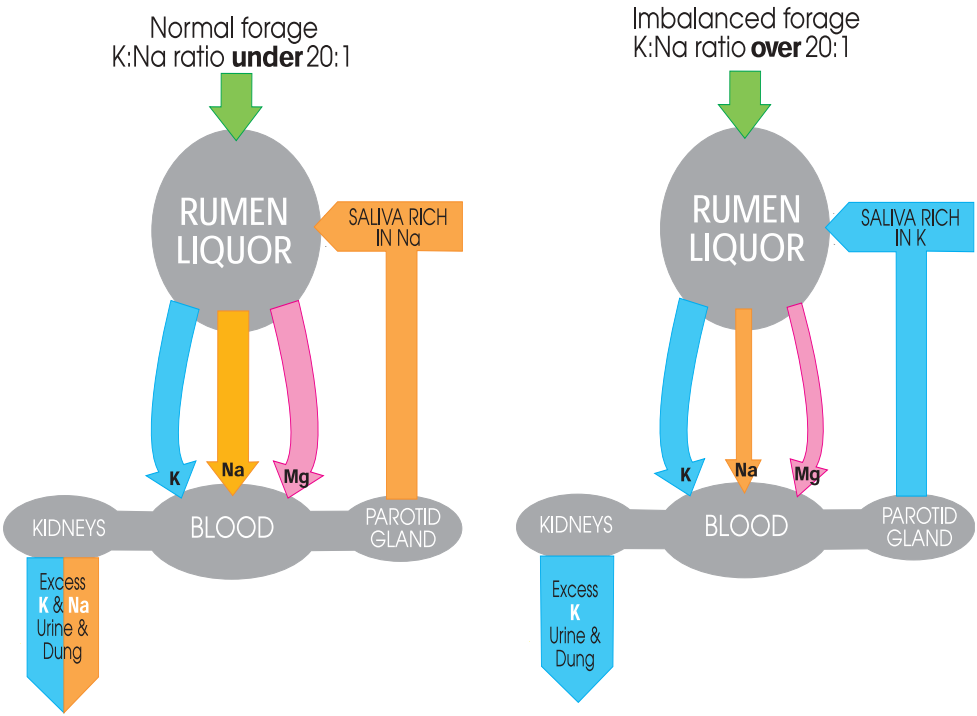
- the nitrogen rate used (which will affect yield & therefore offtake)
- level of soil K reserves
- use of organic manure
- soil type

Potassium, magnesium and sodium in the animal

Much of the sodium consumed by cattle and sheep is used in the production of saliva which is secreted into the rumen to maintain a constant pH by neutralising acids formed by bacteria in the rumen liquor. If the sodium content of forage is too low, the animal automatically substitutes potassium for sodium as an alternative buffer in the saliva and diverts sodium to maintain blood Na level as first priority.

The resulting increase in K:Na ratio in the rumen leads to reduced resorption of Mg through the rumen wall into the blood - hence placing the animal at risk to hypomagnesaemia. However, it is only in extreme cases that a low blood level of magnesium occurs (less than 1.8mg/100ml of blood in cows) and the consequences of the condition (reduced milk yield and even death) may arise without ever detecting low blood Mg.

Fate of forage potassium, magnesium and sodium



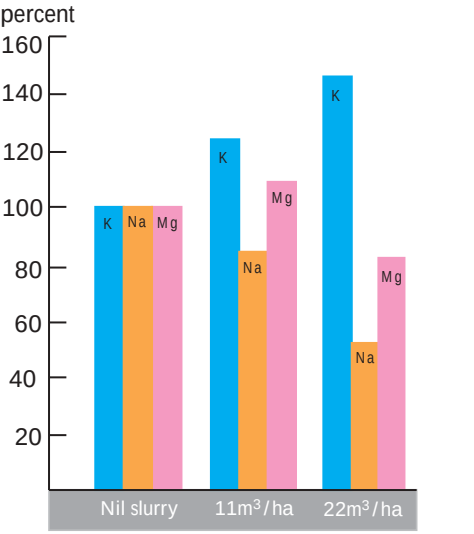
Fertilise to balance potassium, magnesium and sodium

The sodium and magnesium content of grassland can be improved by using sodium and magnesium fertilisers to balance the levels of K required for grass production. A list of fertilisers containing potassium, magnesium or sodium is given on page 11. Extra minerals may be required for high yielding dairy cows and lactating sheep. Feed analysis should be used to confirm supplements required.

Slurry

Slurry is a valuable source of minerals containing a little sodium, some magnesium and a lot of potash. Modest applications of slurry may increase K and Mg levels in herbage. With larger applications however, the high concentrations of potassium tend to depress both Na and Mg levels. The nutrient contribution of slurry should be taken into account when deciding fertiliser policy. In particular, spring potash dressings should be adjusted when slurry has been applied over winter to avoid excess levels of K being available to the grass in the spring.

Slurry effect on herbage minerals



Good farming practice

1 Soil analysis

Soil sample every 4-5 years to check on fertility status and trends.

TARGET INDEX 2- FOR K, 2 FOR P AND Mg

2 Herbage analysis

Where mineral disorders are a problem take herbage samples when grass is growing actively (eg. May) to check on K, Mg and Na status.

TARGET LEVELS

Potassium	Magnesium	Sodium
Over 3% - high - review timing and quantity - check K:Na and K:Mg ratio **Below 1.75% - low** - check amount of K applied - review manuring policy	**Under 0.2% - low** - consider magnesium application **K:Mg over 20 : 1 - too wide** - reduce ratio (usually by applying magnesium)	**Under 0.15% - low** - consider applying sodium **0.15 - 0.5%** - added benefits to palatability **K : Na over 20 : 1 - too wide** - reduce ratio (usually by applying sodium)

Potash

See PDA leaflet 14 Potash for Grassland and the PDA Grassland Kalculator for detailed recommendations.

Recommended rates of potash for grazed grass are 60kg/ha and 30kg/ha of K_2O for soil index 0 and 1 respectively. For soils with higher soil fertility levels no potash is required.

Very large quantities of potash are removed in grass silage which must be replaced to maintain soil fertility and yield potential. The following is a guide to typical potash offtakes from multi-cut silage systems.

Total annual fresh yield (25% dry matter)	Potash offtake (kg K_2O/ha)
1 cut system (23 t/ha)	140
2 cut system (38 t/ha)	230
3 cut system (47 t/ha)	280
4 cut system (54 t/ha)	320

Timing of application

Grazing

Avoid applying potash between March and June except as small dressings of about 10 kg K_2O/ha

Cutting

Apply up to 80-90 kg K_2O/ha for each cut according to soil analysis. Make allowance for potash contribution of slurry or manure used. Where larger amounts of potash are required to improve soil reserves additional potash should be applied in the autumn/winter.

Magnesium

Low soil magnesium levels will affect grass yield as well as mineral balance in the animal. Apply 50-100 kg/ha MgO every three to four years at Mg index 0. Yield response is less certain at index 1 but magnesium application is justified in terms of insurance for grass yield and mineral balance for the animal, to maintain a soil magnesium index of 2.

Where lime is required and Mg levels are 0 and 1, use magnesian limestone as the most cost effective magnesium source. Where pH is satisfactory, specific magnesium fertilisers (see page 11) should be used for soil improvement. Use water soluble forms of magnesium where rapid plant uptake is required.

Epsom salts applied as a foliar spray may be used to help boost magnesium intake by the animal. Alternatively calcined magnesite may be dusted on pastures for direct grazing and ingestion by the animal at critical times.

Sodium

Sodium is very soluble and is rapidly taken up by plants but levels cannot be built up on a long term basis as Na is not firmly held in the soil.

To improve herbage mineral balance
Apply up to 140 kg/ha Na_2O as an early spring dressing. A split application may be preferable at higher rates.

To improve pasture palatability
Apply regular dressings of about 10kg/ha Na_2O through the season.

Guide to potash, magnesium and sodium content of a range of fertilisers

PRODUCT	% K_2O	%Na_2O	%Na	%MgO	%Mg
Muriate of Potash	60	-	-	-	-
Korn-Kali ®	40	4	3	6*	3.6*
Agricultural Salt	-	50	37	-	-
Magnesia Kainit ®	11	27	20	5*	3*
Sylvinite ™	21	25	19	1.5*	1*
Meadowsalt ™	21	25	19	1.5*	1*
Nitrate of Soda (16%N)	-	36	27	-	-
Kieserite (Granular)	-	-	-	25*	15*
Calcined Magnesite	-	-	-	73-85	44-51
Magnesian Limestone	-	-	-	5-20	3-12

* *Water Soluble*

Nutrient description

Levels of potassium, sodium and magnesium as analysed in soil or herbage are expressed in elemental terms ie. K, Na, Mg.

Nutrient content of fertilisers and application rates of these nutrients to grass are expressed in the oxide form ie. K_2O, Na_2O, MgO.

To convert:-

K	to	K_2O	Multiply by 1.205	K_2O	to	K	Multiply by 0.830
Mg	to	MgO	Multiply by 1.658	MgO	to	Mg	Multiply by 0.603
Na	to	Na_2O	Multiply by 1.348	Na_2O	to	Na	Multiply by 0.742
Na	to	NaCl	Multiply by 2.542	NaCl	to	Na	Multiply by 0.393

Other PDA leaflets

1 Role of Potash (out of print)
2 Potash - Maintaining the Balance (out of print)
3 Potash for Quality (out of print)
4 Potash manuring for Arable Crops
5a Results from Cereal Demonstration Plots
5b Results from Grass Demonstration Plots
6 Potash, Magnesium & Sodium Fertilisers for Grass
7 P & K Balance for Cereals
8 Principles of Potash Use
9 Potash for Silage
10 Potash & Cereal Straw
11 Cereals and Potash
12 Potash for Sugar Beet
13 Oilseed Rape and Potash
14 Potash for Grassland
15 Potash for Potatoes
16 Fodder Beet -Fertiliser Requirements
17 Forage Maize - Fertiliser Requirements
18 Grain Legumes need Potash
19 Potash for Heavy Soils
20 Potash & Biosolids
21 Cutting Fertiliser Costs (out of print)
22 N & K top dressing for arable crops
23 Potash for Organic Growers
24 Effective use of Soil Analysis
25 What you should know about fertilisers
26 Nutrient requirements of forage crops
27 Fodder Beet - P & K offtake
28 Why Maintain Soil Potash Reserves?

Grassland Kalculator
Arable Kalculator
P&K Offtake Standards
Nutrient Content of Manures

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