THE IMPORTANCE OF MAINTAINING ADEQUATE SOIL FERTILITY

Adequate supply of the base nutrients phosphorus (P), potassium or potash (K) and magnesium (Mg) is essential for the production of any crop but the management of these nutrients for vegetable production where quality is equally as important as yield is a little more complex. Here, ***Jerry McHoul*** *Technical Manager of* ***Potash Ltd,*** *talks about the importance of maintaining adequate soil fertility and how the forms of the nutrients applied can have consequences for crop quality.*

Total fertiliser costs including nitrogen typically amount to around 2-6% of the variable costs of growing cash crops such as vegetables. When this is compared to the percentage of total costs for arable crops such as wheat and OSR the value is more likely to be 30-40%. When you consider that at current prices of fertilisers and grain, it remains highly economic to apply fertilisers to arable crops, the economic return for cash crops is even greater and penalties for failing to maintain adequate base nutrients in the soil can be severe.

Analyse the soil and the foliage

It appears that regular soil analysis is still not being practised on a significant proportion of UK farms including those that grow high value crops such as potatoes and vegetables. This saving of a few pounds represents a completely false economy; a little spent on regular soil testing will show exactly what your soil needs and perhaps more importantly from an environmental angle as well as a financial one, what you don't need. For cash crops such as vegetables the addition of micronutrient status (broad spectrum type test) is also worth every penny to highlight potentially costly shortages in some of the key trace elements such as boron and molybdenum.

Analysis of the foliage is also useful for cash crops to get an idea of what the plant is actually taking up from the soil. Soil is a very complex dynamic substance with so many biological, chemical and physical processes constantly occurring, the actual availability of nutrients to a plant is in a state of constant flux. By analysing the plant tissue at critical growth stages, corrective measures can be applied in the form of foliar sprays or fertigation before economic losses occur and lessons can be learned for the future. Foliar analysis is also a more accurate way of determining the status of some nutrients like manganese. Sampling protocols can be found from any of the reputable analysis laboratories and the HDC provide excellent information on the interpretation of the results.

Feed the soil, not the crop

Management of the base nutrients should be concerned with maintaining the desired index for the particular crop or rotation in question. Unlike nitrogen or sulphur which are highly leachable, P, K and Mg can be built up in most soils (except sands) and held until they are required by the crop. Many classic experiments have shown that when analysed, much of the P, K and Mg found within plant tissue originates from the soil and not from the current seasons fertiliser application. For this reason, nutrient planning should be done well in advance of the crop and thought should be given to all of the inputs and all of the outputs of nutrient in a rotation so that a nutrient balance can be calculated or at least estimated in advance of the next crop. It should be remembered that most vegetable crops are shallow rooted and many are in the ground for as little as 10-20 weeks. The nutrient supply therefore must be immediately available and generally maintained at higher indices than arable crops due to the poorer root exploration.

Table 1. Nutrient offtake values for vegetable crops

Crop	Phosphorus (P_2O_5)			Potash (K_2O)			Magnesium (MgO)		
	Crop residue	Harvested part	Total	Crop residue	Harvested part	Total	Crop residue	Harvested part	Total
Beetroot	0.6	1.5	2.1	2.8	5.0	7.8	0.4	0.3	0.7
Broccoli	2.3	1.8	4.1	3.4	5.0	8.4	0.5	0.5	1.0
Brussels sprouts	3.5	2.4	5.9	2.8	7.0	9.8	0.5	0.6	1.1
Round lettuce	0.7	1.0	1.7	1.7	3.8	5.5	0.2	0.3	0.5
Carrots	0.5	1.0	1.5	1.6	4.3	5.9	0.2	0.3	0.5
Cauliflower	1.3	1.2	2.5	4.8	3.7	8.5	0.5	0.4	0.9
Celery	0.6	2.0	2.6	3.4	5.4	8.8	0.4	0.3	0.7
Endive lettuce	0.4	0.6	1.0	4.0	3.7	7.7	0.3	0.3	0.6
Green peas	2.5	2.5	5.0	6.7	4.0	10.7	0.5	0.8	1.3
Iceberg lettuce	0.4	0.6	1.0	2.3	3.2	5.5	0.3	0.2	0.5
Kale	0.6	1.6	2.2	5.3	5.5	10.8	0.7	0.6	1.3
Leek	0.5	0.4	0.9	1.2	3.6	4.8	0.2	0.3	0.5
Onion	0.5	1.0	1.5	1.9	1.7	3.6	0.5	0.2	0.7
Red cabbage	0.6	0.8	1.4	2.5	3.3	5.8	0.4	0.3	0.7
Runner beans	2.0	0.8	2.8	3.6	2.7	6.3	0.3	0.4	0.7
Savoy cabbage	0.9	1.2	2.1	5.2	4.0	9.2	0.5	0.3	0.8
Spinach	0.5	1.4	1.9	2.4	7.0	9.4	0.2	1.2	1.4
Sweet corn	N/D	N/D	2.5	4.9	5.0	9.9	0.6	0.2	0.8
White cabbage	0.6	1.0	1.6	2.1	3.2	5.3	0.3	0.3	0.6

Values are kg nutrient per fresh tonne
Source K+S KALI GmbH
If residues are returned back to the soil use harvested figures

Phosphorus

Soil phosphorus levels tend to be naturally higher on lighter, sandy soils and lower on silt and clay based soils. Phosphorus is particularly critical at the early stages of growth and placement of fresh P fertiliser can prove beneficial before the root has had a chance to develop and explore the soil for nutrients. For most field vegetables, the target P index should be 3 although some crops are responsive to additional fresh phosphate particularly when placed near to the crop. For this reason upto 60 kg/ha of phosphate can be placed as a starter fertiliser although this amount should then be deducted from the overall P recommendation. Generally, animal manures and biosolids provide useful quantities of P although the nutrients are released only slowly and availability of the P can be variable according to type of material.

Potash

Of all plant nutrients, potash is required in the greatest quantities and offtakes are directly related to biomass. Target potash index for vegetables is 2+ but remember that high yielding leafy vegetables such as cabbage can remove huge quantities of K and this should be taken into account if yields are higher than 'average.' Potash has many functions in the plant but perhaps most importantly in vegetable crops, is the role in maintaining osmotic balance in the plant to enable it to take up other nutrients effectively and then to assist in the transport of these nutrients around the plant. The plant when adequately supplied with potash is able to withstand periods of drought better and stand over the winter with increased frost resistance. Soil applied potash can be applied in two forms; potassium chloride (muriate of potash or MOP) or potassium sulphate (sulphate of potash or SOP). Both are highly concentrated forms of the nutrient and are readily water soluble for plant uptake but there are some important differences to consider; MOP contains chloride which can be harmful to some chloride sensitive species (many types of fruit and vegetable) particularly when at the seedling stage. The most sensitive species include beans, peas, onions, cucumber, cauliflower and spinach although most vegetables are sensitive at the seedling stage. (Notable exceptions are celery and asparagus which are highly chloride tolerant).

For this reason, SOP is often preferred for fruit and vegetable production not least because of the additional benefits of:

- A useful level of available sulphur
- Low salt index for safe use in intensive systems (under glass or plastic or for fertigation)
- Safer for use in top dressing or for application close to planting in the seedbed

The physiological effects of using SOP as a potash source in crops is well documented but can be summarised as follows:

- higher dry matter in potatoes (less fat absorption on frying)
- Increased tuber numbers (generally of a smaller size)
- increased organic acid production in produce
- improved flavour characteristics
- improved storage potential (crops less hydrated)

Magnesium

As can be seen from the offtake values for vegetable crops, magnesium is most certainly not a micronutrient; a 70 ton/ha kale crop will take up over 100 kg MgO and 40 kg of this will be removed from the field with the harvestable portion. Target index is 2 with 150 kg MgO and 100 kg MgO recommended at indices 0 and 1 respectively. Consider a maintenance application at index 2 however, to replace offtake so that the next crop in the rotation is not starting with index 1. Around 25% of the magnesium found in a plant is present as a part of chlorophyll, the green substance used by all green plants for photosysnthesis. A shortage of magnesium will therefore result in reduced productivity. Magnesium behaves similarly to other cationic nutrients (e.g. potassium, calcium, sodium) in the soil and so an excess of any one of these can lead to another nutrient becoming less available to the plant. For this reason, the levels of all of these nutrients should be considered relative to one another and excesses of any one should be avoided.

The critical point with magnesium is that there are many forms available most of which are insoluble in water and are therefore only very slowly released and even then only in acid conditions. For a water soluble form for a fast growing vegetable crop, the mineral Kieserite (naturally occurring magnesium sulphate) is available as a granular fertiliser or as a component of many types of compound fertiliser together with other nutrients such as potash and sulphur (e.g. Patentkali, Korn-Kali etc.)

In hot dry years (2006 was a good example), even soils adequately supplied with magnesium sometimes fail to deliver enough Mg at the peak demand period and hence Mg deficiency can be seen. In order to prevent these problems at times of peak demand, a foliar application of magnesium (e.g. bittersalts) can prove beneficial when tank mixed with the spray program and costs just around £3-15 / ha depending on products / rates used. Such foliar applications can also be beneficial when soil conditions are not conducive to magnesium availability (high pH, chalky soils, prolonged cold temperatures or excessive soil potash levels).

Severe magnesium deficiency in potatoes.

Don't forget Humic Acids

On the continent, growers are used to dealing with the idea of Coefficient of Utilisation (COU) for the major fertiliser elements. This is the ratio between the amount of fertiliser applied, compared to that actually used by the crop. Although it might be reasonable to expect that every kg of nutrient applied is available to the crop, this is often far from what is actually happening in the soil, writes **Chris Tye** of **Tradecorp**.

So what can be done to improve this situation? There are a number of factors that influence COU including the type of fertiliser, eg Ammonium Nitrate vs Urea, pH of the soil, and interactions with other elements e.g. Phosphate lock-up with Calcium or Iron.

In recent years agronomists have been looking at the role that organic matter can play in the improvement of COU. It has always been accepted that organic matter improves soil fertility. However it is only in the past 20 years that a real understanding of how it works has come to light. Organic matter undergoes a process of decomposition and the final results of this is a group of molecules called Humic Acids (HA). It is these molecules that hold the key to improving soil fertility and increasing the COU of key fertiliser elements.

The main mode of action of these HA's is that they increase dramatically the Cation Exchange Capacity (CEC) of soil; this is the ability of the soil to hold nutrients in an "available" form for the plant. Generally speaking, the higher the CEC the lower the risk of nutrients being leached or locked-up.

HA's also stimulate the biological life of the soil; work done with the University of Lithuania has shown a dramatic increase in the activity of the enzymes involved in the Nitrogen cycle in the presence of HA's.

Preliminary results from the TETRA project (a study sponsored by Belgium Govt.) has shown a clear link between the use of Humic acids and a corresponding increase in nutrient uptake and increased yields.

But how can you increase the level of these Humic acids in your soil? One solution is to use a concentrated formulation of active Humic acids such as found in Humifirst. This is a liquid formulation of Humic acids produced from the highest quality source of Humic acids (American Leonardite). It is ISO 9001 certified and has achieved official registration in France, Belgium, Switzerland and Poland.

Chris Tye, UK Sales Manager of Tradecorp.