APAL PLANT TISSUE TEST - REPORT NOTES

Understanding Plant Nutrients

The main nutrients are:

Major nutrients
- Nitrogen (N)
- Phosphorous (P)
- Potassium (K)

All required in relatively large quantities by agricultural crops and pastures.

Secondary Nutrients
- Calcium (Ca)
- Magnesium (Mg)
- Sulphur (S)

All required in moderate quantities by agricultural crops and pasture species

Trace Elements
- Zinc (Zn)
- Boron (B)
- Manganese (Mn)
- Copper (Cu)
- Iron (Fe)
- Molybdenum (Mo)

All required in relatively small quantities by agricultural crops and pasture species.

- Selenium (Se)
- Cobalt (Co)

Essential for animals.

NUTRIENT	ROLE IN PLANT/ANIMAL NUTRITION	DEFICIENCY SYMPTOMS	DEFICIENCY MADE WORSE BY	CROPS SENSITIVE TO DEFICIENCY
Nitrogen	• Amino acid synthesis • Protein, coenzymes, and nucleic acid formation • Chlorophyll and ATP synthesis.	• Lack of growth or stunted growth • Generally yellowing of foliage, older leaves first. • Loss of leaves under severe deficiency • Purplish colouration due to accumulation of anthocycanin pigments.	• Low organic matter • High carbon (straw) residues added to soils	• Annual, fast growing crops, potatoes, strawberries, fruit crops, vegetables, pastures, cereals
Phosphorus	• Energy transfer • Formation of nucleic acids • Protein synthesis • Cell membrane component	• Reduced growth • Production of dark green foliage. • Reduced tillering in cereals • Reddening or yellowing of leaf margins and necrosis of older leaves.	• Low organic matter • Acidic or very alkaline soils • Cold wet conditions • High calcium levels	• Maize, winter sown cereals (in spring), pip fruit and soft pip fruit, pasture species
Potassium	• Enzyme activator and coenzyme functions • Protein synthesis • Stomatal function, turgor potential	•	• High rainfall leaching of soils • Soils with high illite type clay minerals • High Mg soils	• Cotton and other row crops, row crops, pasture species, fruit crops, cereals
Calcium	• Cell division and elongation • Proper working and permeability of cell membranes • Controls absorption of nutrients other than potassium	• Poor soil structure • Poor decomposition of dead plant material • Bitter Pit in fruit • Loss of fruit firmness • Low storage potention of fruit • Blossom end rot of tomatoes • Cavity spot in carrots	• High nitrogen application (leading to vigorous shoot production) • Hot dry seasons • High levels of potassium	• Grasses and legumes, fruit (apples, pears, peaches, cherries, etc), cereals

NUTRIENT	ROLE IN PLANT/ANIMAL NUTRITION	DEFICIENCY SYMPTOMS	DEFICIENCY MADE WORSE BY	CROPS SENSITIVE TO DEFICIENCY
Magnesium	* Part of the chlorophyll molecule * Involved in phosphate and nitrogen metabolism * Involved in protein synthesis * Involved in water uptake by the plant	* Interveinal chlorosis * Symptoms appear first on older leaves * Reduced crop growth	* Sandy or acidic soils * Soil rich in potassium or soils receiving high potassium applications * Cold wet periods	Vines, fruit trees, sugar beet, potatoes, oilseed rape, cereals, grass species
Sulphur	* Constituent of proteins, amino acids (thiamine) coenzyme A and vitamins (biotin) * As essential as phosphorus * Necessary for synthesis of oils in plant * Plants use equal amounts of sulphur and phosphorus * Essential for healthy growth * Improves crop quality (e.g. protein in wheat)	* General yellowing of young leaves * Unusually no necrosis of leaves * Reduced or stunted growth	* Low organic matter soil * High rainfall, cold wet soils * Poor soil aeration	Oilseed crops, legumes, beans, peas, Alfalfa, pasture species
Zinc	* Necessary for the correct functioning of many enzyme systems * Necessary for the synthesis of nucleic acids * Necessary for auxin (plant hormone) metabolism **Essential for animal production. Improves disease resistance, reproduction and reduces skin and feet disorders**	* Stunted plants * Pale stripes parallel to the leaf mid rib * Formation of rosettes (fruit trees) * Formation of small leaves * Chlorosis (marbling) of young leaves	* Organic soils * High pH soils * Soils rich in phosphorus or soils receiving high phosphorus application * Cold wet conditions	Maize, linseed, cereals. green beans, fruit crops, pasture species
Boron	* Meristem growth * Carbohydrate metabolism * Synthesis of nucleic acids * Pollen germination * Improves calcium utilisation * Increases nitrogen utilisation and reduces excess protein in pasture * Increases protein to energy ratio	* Leaf distortion and leaf texture changes * Death of growing points * Cracking and rotting in fruit * Poor fertilisation and fruit set and poor colour * Poor growth in legumes * Hen & chicken effect in grapes	* High pH soils * Sandy soils * High levels of nitrogen or calcium * Cold wet weather and periods	Sunflower, sugar beet, oilseed rape, vegetable crops, lucerne, vines, fruit trees, legumes
Manganese	* Activator or many different enzyme processes * Involved in nitrate reduction * Necessary for photosynthesis * Protein synthesis	* Interveinal chlorosis (marbling) of younger leaves * Pale striping and brown splits on cereals * Floppy plants (cereals) * Upright growth habit and triangular leaves on sugar beet	* Organic or sandy soils * High pH * Cold wet periods * “Fluffy” soils	Cereals (especially barley & oats), sugar beet, potatoes, vines, fruit crops, grasses **Excesses in soil suppresses cobalt**

NUTRIENT	ROLE IN PLANT/ANIMAL NUTRITION	DEFICIENCY SYMPTOMS	DEFICIENCY MADE WORSE BY	CROPS SENSITIVE TO DEFICIENCY
Copper	* Involved in many enzyme processes * Necessary for proper photosynthesis * Involved in the manufacture of lignin (cell walls) * Involved in grain production **Essential for bone development, calcium utilisation, fertility and healthy growth in animals.**	* Spiralling of leaves, especially the flat leaf of cereals * Chlorosis (marbling) of leaf tips * Stunted plants * Poorly filled ears (cereals) **Animal deficiency symptoms are brown hair, poor growth rates, scouring and poor fertility.**	* Organic, chalky or sandy soils * Reclaimed peat land * High nitrogen application * High plant molybdenum level	Cereals, legumes **Animals with large bone structure e.g. cattle - especially Simmental..**
Iron	* Necessary for the formation of chlorophyll * Necessary for photosynthesis * Necessary for the formation of proteins	* Yellowing (chlorosis of youngest leaves). Can be blotchy patches * Leaves can be all white with only veins green	* High pH soils * Calcareous soils * High levels of copper * Poorly drained crops	Vines, fruit trees **Excesses in plants suppresses animal copper and zinc. Excess in soil increases phosphate retention.**
Molybdenum	* Necessary for nitrogen metabolism * Necessary for chlorophyll * Involved in iron and phosphate metabolism **Excess suppresses copper in animals: > 1.2ppm in plants**	* Reduced plant growth (symptoms of nitrogen deficiency) * Reduced leaf area (whiptail in cauliflowers)	**Molybdenum availability controlled by pH:** * Low pH soils (acid condition) = Low Mo/High pH = High Mo * Low levels of organic matter = Low Mo	Leguminous crops (peas, beans, soya, lucerne, clovers etc), cruciferous crops (oilseed rape, cauliflower, cabbage etc)
Selenium	* Involved in Enzyme Glutathoine Peroxidase * Essential for muscle control. Especially skeletal and cardiac muscles * Fertility * Healthy growth	* White muscle disease (nutritional muscular dystrophy) * Heart failure * Paralysis, usually hind legs * Ill thrift * Growth suppression & depression * Diarrhoea in cattle of all ages * Reduced fertility * Retained placenta	* Acid soils * High protein diets * High sulphur * Arsenic	
Cobalt	* Essential component of Vitamin B_{12} * Active intestinal organisms	* Decreased appetite * Listlessness * Retarded growth * Decreased milk production * Muscular inco-ordination * Rough hair * High mortality rate in calves * Poor growth rates * Scouring	* Low exchange soils * High protein diets * Stress	

RATIOS BETWEEN ELEMENTS

The report also provides ratios between the various elements (nutrients).

These ratios further emphasise the affects of nutritional imbalances. They show how a deficient element can upset the total balance within the nutritional status of the plant, and how the important interrelation between nutrients can be adversely effected.

Nutritional imbalances in the plant will be limiting factors in the plant productivity, having a direct and adverse affect on yields, produce quality and animal health.

PLANT NUTRIENT INTERACTIONS

Antagonism

Mulder's Chart shows some of the interactions between plant nutrients.

High levels of a particular nutrient in the soil can interfere with the availability and uptake by the plant of other nutrients. Those nutrients which interfere with one another are said to be antagonistic.

For example, high nitrogen levels can reduce the availability of boron, potash and copper; high phosphate levels can influence the uptake of iron, calcium potash, copper and zinc; high potash levels can reduce the availability of magnesium. Thus, unless care is taken to ensure an adequate **balanced supply of all the nutrients** – by the use of analysis – the application of ever higher levels of nitrogen, phosphorus and potassium in compound fertilisers can induce plant deficiencies of other essential nutrients.

Stimulation

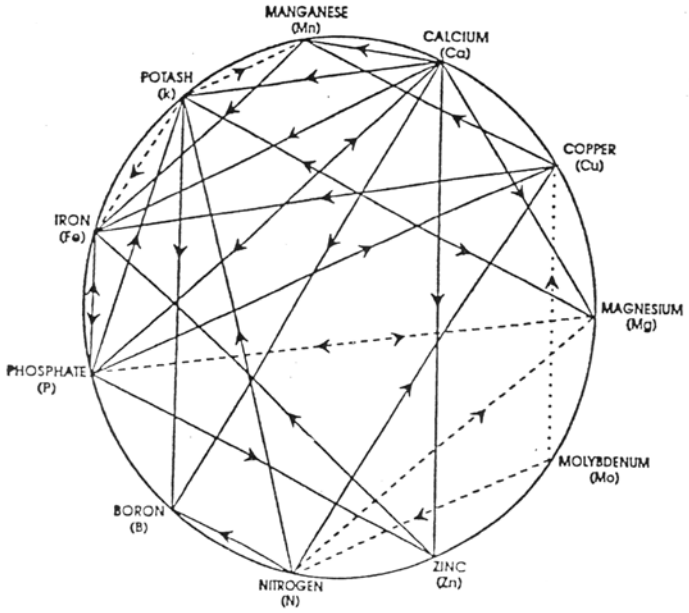
Stimulation occurs when the high level of a particular nutrient increases the demand by the plant for another nutrient.

Increased nitrogen levels create a demand for more magnesium. If more potassium is used – more manganese is required and so on.

Although the cause of stimulation is different from that of antagonism, the result is the same – induced deficiencies of the crop if not supplied with a balanced diet.

High levels of molybdenum in the soil and in the herbage reduce an animal's ability to absorb copper into the blood stream, and ruminant animals grazing these areas have to be fed or injected with copper to supplement their diet (see Mo/Cu dotted line).

Mulder's Chart



ANTAGONISM ——————→ A decrease in availability to the plant of a nutrient by the action of another nutrient (see direction of arrow).

STIMULATION - - - - - - - - - - - - An increase in the need for a nutrient by the plant because of the increase in the level of another nutrient.