UNDERSTANDING NUTRITION

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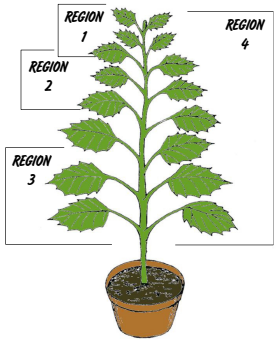
NUTRIENTS

Major
- Nitrogen
- Potassium
- Phosphorus
- Magnesium
- Calcium

Minor
- Iron
- Manganese
- Zinc
- Copper
- Boron
- Sulphur
- Molybdenum

Distinction between major and minor elements only relates to quantities not their importance

Nutritional regions



Common Nutritional Problems

Region on plant	Type of problem	Nutrient	Typical leaf symptoms and other comments
1	deficiency	Fe	Interveinal chlorosis, may turn totally yellow to white with necrosis
		Mn	Interveinal chlorosis, does not usually turn white & necrotic
		Cu & Zn	Marginal chlorosis, becomes strap-shaped; leaf deterioration & collapse with shoot & root rot
		B	New growth impaired, leaves reduced in size; multiple shoot development, pith necrosis, & shoot collapse
		Ca	New growth with marginal chlorosis, some necrosis, distortion, leaf & shoot collapse, wimpy appearing leaves
		Mo	New growth showing whiptail appearance; shoot development impaired
2	deficiency	Mo	Symptoms most common in poinsettias in this region of the plant. Leaves display marginal chlorosis and distortion; may show progressive deterioration with necrosis and collapse
	toxicity	Fe	Symptoms may show in seedling geraniums in this region instead of expected region 3. Fe excess probably occurred simultaneously in affected tissue during rapid growth phase

Common Nutritional Problems

Region on plant	Type of problem	Nutrient	Typical leaf symptoms and other comments
3	deficiency	Mg	Marginal chlorosis, often inverted "V" pattern. Chlorotic area enlarges to encompass total leaf. Unusually limited leaf necrosis, if any
		K	Similar to Mg deficiency initially, but chlorotic tissue often turns necrotic
		P	Darker green tissue often turns purple to reddish. Problem rarely occurs in mixes containing vermiculite with nutrient change containing P
	toxicity	Fe	Initially chlorotic flecking or spots. Spots and flecks enlarge, coalesce, become reddish-brown to black with eventual leaf collapse
		Mn	Similar to Fe toxicity. Both Fe and Mn may be implicated in same affected tissue
		B	Chlorosis precedes ultimate necrosis. Leaf symptoms marginal at the tip or scattered within leaf laminae
4	deficiency	N	Depending on environmental stress, plants may display chlorosis on older leaves or all over. Reduced leaf and plant size are common
		S	Pale green to whitish green colour. Rarely occurs
	Toxicity	Fe	Appears on cutting geraniums throughout the plant as small necrotic flecks, 0.5 to 3mm in length. Symptoms most severe in older tissue

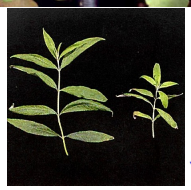
Antagonisms between nutrients

If excessive in media or tissue*	May cause deficiency of
Nitrogen	Potassium
Potassium	Nitrogen, calcium, magnesium
Phosphorus	Iron, zinc, copper
Calcium	Magnesium, boron
Magnesium	Calcium, potassium
Sodium	Potassium, calcium, magnesium
Manganese	Iron, molybdenum
Iron	Manganese
Zinc	Manganese, iron
Copper	Manganese, iron, zinc
Molybdenum	Copper

* High levels of these elements in root media or tissue may cause deficiencies of the nutrients listed in the right column, especially if their tissue levels are borderline or low.

Nitrogen deficiency - region 4





- Stunted growth
- Pale green/yellow leaves
- Thin shoots

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Phosphorus deficiency – region 3



- Stunted growth
- Dull green foliage
- Purple hue

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Potassium deficiency – region 3




- Dark green foliage
- Brown margins
- Small immature fruits
- Poor flower colour

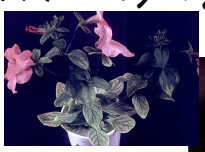
Calcium deficiency – region 1

- Leaf rolling
- Mainly on younger leaves
- Bitter bit in apples
- Blossom end rot in toms





Magnesium deficiency – region 3



- Yellowing of older leaves between veins
- Example: Escallonia

Sulphur deficiency – region 4


- Pale green/white leaf colour
- Rarely occurs

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Iron deficiency – region 1, 2,3 or 4

- Interveinal chlorosis on younger leaves, may turn totally yellow or white with necrosis
- Example: Hibiscus, tomatoes, conifer sp.

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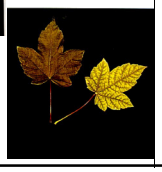
Manganese deficiency – region 1

- Interveinal chlorosis
- Leaf distortion
- Doesn't usually turn yellow and white with necrosis



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Boron deficiency – region 1

- Cracked stems
- Internal browning
- Distorted leaf tips – new growth impaired

Copper deficiency – region 1

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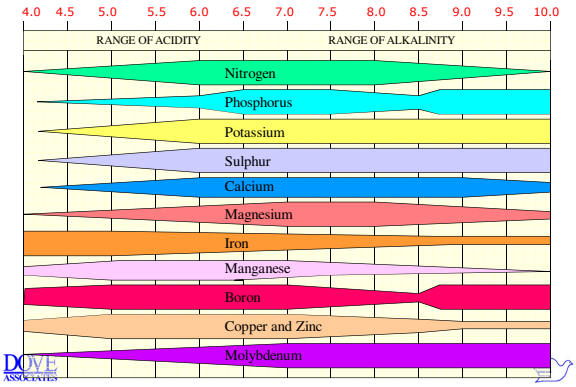
Zinc deficiency – region 1

- Neither are a major problem in the UK
- Marginal chlorosis
- Leaf deterioration & collapse with shoot and root rot

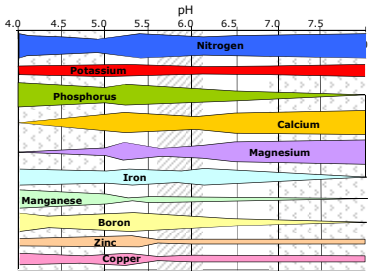
Molybdenum deficiency – region 1,2

- Long thin leaves
- Leaf tip chlorosis/distortion
- New growth can be 'whip-like'

Effects of soil pH on availability of nutrients



Effects of soil-less growing media pH on availability of nutrients



THE CHEMISTRY

Name	Symbol	Atomic weight
Nitrogen	N	14
Hydrogen	H	1
Oxygen	O	16
Potassium	K	39
Phosphorus	P	31

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THE CHEMISTRY

Nutrient content can be expressed in two ways:

eg Potash; Potassium; K

K_2O = K = 39 x 2 = 78
O = 16
Total = 94
Of which only 78 (82%) is K

A fertilizer could state K @ 78% or K2O @ 94% and this would be the same amount of K in the material

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Conversion information

A	B	A to B	B to A
Nitrogen (N)	Ammonia (NH_4)	1.2159	0.8224
Nitrogen (N)	Nitrate (NO_3)	4.4266	0.2259
Phosphorus (P)	Phosphorus pentoxide (P_2O_5)	2.2914	0.4364
Potassium (K)	Potassium oxide (K_2O)	1.2046	0.8301
Magnesium M	Magnesium oxide MgO	1.6579	0.6032

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THE CHEMISTRY IN ACTION

eg Potassium nitrate

KNO_3

K = 31
N = 14
O_3 = 16 x 3 = 48
Total 93

K = (31/93)x100 = 33%

K_2O = 33 x 1.2046 = 39.75%

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NUTRIENTS

Nitrogen
Phosphate
Potassium

	% of Nutrient			
	N	P	K	Mg
Ammonium nitrate	34			
Mono ammonium phosphate	11	48		
Potassium nitrate	13		42	
Calcium nitrate	15			
Phosphoric acid		54		
Magnesium sulphate				20

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Dissolving Nutrients

Solubility table grm/100ml	Cold	Hot
Ammonium nitrate	118	871
Calcium nitrate	102	376
Urea	78	
Mono ammonium phosphate	22	173
Potassium nitrate	13	247
Magnesium sulphate	26	73
Sodium borate	1	14
Ferrous sulphate	15	48
Sodium molybdate	56	115

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Feed rate equivalents

PPM	RATIO	DECIMAL	%	Oz/Gal
10	1:100.000	0.00001	0.001	0.0013
20	1:50.000	0.00002	0.002	0.0026
50	1:20.000	0.00005	0.005	0.0065
100	1:10.000	0.0001	0.01	0.013
200	1:5.000	0.0002	0.02	0.026
500	1:2.000	0.0005	0.05	0.065
1.000	1:1.000	0.001	0.10	0.13
2.000	1:500	0.002	0.20	0.26
5.000	1:200	0.005	0.50	0.65
8.000	1:128	0.008	0.80	1.0
10.000	1:100	0.001	1.0	1.3
16.000	1:64	0.016	1.6	2.0
20.000	1:50	0.02	2.0	2.6
30.000	1:33	0.03	3.0	3.75
40.000	1:25	0.04	4.0	5.2
50.000	1:20	0.05	5.0	6.5
52.500	1:19	0.0525	5.25	6.72
100.000	1:10	0.10	10.0	13.0

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CROP LIFE PERIOD

* High Potash at fruit ripening
* High phosphate at fruit initiation time and root establishment
* High nitrogen for extension growth
* High potash for an increase in winter hardiness
* Pre-mixed feeding products

Nursery Stock

Spring 1:0:1 or 1:1:1

Summer 2:0:1 or 2:1:1

Autumn 1:0:2 or 1:1:2

Conductivity for normal growth should be around 400µS to 600µS

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TISSUE ANALYSIS LEVELS: Azaleas

Nutrient	Deficient	Low	Sufficient	High	Excess
N	<1.8	1.81-1.99	2.00-3.00	3.01-3.20	>3.21
P	<0.15	.016-.019	0.2-0.50	0.51-0.64	>0.65
K	<0.75	0.76-0.99	1.00-1.60	1.61-1.70	>1.71
Ca	<0.2	0.21-0.44	0.45-1.60	1.61-1.75	>1.76
Mg	<0.17	0.18-0.19	0.20-0.50	0.51-0.55	>0.56
Mn	<30	31-49	50-300	301-400	>401
Fe	<50	51-59	60-150	151-175	>176
B	<20	21-30	31-100	101-200	>201
Cu	<5	6	7-15	16-20	>21
Zn	<15	16-25	26-60	61-69	70

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FERTILISER TYPES

Choice depends on:

- Type of plants being grown
- Situation e.g. field- or container-grown
- How it will need to be applied
- Frequency of application – several applications are better than one

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FERTILISER TYPES

STRAIGHTS

- Applied to materials like potassium nitrate, ammonium nitrate and magnesium sulphate
- One type of fertiliser not one element

COMPOUNDS

- Mixture of various straight fertiliser crystals
- Potassium nitrate + ammonium nitrate = compound containing K. NO_3 and NH_4

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FERTILISER TYPES

STRAIGHTS

COMPOUNDS

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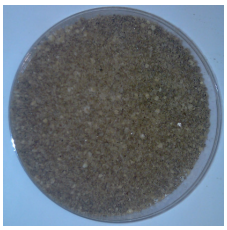
FERTILISER TYPES

SLOW RELEASE FERTILISERS

- Contain materials not immediately available to crop or contain an additive that restricts rate of nutrient release



Sincron

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FERTILISER TYPES

BASE

- Supply 'base' nutrients to a mix
- Usually a complex compound containing N. P. K and TEs

WATER SOLUBLE FERTILISERS (powder/crystals/tablets)

- Used in production of liquid feeds: readily soluble in water
- Fast-acting, short-term control. can leach out easily
- Good as a foliar feed

PG Mix

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FERTILISER TYPES

CONTROLLED RELEASE FERTILISERS (CRF)

- Straight or compound fertilisers in a capsule
- Release nutrients over a period of time
- Hard resin or elastic type coating
- Nutrient release depends on temperature and moisture levels
- Longevity controlled by thickness of coating/pore size in coating
- Dissolved nutrient leaks into soil solution via osmosis

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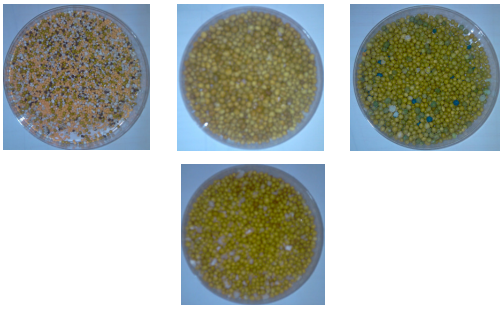
CRF FERTILISERS



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CRF Feeding Equipment

Vibrating hopper

CRF dispenser

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FERTILISER TYPES

Solid
- Dry powder or granular
- Applied to soil or compost surface and watered in
- Applied before planting or as an annual top-dressing

Organic
- From plant/animal sources
- Take longer to break down in soil: retain moisture and nutrients
- Available to the plant for longer e.g. green compost
- Better applied as a pellet – easier to handle

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MAINTAINING NUTRIENT LEVELS

- Top dressing: solid fertilisers
- Liquid feeding: water soluble fertilisers as foliar or compost applications

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TOP DRESSING

- Useful for long-term, containerised plants
- Autumn or early spring application
- Compound fertilisers only
- Quickly dissolves in moist compost
- Immediately available to the plant
- Sometimes requires washing into the compost
- Important to know pot size

Examples: Floranid Permanent, Osmocote Top Dress, Sincron

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TOP DRESSING

Using CRF granules
- Inaccurate and wasteful – loose product
- Moss, liverwort and mulches need to be removed before application
- CRF plugs – a better version for slow release

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TOP DRESSING

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TOP DRESSING

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LIQUID FEEDING

- To top-up or boost plant feed levels
- Feed applied to foliage or via the compost

Continuous low level feeding better for crops:

- Avoids peaks and troughs of nutrition
- Reduces plant stress because of high EC levels
- Avoids the risk of forgetting to apply feed!

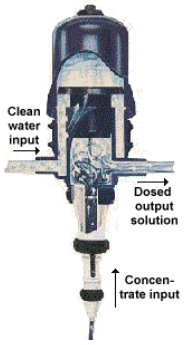
Application Methods

1) Main water pump suction injection
2) Venturi suction system
3) Direct injection pump
4) Water actuated injector pump
5) By-pass tank system
6) Conductivity controlled

Advantages of Liquid Feeding

1) Low labour requirements
2) Low energy requirements
3) Ensures continual availability of nutrients at right levels
4) Allows adjustment of nutrients to suit crop stage
5) Safer environmental application method
6) Greater efficient use of applied nutrients by crop
7) Higher yields can be gained on marginal land
8) Lower production costs

Liquid Feeding Equipment



Liquid Feeding Equipment

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Barrel diluters

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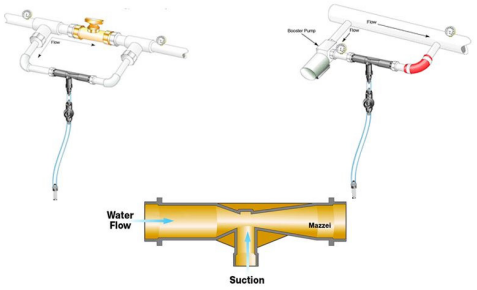
Liquid Feeding Equipment



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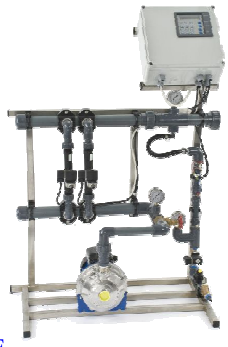
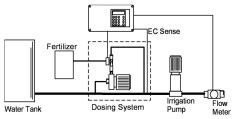
Liquid Feeding Equipment



- Venturi injector on low pressure side of irrigation pump.
- Small pump to drive Venturi.
- Flow meter is optional.



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