Crop Science – crop nutrition
pH, Liming & Micronutrients

Harper Adams University

ESSENTIAL ELEMENTS

Element	Symbol	Form absorbed by Plants	Bag Declaration
Major Nutrients			
Nitrogen	N	NH_4^+ & $N0_3^-$	% total N[(b)]
Phosphorous	P	HPo_4^{2-}	% P_2O_5
Potassium	K	K^+	% K_2O
Calcium	Ca	Ca^{2+}	% CaO
Magnesium	Mg	Mg^{2+}	% MgO
Sulphur	S	SO_4^{2-}	% SO_3
Sodium	Na	Na^+	% Na_2O
Trace Elements			
Iron	Fe	Fe^{2+}	% Fe
Mangenese	Mn	Mn^{2+}	% Mn
Boron	B	$B(OH)_3$	% B
Copper	Cu	Cu^{2+}	% Cu
Zinc	Zn	Zn^{2+}	% Zn
Molybdenum	Mo	MoO_4^{2-}	% Mo

Soil pH

- $pH = \log \frac{1}{[H^+]}$

$H^+_{OH^-}$	H^+OH^-	$_{H^+}OH^-$
Acid	Neutral	Alkaline
pH < 7	pH	pH > 7

Why Soils Become Acidic

- Crop uptake of lime
- Leaching
- Acid rain
- Ammonium fertilisers
- Organic manures

Importance of Soil pH

- Suitability to different crops
- Behaviour of fertilisers
- Trace element availability
- Microbial activity

Optimum pH

	Mineral Soils	Peat Soils
Arable	6.5	5.8
Grass/grass clover	6.0	5.3

- **ALL** crops can tolerate lower pH on **ORGANIC & PEAT** soils

pH below which yield maybe affected	
	pH
S Beet	6.5
Barley	5.8
Wheat	5.5
OSR	5.8
Potatoes	4.8
Rye grass	4.7

Correction of Soil Acidity

1. Detection of soil acidity (pH)
   - Correct soil sampling

2. Assessment of amount of lime required
   - Exchangeable acidity - soil texture

Lime requirement (t/ha ground lime stone) - Arable					
	Soil pH				
	6.0	**5.5**	**5.0**		
Sands & loamy sands	4	7	10		
Sandy loams & silts	5	8	12		
Clay loams & clays	6	10	14		
Organic soils	6	10	14		
Peats	0	8	16		

Correction of Soil Acidity

1. Detection of soil acidity (pH)
   - Correct soil sampling

2. Assessment of amount of lime required
   - Exchangeable acidity - soil texture

3. Choice of suitable liming material
   - Neutralising value

Neutralising value

- Used to compare effectiveness of different liming materials

  - ***the parts by weight of pure calcium oxide (CaO) which have the same neutralising value as 100 parts by weight of the liming material being considered***

- Neutralising value of liming materials

Burnt lime (CaO)	= 80 - 95
Ground limestone ($CaCO_3$)	= 50
Slaked lime ($Ca(OH)_2$)	= 70
Ground Magnesian limestone	= 50 -55
Sugar beet factory lime	= 20-25

Correction of Soil Acidity

1. Detection of soil acidity (pH)
   - Correct soil sampling

2. Assessment of amount of lime required
   - Exchangeable acidity - soil texture

3. Choice of suitable liming material
   - Neutralising value
   - Particle size
   - Magnesium index
   - Cost

Trace Element Deficiencies
Manganese

- Most common trace element deficiency in the UK

- Soil conditions that predispose:-
  - high pH
  - high organic matter
  - poor drainage
  - poor seedbed consolidation

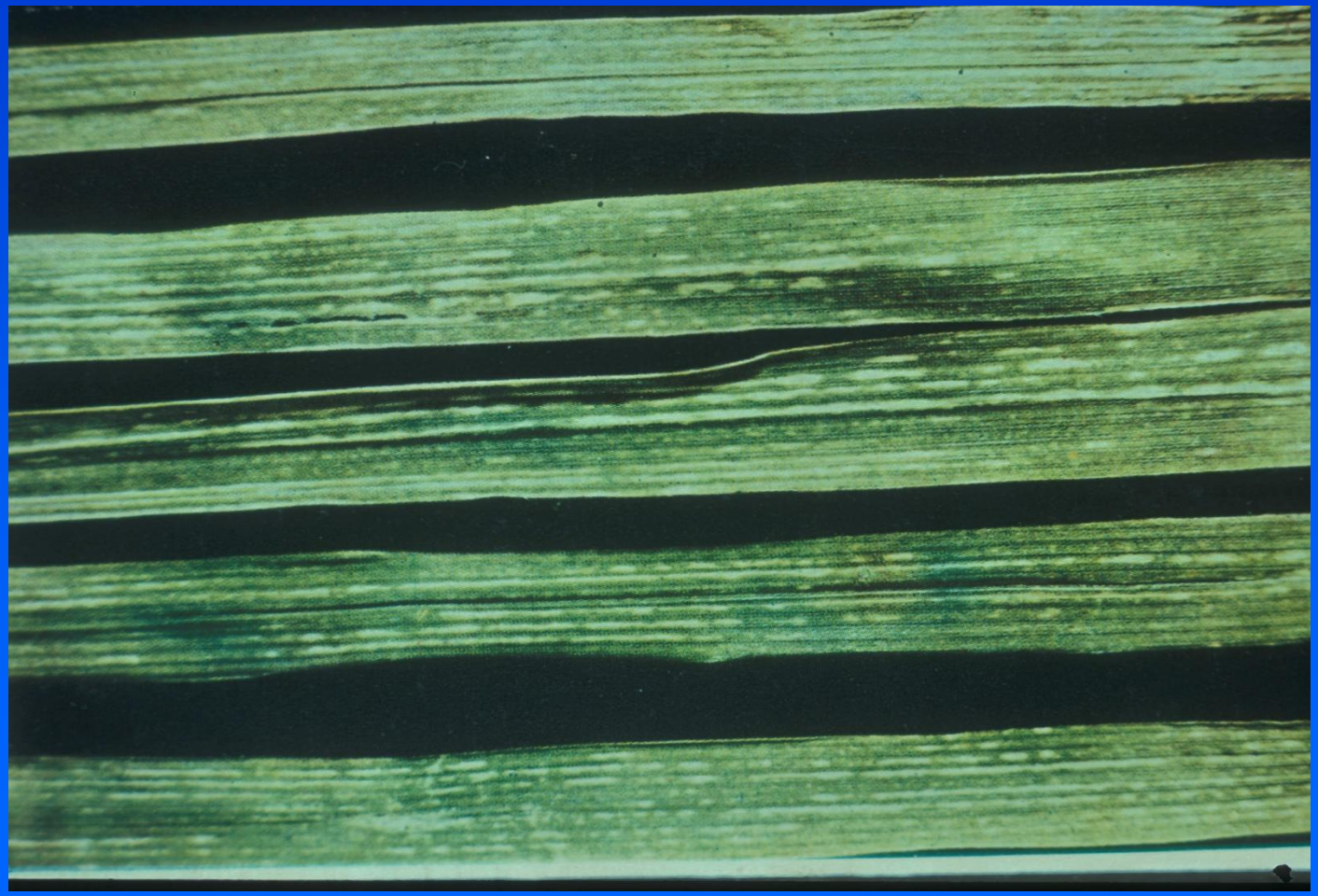
- Diagnosis
  - leaf analysis to confirm visual symptoms

- Treatment
  - foliar spray of manganese sulphate

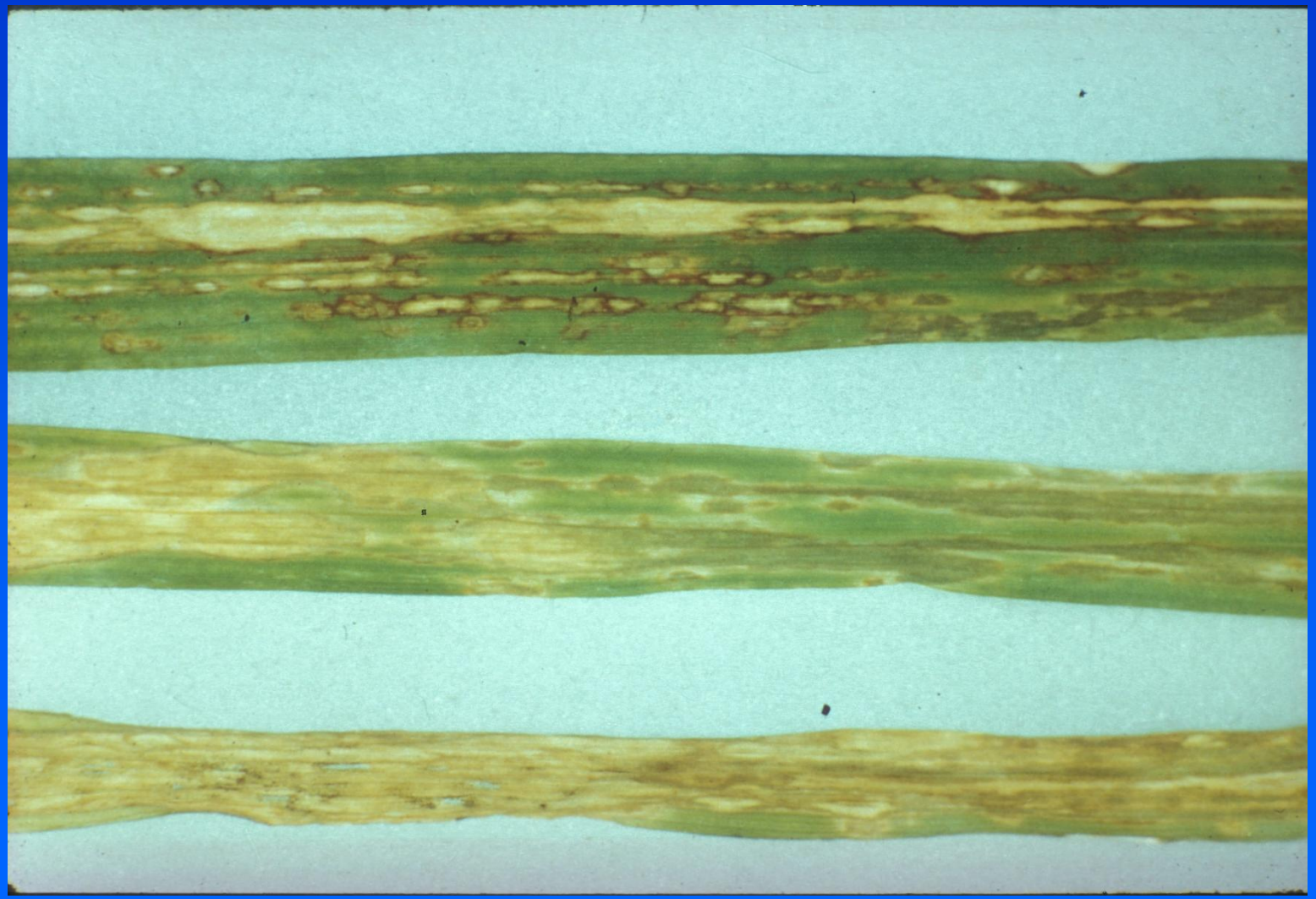
Manganese deficiency

Manganese deficiency - barley

Manganese deficiency - wheat



Manganese deficiency - oats



Copper

- Deficiency in specific situations
  - Organic soils with high pH
  - Sandy calcareous soils
- Diagnosis
  - soil analysis used to confirm visual symptoms
- Treatment
  - Foliar spray of copper oxychloride