Update on Vegetable Nutrition

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THE UNIVERSITY OF WARWICK

Update on Vegetable Nutrition

Nitrogen

- – Assessment of Soil Nitrogen Supply
- – Difficult seasons
- - When to apply N

Magnesium

Potash

Other Nutrients

Why Nitrogen

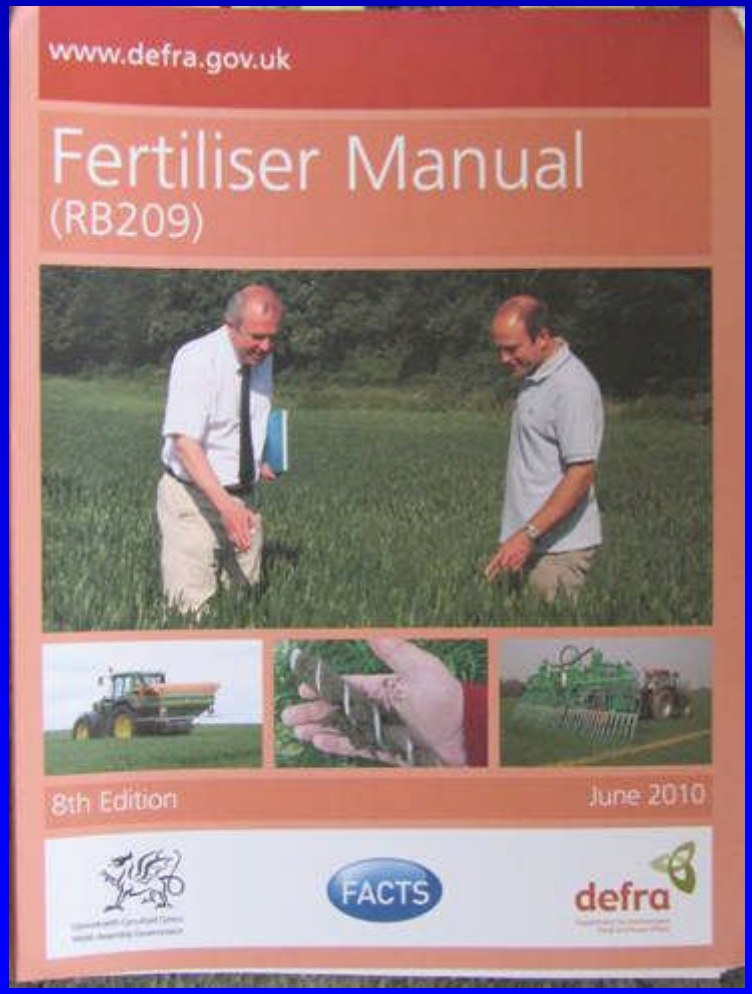
- **Nitrate**
  - drinking water limit (50 mg/l)
  - eutrophication of coastal/marine waters
- **Ammonia**
  - damaging to ecosystems sensitive to acidification and/or nitrogen enrichment
- **Nitrous oxide**
  - a greenhouse gas

NB – Pollution Swapping Issues

Why Nitrogen

- Carbon balance
- Massive energy input into N fertilisers
- Produce quality
  - Fresh salads have max nitrate content
- Wrong amount of N
  - disease risk
  - no marketable crop
- Directives
  - Nitrates Directive
  - Water framework directive – good ecological status.
  - Bathing water directive
- Good farming practice
  - Single farm payment
  - Stewardship schemes

Fertiliser Manual RB209 (8th Edition)



RB209 – Contents - selection

- Principals of nutrient management
- Organic manures
- Assessing soil nitrogen supply
- Arable and forage crops
- Vegetables and bulbs
- Fruit vines and hops
- Biomass crops
- Grass
- Appendices

Soil Nitrogen Supply Index

Index	Min N kg/ha To 90 cm
0	<60
1	61-80
2	81-100
3	101-120
4	121-160
5	161-240
6	> 240

- **By measurement**
- **By tables**

Soil Nitrogen supply by measurement

Sampling by machine or by hand auger to 90 cm depth

NO_3^- and NH_4^+ mineral N

Field Assessment Method

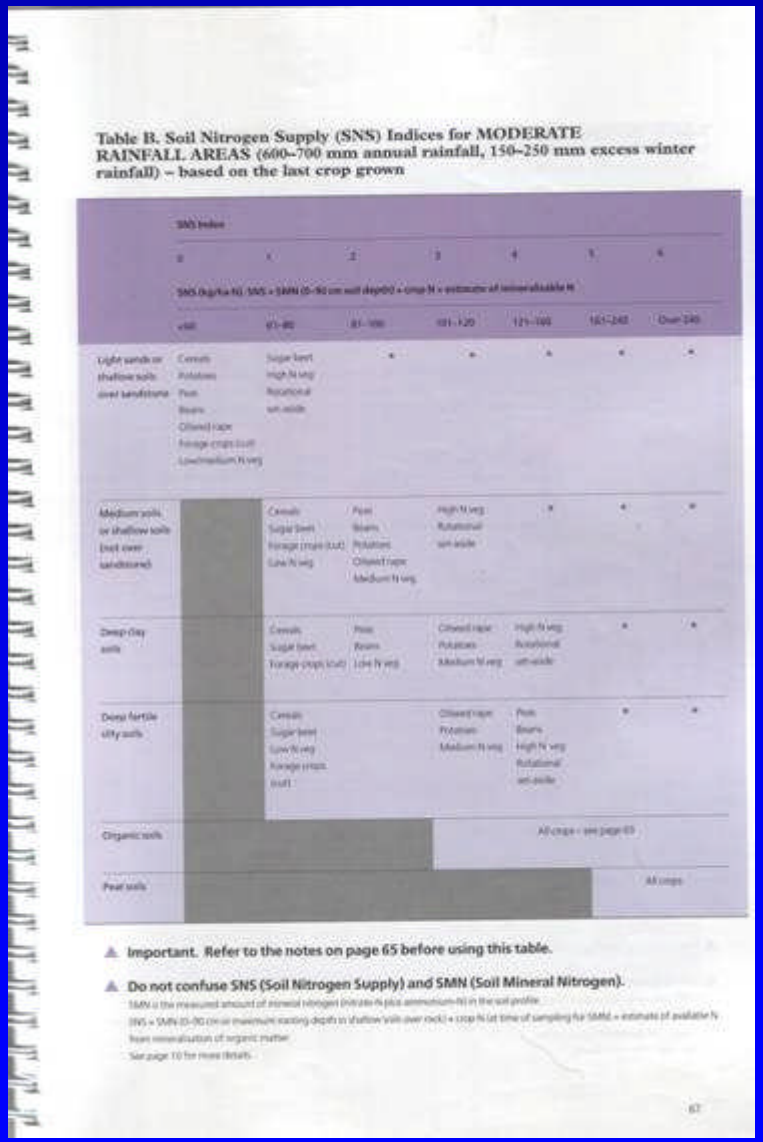


Table B. Soil Nitrogen Supply (SNS) Indices for MODERATE RAINFALL AREAS (600–700 mm annual rainfall, 150–250 mm excess winter rainfall) – based on the last crop grown

Important. Refer to the notes on page 65 before using this table.

Do not confuse SNS (Soil Nitrogen Supply) and SMN (Soil Mineral Nitrogen).

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SNS Index depends on

- **Overwinter Rainfall**
- **Soil Type**
- **Previous crop**

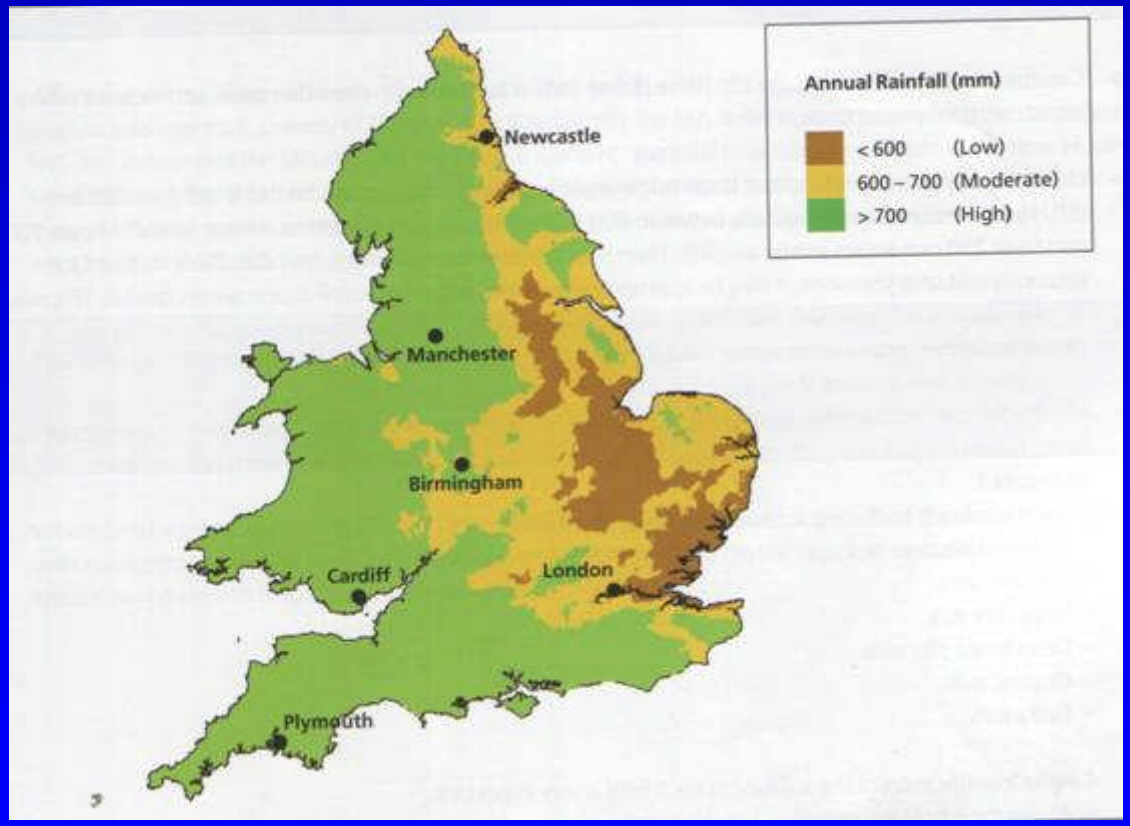
RB209 – Overwinter rainfall allowance

	Annual Rainfall mm	Excess Winter Rainfall mm (EWR)
Low	<600	<150
Moderate	600 - 700	150 - 250
High	>700	>250

EWR – rainfall between field capacity and Drain flow ceases – evapo-transpiration

RB209 – Overwinter rainfall allowance

Annual Rainfall in England and Wales



Crop Residues

Soils

Light sands or shallow soils over sandstone
Medium or shallow soils not over sandstone
Deep clayey
Deep silty
Organic (10-20% om)
Peaty (>20% om)

Soils after High Residue Vegetables

Soil	EWR	SNS INDEX
	Low	4 (5)
Silt Loam	Moderate	4
	High	3
	Low	2
Loamy Sand	Moderate	1
	High	1

Soils after Low Residue Vegetables

Soil	EWR	SNS INDEX
	Low	2 (3)
Silt Loam	Moderate	1
	High	1
	Low	0 (1)
Loamy Sand	Moderate	0
	High	0

Assessment of Soil Nitrogen Supply

Factsheet 09/12 (Project FV 345a)

Field Vegetables

Soil Nitrogen Supply for field vegetables

Clive Rahn, PlantNutrition Consulting

This factsheet reports on the findings of an HGCA project investigating the best practice for predicting soil nitrogen supply. The project aimed to achieve consensus across the industry on best practice for the estimation of Soil Nitrogen Supply (SNS). HDC funded an extension to the project to include an additional 10 sites following Brassica crops. The additional sites provide data on the high but often variable contribution that Brassica residues can make. This collaboration with HGCA allows field vegetable growers to benefit from the best practices for SNS estimation and use of Soil Mineral Nitrogen (SMN) being developed in the arable sector.

Action points

Which fields to sample

- The contribution from vegetable crop residues needs to be carefully determined - in some cases the SNS index can be much lower than expected.
- Consider sampling Soil Mineral Nitrogen (SMN) in fields with high or uncertain amounts of residues such as in intensively cropped Brassica rotations or in fields where there is a past history of grass or regular inputs of organic manures.
- Measurements of SMN on peat and peaty soils can be unreliable.
- Choose the Field Assessment Method described in the Fertiliser Manual (RB 209) for soils where mineral N status is expected to be low (<120kg/ha).

Time to take samples

For growing field vegetables, previous experience has shown:

- Take samples as close to planting date as possible after N has mineralised from previously incorporated residues. N release from winter incorporated residues (sprouts) can be slow.
- Introduce soil sampling for assessment of soil mineral N over a number of seasons so that experience can be gained in its use.
- Avoid sampling within two months after applications of nitrogen fertiliser or organic manures

Sampling and handling of samples

- For most crops, sampling soils to three depths 0-30, 30-60 and 60-90cm is appropriate. Sampling can be shallower for shallow rooted crops.
- Care needs to be taken to avoid contamination of samples from lower layers with soil from the surface.
- At least 15 sampling points are needed in a "W" pattern where previous crop management was uniform.
- Avoid excessive mixing when sub-sampling.
- It is important that samples are chilled to between 2-4°C as soon as possible after sampling and are analysed fresh within 72 hours.

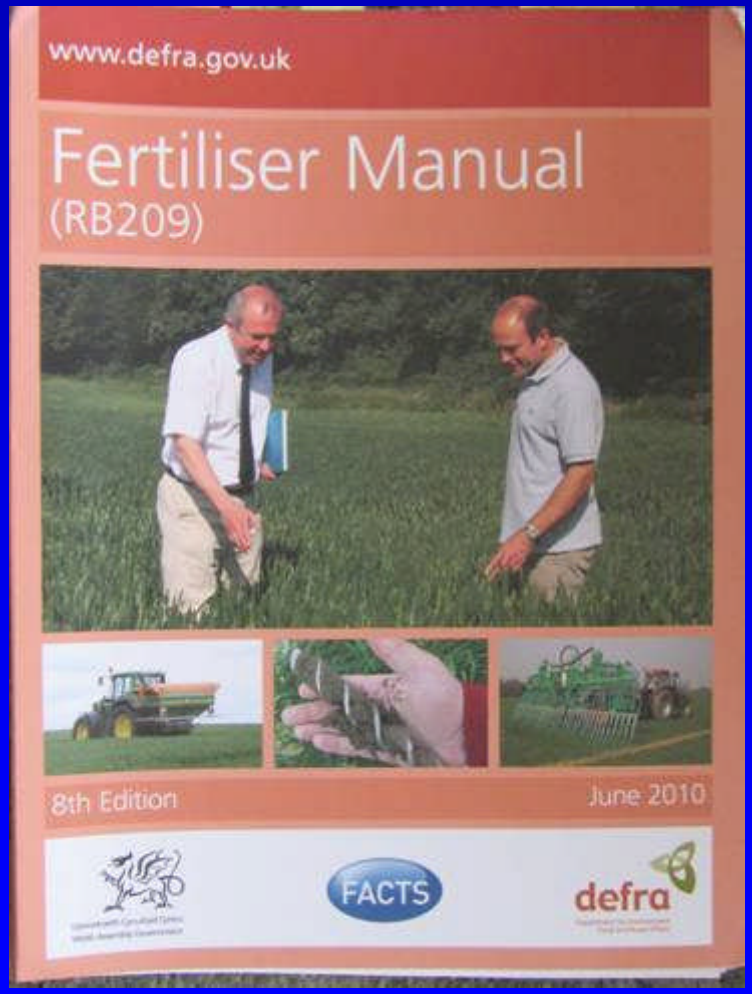
Interpretation of results (assuming good growing conditions)

- For most soils, a conversion factor of 4 can be used to convert mg/kg to kg/ha for each 30cm layer of soil.
- Sampling shallower than 90cm depth. Mineral N has to be scaled to 90cm for assessment of SNS Index.
- Consider using the WELL_N computer decision support system as a tool to interpret the results of the soil analysis when mineral N is not evenly distributed to 90cm.
- If SMN measurements indicate that large changes in N use are required, crops should be monitored for signs of deficiency or excess and the planned N strategy should be adjusted if necessary.

HDC Factsheet

Soil Nitrogen Supply for Field Vegetables

Fertiliser Manual RB209 (8th Edition)



Pillars of the system

- **Whole Crop Grown** – in the field t/ha Dry matter Yield to deliver **marketable crop.**.
- **Nitrogen Offtake** – How much a crop needs to take up to support this size of plant.
- **Supply of N** – from previous crops, SOM and fertiliser.

Supply of Nitrogen

- Mineral N to rooting depth.
- Estimate of N release from Soil organic matter.

RB209 - N Fertiliser recommendation framework

Crop	Fresh Mkt Yield t/ha	% Dry matter Marketable	Dry wt harvest Index	Total dry matter t/ha	Relation N% and dry matter yield 'a'	'b'	% N	Tot N uptake kg/ha	Minlise kg/ha	Period dates	Root depth cm	Recovery Fert %
Brussels sprouts	20.3	16.96	0.26	13.25	2.50	3.50	2.78	368	120.5	20/5-17/12	90	60
White Cabbage Storage	110.0	8.60	0.65	14.55	2.55	0.80	2.60	378	121.7	1 /5-12/11	90	60
Head Cabbage - pre Christmas	60.0	8.60	0.48	10.77	2.55	0.80	2.67	288	43.5	18/5-19/7	90	60
Head Cabbage post Christmas	53.0	8.60	0.46	10.00	2.55	0.80	2.70	270	73.6	25/7-15/01	90	60
Collards Pre Christmas	20.0	8.60	0.34	5.06	3.45	0.60	4.01	203	51.0	16/7-24/9	45	60
Collards Post Christmas	30.0	8.60	0.38	6.84	3.45	0.60	3.80	260	40.7	15/9-15/01	60	60
Cauliflower (Over Winter)				8.11	3.45	0.60	3.70	300	85.2	30/7-10/03	75	60
Calabrese	16.3	10.38	0.17	9.95	1.80	3.50	2.27	226	35.8	27/04-25/06	90	60
Cauliflower summer	30.6	8.24	0.37	6.81	3.45	0.60	3.80	259	43.5	21/5 – 21/7	75	60
Celery								205_K	32.0	15/05-1/07	60	60
Lettuce (Crisp)	45.5	5.30	0.50	4.82	2.60	1.10	3.42	165	21.8	15/05-15/06	45	60
Radish	50.0							100_K	24.3	2/05-11/06	30	60
Bulb onions spring	60.5	12.65	0.81	9.45	1.20	3.50	1.56	147	20.4	18/03-12/05	60	60
Bulb onions overwintered	60.5	12.65	0.81	9.45	1.20	3.50	1.56	147	20.4	as above	60	60
Salad onions	30.0	12.65	0.81	4.69	1.20	3.50	2.44	114	20.4	as above	30	60
Salad onions overwintered	30.0	12.65	0.81	4.69	1.20	3.50	2.44	114	20.4	as above	30	60
Leeks	47.0	14.24	0.57	11.75	2.00	4.00	2.38	279	132.3	21/4-12/12	45	60
Beetroot	60.0							270_K	65.4	18/5-16/08	60	60
Parsnips and (Turnips)	48.0							241_K	91.7	30/03-27/08	90	60
Carrots	150.0	11.42	0.81	21.15	0.82	7.00	0.84	178	66.4	2/05-8/08	90	60

Some data used from KNS system when not available from UK

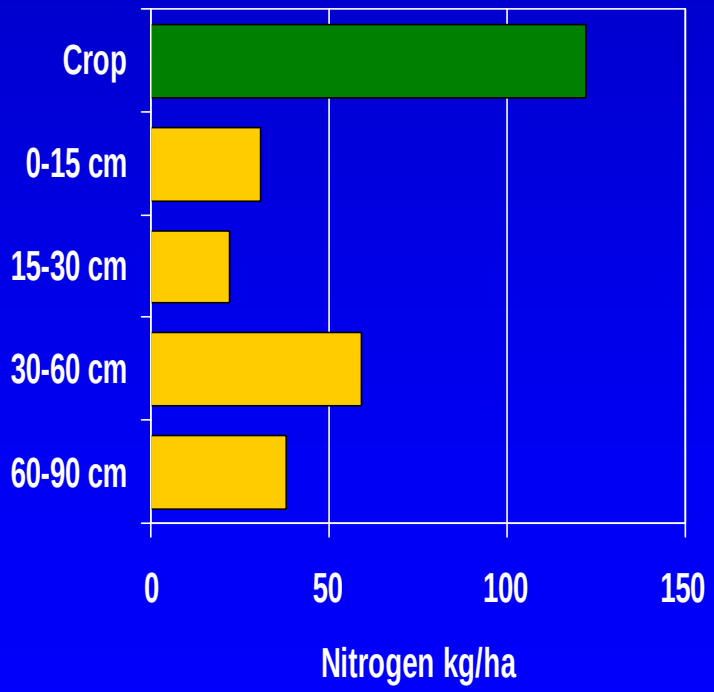
Recommendations – Example

SNS Index (kg/ha N to 90 cm)	0 (50)	1 (70)	2 (90)	3 (110)	4 (140)	5 (200)	6 (250)
Lettuce	200	180	160	150	125	75	30
Cauliflower	290	260	230	210	160	80	0

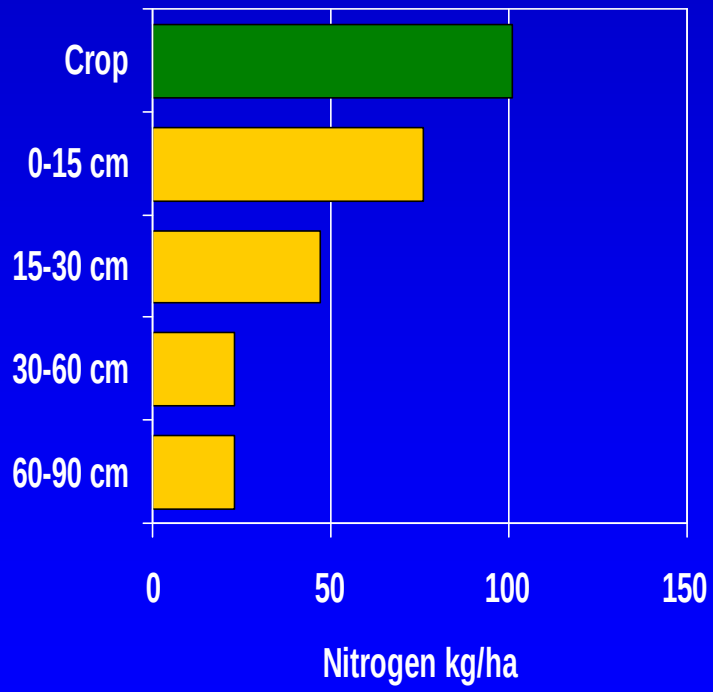
Difficult seasons?

Supply of N - in soil and crop at harvest of cauliflowers

Sandy loam soil.



Silt soil.



Other recommendation Systems

Advantages

- Field specific
- Dynamic
- Can justify fertiliser applications
- Provides consistent recommendations.

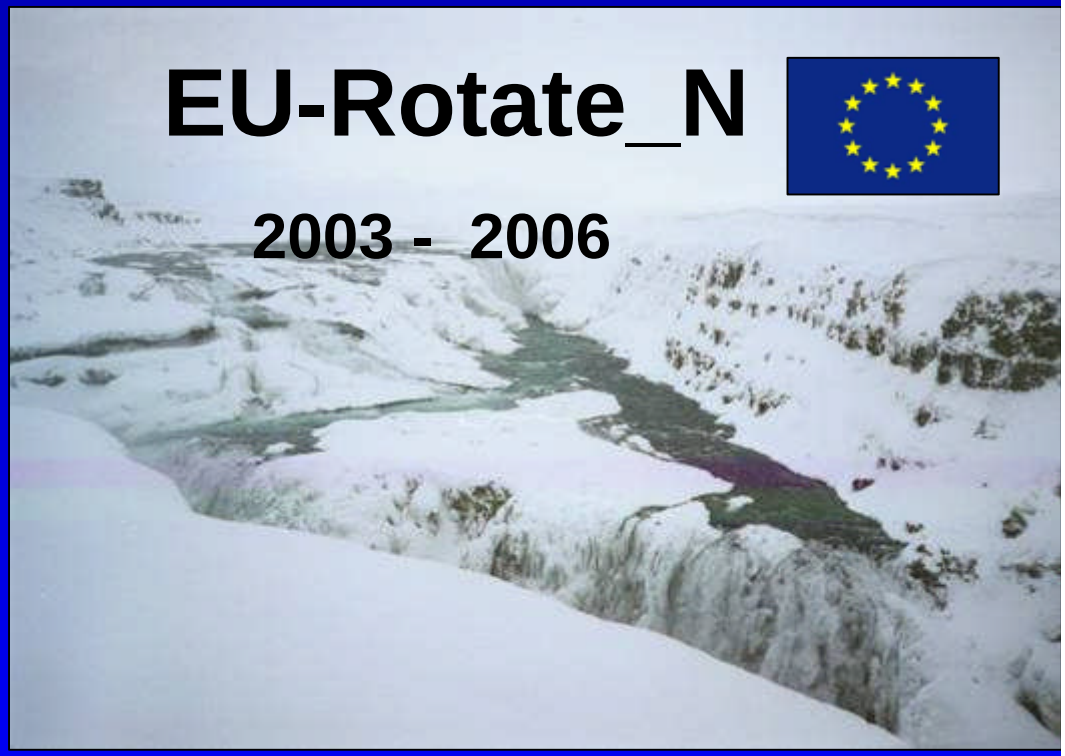
Disadvantages

- Time to input data

Models - rotations

Description

- daily time step
- 5 cm cells
- growth and N supply simulated
- crop residues + SOM
- rotations
- environmental and economic

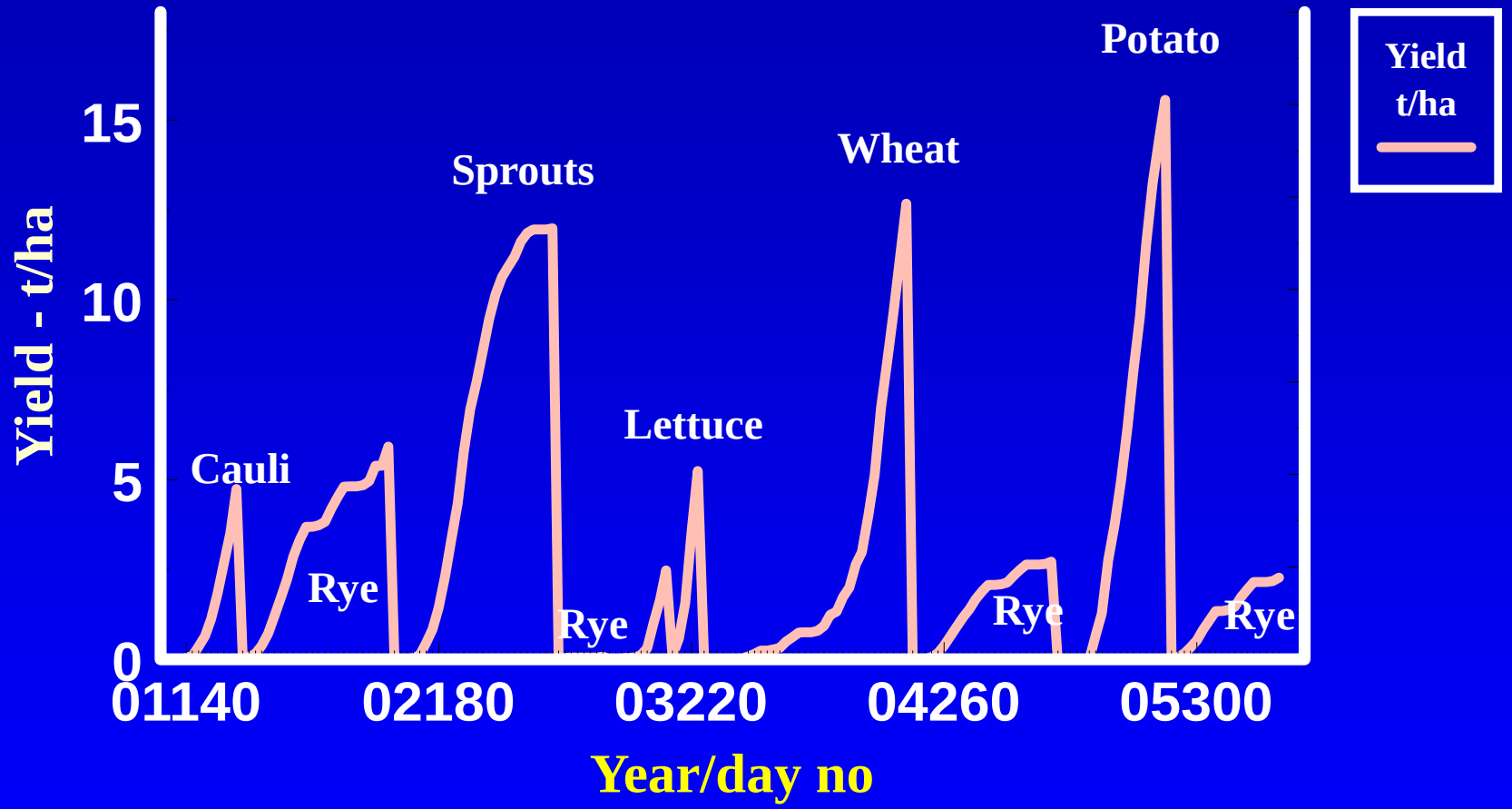


Disadvantages

- Research model
- needs more work

Download from
Warwick Crop Centre
www.warwick.ac.uk/go/eurotaten

COMPUTER SIMULATION OVER WHOLE CROP ROTATION



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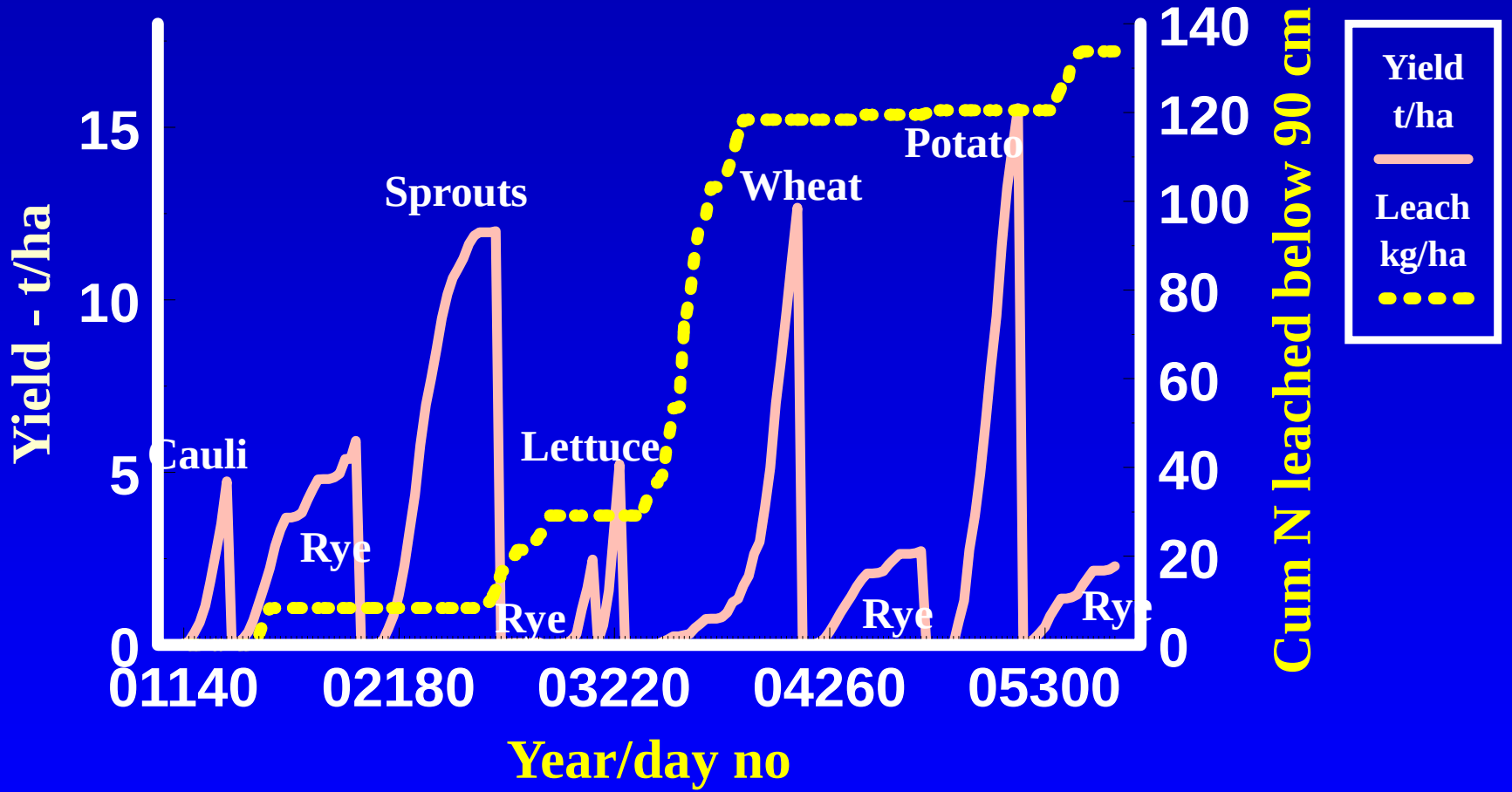
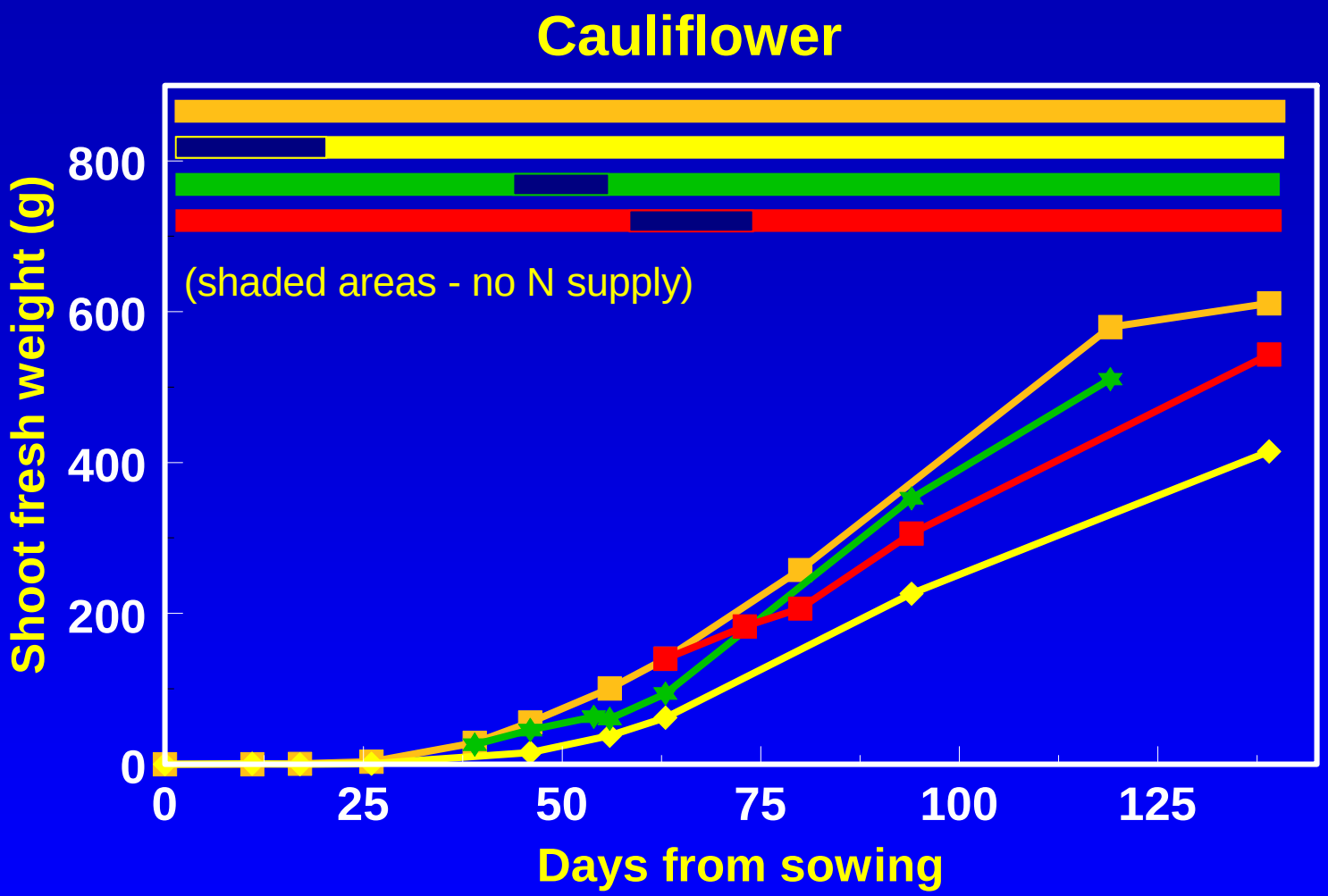
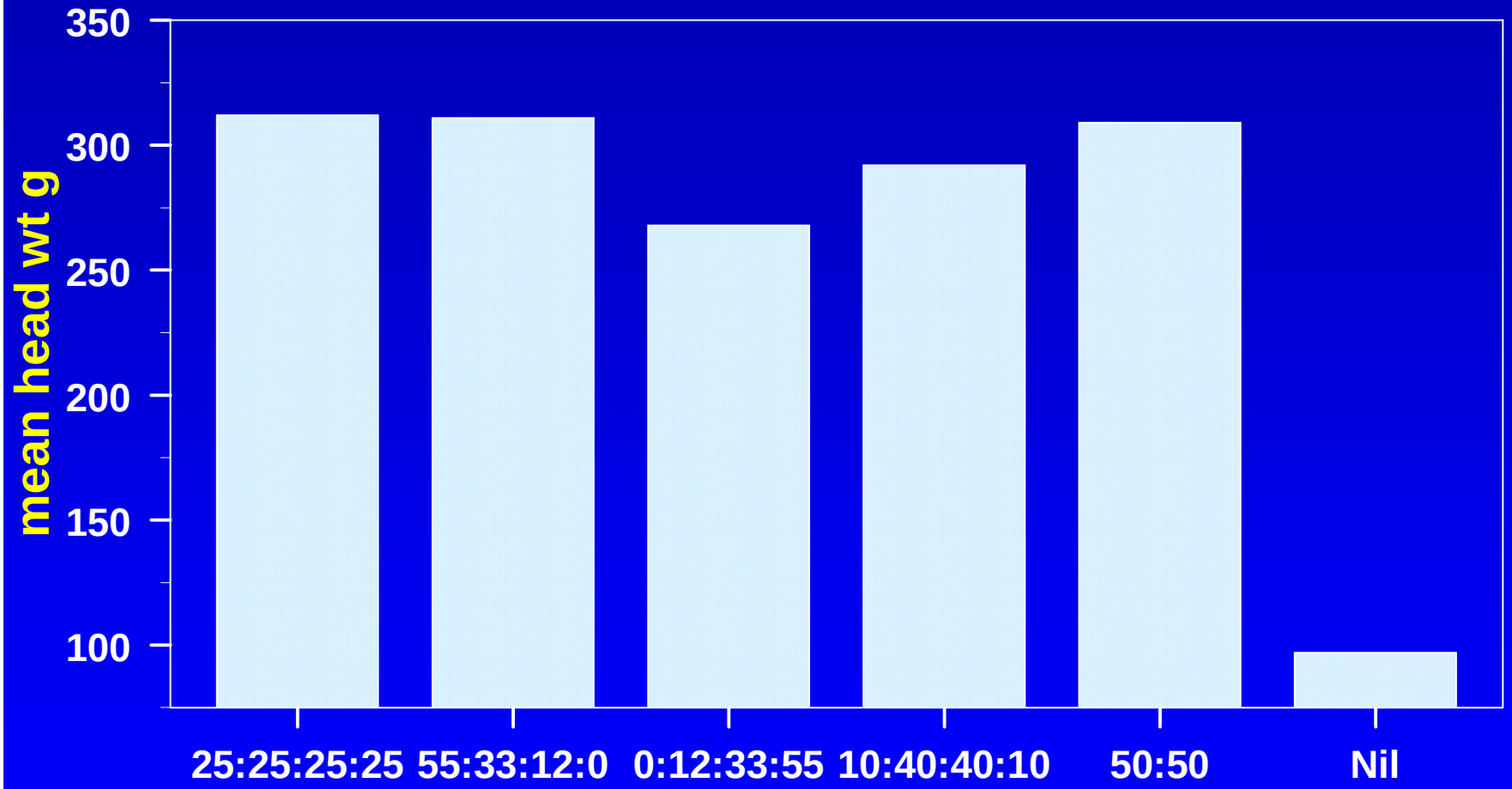


When to Apply?



Burns (1996) - Acta Horticulturae 428

Effect of fertiliser splitting on yield of broccoli



After Ulrike (1997)

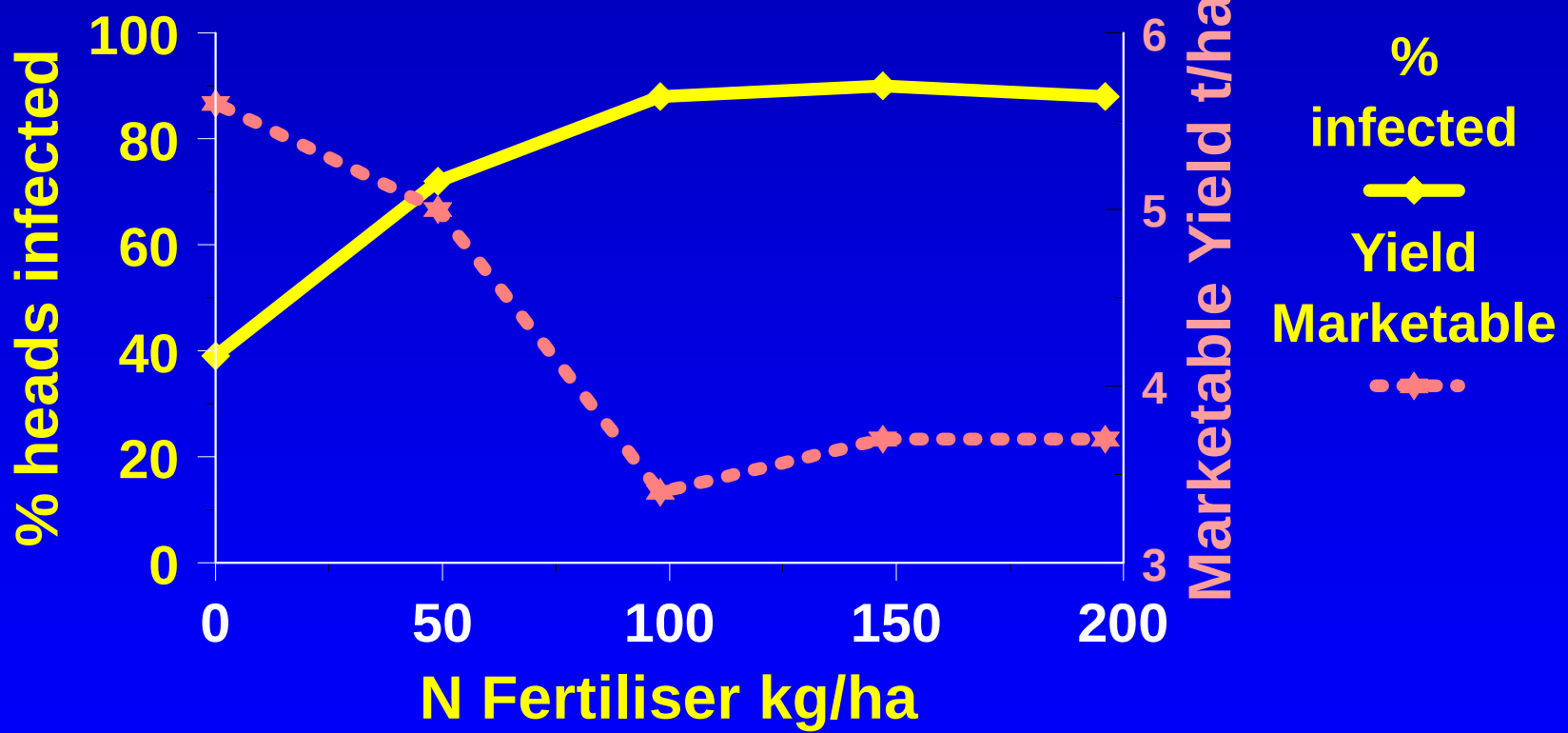
Growing Season losses of Nitrogen

% N leached below 30cm

Soil	Drainage mm		
	25	50	100
Loamy sand	15	35	85
Sandy loam	10	25	65
Sandy silt loam	5	20	60
Silty clay loam	0	10	45
Peats	?	?	?

Losses can also occur by denitrification

Nitrogen fertilisation and head rot in broccoli



After Everaarts (1994) Neth J Ag Sc 42 p 195
cv Emperor

Other Nutrients

Other Nutrients - Mg

Strong Intervenal Chlorosis

Other Nutrients - Mg

Often temporary - check

- Soil Mg status
- Soil K status
- Soil structure

Can often occur as growth accelerates in the spring

Other Nutrients - Mg

- Wet cold soils
- Poor root growth
- High soil K
- High EC

Last Resort - can spray foliage with 1- 2% $MgSO_4$ with wetting agent

MAINTAIN GOOD SOIL STRUCTURE !

Potash deficiency in Field Vegetables

Older leaves severe marginal scorch and forward curling of leaf margins.

More severe on light soils where K mining has occurred.

DIAGNOSIS

Observe context

Soil

Crop

pH

Pattern

Environmental factors affecting mineral nutrition

Boron - Light soils pH > 6.5, red beet, carrots, celery, cauliflowers, kale. - **Diagnosis** use soil <0.1 or plant <20ppm

Copper - peats, loamy sands, thin over chalk - carrots, onions. **Diagnosis** use soil <1.6 or plant <3 ppm

Manganese - Organic + peaty soils and sands pH>6.0. Carrots, onions. - **Diagnosis** use leaf <20 ppm.

Molybdenum - Most soils low pH - Cauliflower. **Diagnosis** - use soil <5.5 or plant < 0.1

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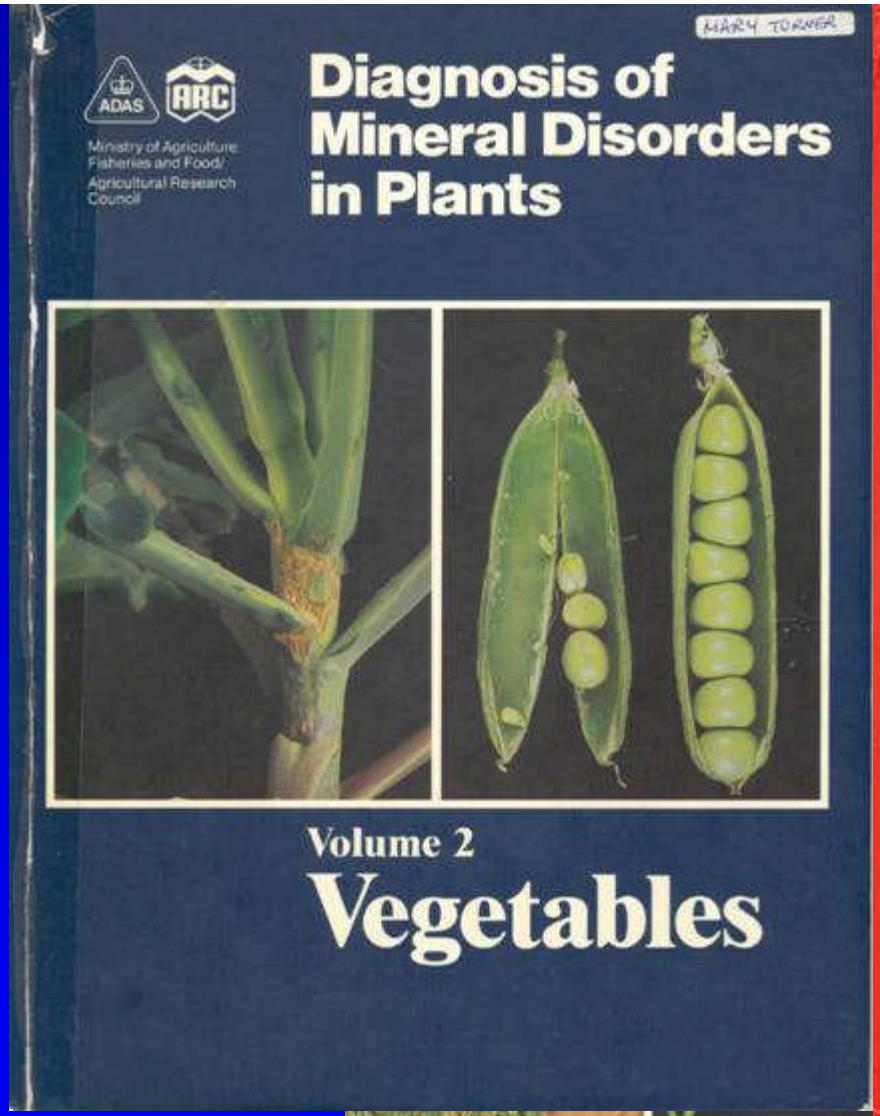
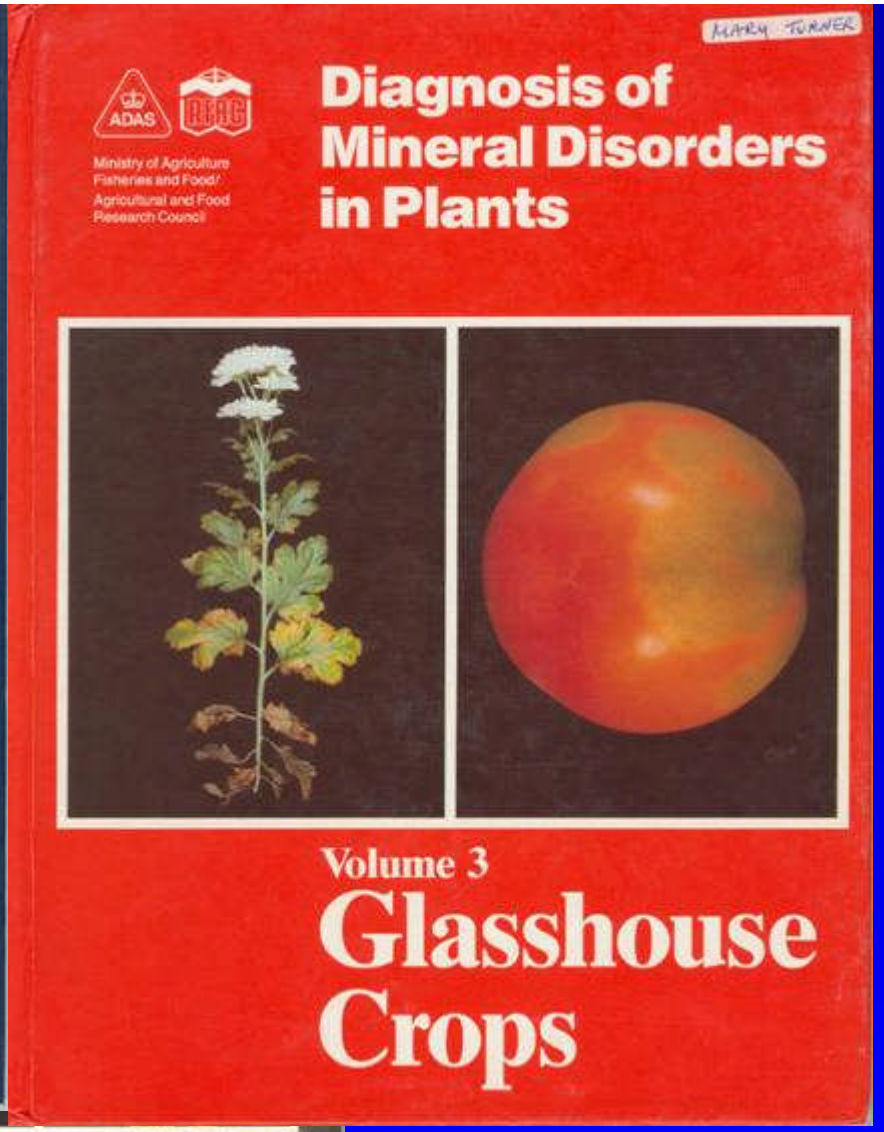
Analysis Methods - Soil Extractable, Plant Total.


MARY TURNER
ADAS
ARC
Ministry of Agriculture Fisheries and Food/ Agricultural Research Council
Diagnosis of Mineral Disorders in Plants
Volume 2
Vegetables


MARY TURNER
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Ministry of Agriculture Fisheries and Food/ Agricultural and Food Research Council
Diagnosis of Mineral Disorders in Plants
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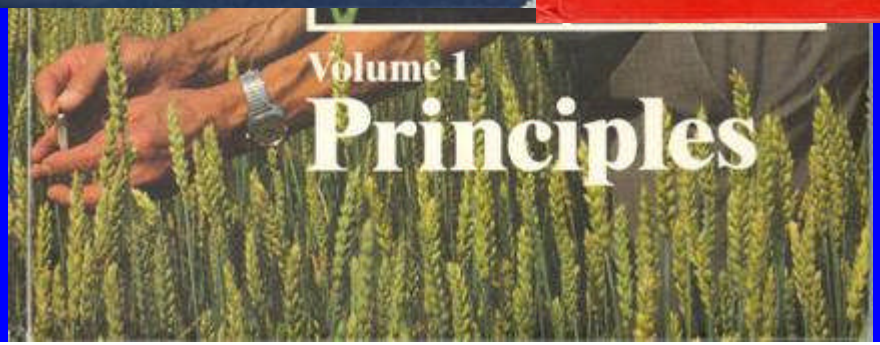
Glasshouse Crops


Volume 1
Principles

Other Sources of Information

Diagnosis of Mineral Disorders in Plants.
Scaife, A. and Turner, M. (1983).
Vol. 2. Vegetables. (Robinson, J.B.D., Ed), HMSO, London. pp96.

The Diagnosis of Mineral Deficiencies in Plants by Visual Symptoms
by Thomas Wallace, M.C., D.Sc., A.I.C.
http://customers.hbci.com/~wenonah/min-def/index.html

Nutrient Requirements and Specific Deficiency Symptoms of Vegetable Species

http://www.hortnet.co.nz/publications/guides/fertmanual/vege2.htm#I2

Summary

- Consider assessing soil N supply.
- Don’t panic when it rains.
- Magnesium deficiency check soil conditions.
- Check deficiencies by context and analysis.

Thank You

Any Questions