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Making the Most of Manures & Composts

Introduction	George Chalmers
Soil Structure & Compaction	Gavin Elrick
Nutrient Planning	Alan Bruce
Farming Water Scotland	Peter Wright
Lunch	

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Gavin Elrick

Soil Structure & Compaction

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Nutrient Planning

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Main Nutrients

- Nitrogen
- Phosphate
- Potash
- Magnesium
- Sulphur

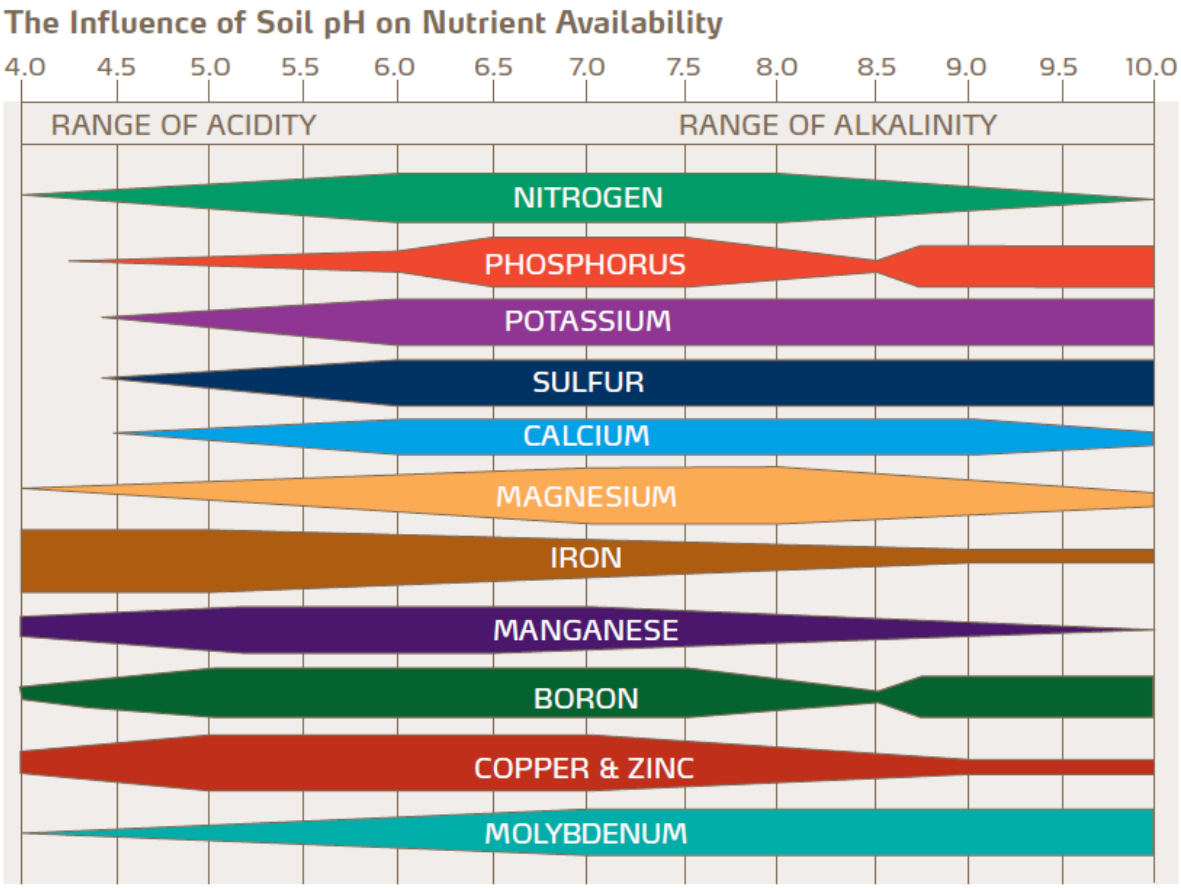
Soil Testing

- Availability of nutrients is affected by the pH of the soil.

Low pH

- Phosphorus (poorer availability below 6)
- Calcium (poorer availability below 6)
- Sulphur (poorer availability below 5.5)
- Potassium (poorer availability below 5.5)

Nutrient Availability

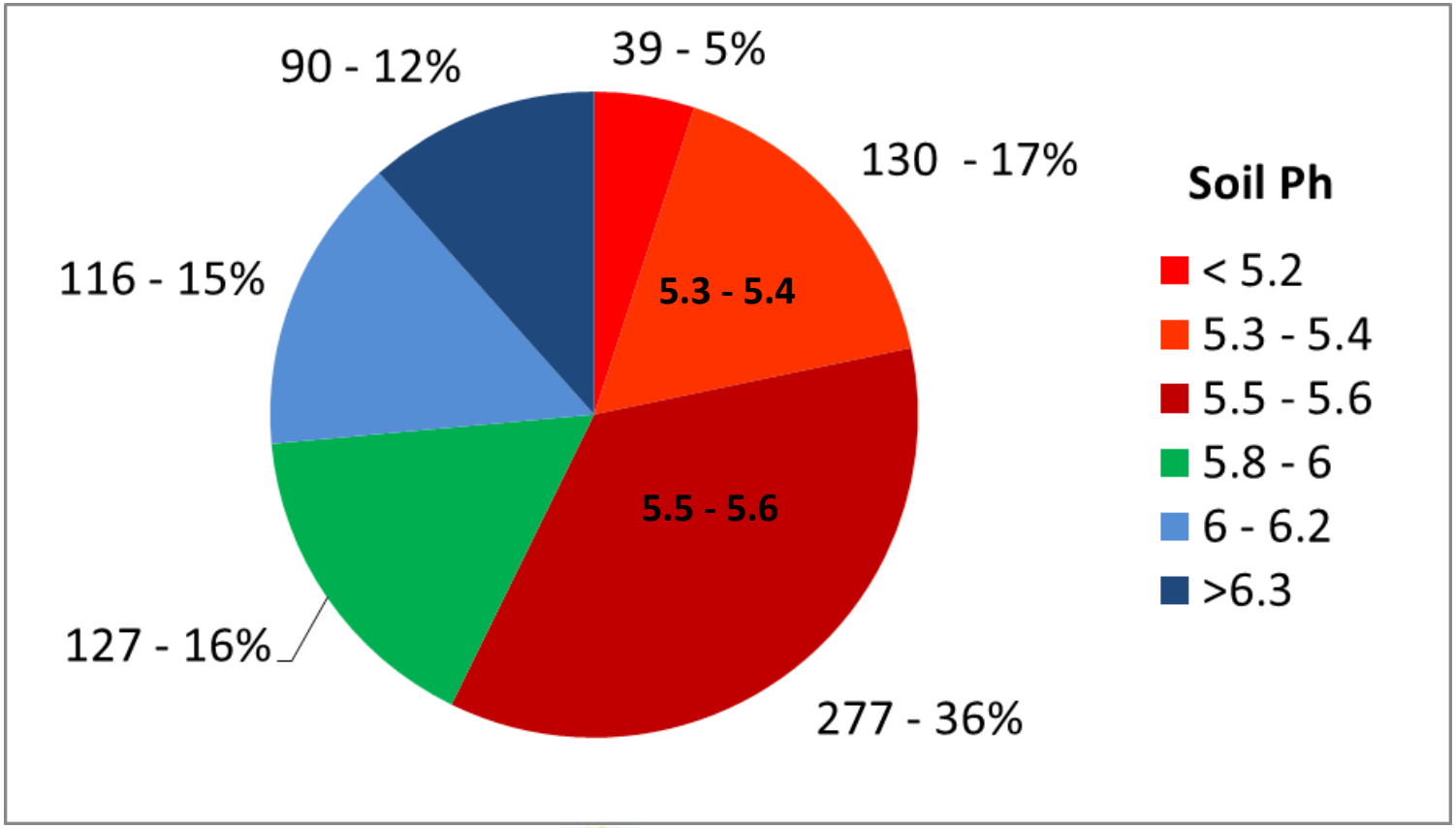


Soil Testing

- Understanding your soil test: Plant available P and K
  - *Plant available* means the amount of P and K in your soil at the time of testing that is in a form that plants can **directly** access

- Use the results

Study of 779 Grassland fields - Soil pH



Nitrogen

- **Cereals** – Lusher, greener growth, optimal tiller production, increased grain yields and protein content, improved grain quality.
- **Grass** – Better synthesis of amino acids, improved formulation of co-enzymes and nucleic acids, increased synthesis of chlorophyll and ATP, improved crop vigour and development.
- **Oil Seed Rape** – Improved crop development, increased yield.
- **Potatoes** - Better crop development, improved yield.
- **Made worse by**
- Low or high pH soils, sandy or light soils (leaching.), low organic matter. drought conditions, high rainfall (leaching), addition or high levels of non-decomposed organic matter/manure (eg straw), fast growing crops.

Phosphate

- **Cereals** – better crop establishment, improved early root development, improved yield, even crop maturation
- **Grass** – Essential for energy transfer within the plant, therefore direct effect on yield and quality.
- **Oil Seed Rape** – Improved crop establishment, improved winter hardiness, improved yield.
- **Potatoes** - Increased number of tubers, produces tubers of uniform size, boosts bulking and increases the yield of tubers, increases tuber dry matter content and starch levels, improves storage potential of tubers and reduces storage diseases.
- **Made worse by**
- Acidic or very alkaline soils, low organic matter, cold or wet conditions, crops with a poorly developed root system, soils with low P reserves, Soils with a high phosphate capacity, iron rich soils.

Potash

- **Cereals** – Lusher, greener growth, improved plant development, increased yield and grain quality.
- **Grass** – Internal water regulation, vigorous growth and healthy foliage, required in large amounts.
- **Oil Seed Rape** – improved crop development, improved resistance to stress (e.g. drought, cold weather etc), improved disease resistance, increased yield.
- **Potatoes** - Improved yield and quality, increased tuber size, improved disease resistance.
- **Made worse by**
- Acidic soils (low pH), sandy or light soils (leaching), drought conditions, high rainfall (leaching), heavy clay soils, soils with low K reserves, magnesium rich soils.

Magnesium

- **Cereals** - Crop establishment, improved winter hardiness and tillering, better grain quality.
- Grass – Risk of Hypomagnesaemia (grass staggers), herbage uptake reduces as N and K levels increase.
- **Oil Seed Rape** - better crop establishment, reduced plant losses over winter, increases nutrient levels in the crop for better spring regrowth, improved flowering, more even maturity, boosts grain yield and oil content of seed.
- **Potatoes** - boosts bulking. Increased yield of tubers. Improved disease resistance and skin quality. Increased tuber dry matter content and starch levels.
- **Made worse by**
- Sandy soils, acidic soils, potassium rich soils, soils receiving high potash applications, cold wet periods.

Sulphur

- **Cereals** - Healthy green foliage, even crop maturity, more efficient use of nitrogen by the crop, improved grain protein contents.
- **Grass** - Component of enzymes and other proteins, necessary for chlorophyll formation and efficient N-utilization.
- **Oil Seed Rape** - better crop establishment, reduced plant losses over winter, improved flowering, more even maturity, boosts grain yield and oil content of seed.
- **Potatoes** - Better crop development, Improved yield.
- **Made worse by**
- Acidic soils, light, sandy soils (leaching), low organic matter, poorly aerated soils (waterlogged soils.).
- Areas with low industrial emissions.

Crop Nutrient Requirement

Crop type	Grain/seed or straw	P Content (kg P/t)	K Content (kg K/t)
WB, WW	Grain & Straw	8.4	10.4
WB, WW	Grain only	7.8	5.6
SB, SW	Grain & Straw	8.6	11.8
SB, SW	Grain only	7.8	5.6
SO, WO	Grain & Straw	8.8	17.3
WOSR	Grain only	14.0	11.0

Crop Nutrient Requirements (based on Technical Notes TN633 and TN651

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Nutrient requirement (kg/ha) following a Group 1 crop on a sandy loam soil type at (Moderate – Phosphate and Potash levels).

	Spring barley (feed) (6t/ha)	Spring barley (malting) (6t/ha)	Spring oats (6t/ha)	Winter barley (feed) (8t/ha)	Winter wheat (feed) (8t/ha)	Winter O.S.R. (seedbed) (3.5t/ha)	Winter O.S.R. (Spring)
N	130	110	100	180	200	30	200
P_2O_5	52	52	53	67	67	49	
K_2O	71	71	104	83	83	38	

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Soil Status

P & K adjustments for soil status				
Phosphate (kg/ha)				
Soil Status	V Low	Low	Moderate	High
Cereals/OSR	+80	+40	0	-20
Potash (kg/ha)				
Soil Status	V Low	Low	Moderate	High
Cereals/OSR	+60	+20	0	K Offtake x 0.5

Grass nutrient requirement

	Nutrients Removed	
Crop	P Removal (kg/t)	K Removal (kg/t)
Silage	1.7	6
Hay	5.9	18
Grazing *	1.4	4.8

Grass Nutrient Requirements (based on Technical Notes TN652

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Nutrient requirement (kg/ha) for Site Class 1, on a sandy loam soil type at (Moderate – Phosphate and Potash levels).

	2 or 3 Cut Silage plus grazing	1 Cut Silage plus grazing	Hay plus grazing	Grass with high clover (1 cut plus grazing)	Grass establishment (grass /low clover mix) (direct reseed)	Grass establishment (high clover mix) (direct reseed)
N	310	280	220	100	40-60	0-20
P_2O_5	39+20+15+3 (77)	39+3 (42)	41+3 (44)	39+3 (42)	50	70
K_2O	138+72+54+2 (266)	138+2 (140)	126+2 (128)	138+2 (140)	50	70

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Soil Status - Grass

P & K adjustments for soil status				
Phosphate (kg/ha)				
Soil Status	V Low	Low	Moderate	High
Grass	+80	+40	0	P Offtake x 0.5
Potash (kg/ha)				
Soil Status	V Low	Low	Moderate	High
Grass	+60	+20	0	K Offtake x 0.5

P & K requirements – Grass

Soil Status	Crop	Yield - t/ha	P requirement (kg/ha)	K requirement (kg/ha)
Moderate	1 cut silage	20	34	120
Low	1 cut silage	20	74	140
Very Low	1 cut silage	20	114	200
Moderate	2 cut silage	30	51	180
Low	2 cut silage	30	91	200
Very Low	2 cut silage	30	131	240

Farm Yard Manure

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Benefits

- Primarily nutrient/fertiliser source
  (all nutrients available within 2 years
- Soil health and quality! - they add organic matter (small amounts), which in turn:
  - can help improve workability
  - can help improve water holding capacity/drainage
  - can help reduce soil erosion
- Reduce bagged fertiliser requirements
- Some add trace elements
- Some imported wastes can have a small (or large!) liming effect

Nutrient Value

- The maximum fertiliser value of manure and slurries is achieved when your soil status in on target for P and K
  - P usage efficiency increases from 50% to 100%
  - K usage efficiency increases from 90% to 100%
- P and K will be used to build soils up when they are low and will be wasted when the soil levels are too high
- All the nutrients (100 %) in manure and slurry will be used by the crop within 2 years of application.
- ***They contribute very little to long term soil organic matter & should not be considered as a soil improvers***

Nutrients in farm yard manures

	Total nutrients (kg/t fresh weight) in different Farm Yard Manures						
	Cattle FYM (fresh)	Cattle FYM (old)	Pig FYM (fresh)	Pig FYM (old)	Layer manure	Broiler / Turkey litter	Sheep FYM (fresh)
N	6	6	7	7	19	30	7
Readily available N	1.2	0.6	1.8	1	9.5	10.5	1.4
P_2O_5	3.2	3.2	6	6	14	25	3.2
K_2O	8	8	8	8	9.5	18	8
SO_3	2.4	2.4	3.4	3.4	4	8	3
MgO	1.8	1.8	1.8	1.8	2.6	4.4	1.6

Assess total and available nutrients

- The difference between the total and the available nutrient value is very important with organic fertilisers
- Nutrient content and nutrient availability vary greatly depending on the organic material in question.
  - N in slurries is about 5 - 50% available in Spring (depending on time of application)
  - N in fresh cattle manures is about 20% available in year of application

Nutrient availability from organic manures in year of application

	Nutrient availability in the year of application (%)			
	Slurry	**Poultry Manures**	**FYM**	**Dirty water**
N	35-75	35-70	10-20	?
P_2O_5	50	60	60	?
K_2O	90	90	90	95-100

Get the application rates right!

- Too many farmers are guessing the amount of bulky organic materials to add and/or wrongly estimating quantities applied.
- In these cases, they often apply ***grossly in excess of crop need*** - can lead to:

  – a waste of money and resources
  – nutrient imbalances in the soil and plant
  – increased susceptibility to pests and diseases
  – increased weed problems
  – nutrient leaching and pollution

Nutrient supply from typical application

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	Total nutrients (kg/t fresh weight) in different Farm Yard Manures Application Rate (25 tonnes per Ha (10 tonnes per acre)				
	Cattle FYM (fresh)	Cattle FYM (old)	Pig FYM (fresh)	Pig FYM (old)	Sheep FYM (fresh)
N	150	150	175	175	175
Readily available N	30	15	45	25	35
P_2O_5	80	80	150	150	80
K_2O	200	200	200	200	200
SO_3	60	60	85	85	75
MgO	45	45	45	45	40

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Manures – a valuable resource

- As the price of inorganic fertilisers is rising the manure benefit from organic manures can produce a considerable saving to the overall farm fertiliser bill.
- Typical prices at present:-
  - N £0.70/kg
  - P £0.61/kg
  - K £0.42/kg
- Cost of typical fertiliser grades
  - Ammonium nitrate £240/tonne
  - Triple super phosphate £280/tonne
  - Muiriate of potash £250/tonne

Value of a typical application (2)

	Financial Benefit (£ per Ha) of a typical Application Rate (25 tonnes per Ha (10 tonnes per acre) based on Available N and total P_2O_5 and K_2O.				
	Cattle FYM (fresh)	Cattle FYM (old)	Pig FYM (fresh)	Pig FYM (old)	Sheep FYM (fresh)
Available N	21.00	10.50	31.50	17.50	24.50
Total P_2O_5	48.80	48.80	91.50	91.50	48.80
Total K_2O	84.00	84.00	84.00	84.00	84.00
Total (£)	£153.80	£143.30	£207.00	£193.00	157.30

Value of a typical application (3)

	Financial Benefit (£ per Ha) of a typical Application Rate (10 tonnes per Ha (4 tonnes per acre) based on Available N and total P_2O_5 and K_2O.	
	Layer manure	Broiler / Turkey litter
Available N	66.50	73.50
P_2O_5	85.40	152.50
K_2O	39.90	75.60
TOTAL (£)	£191.80	£301.60

- Rotation
  - WW
  - SB
  - SB
  - GG
  - GG
  - GS
  - GS
  - GG

P & K Removal

Crop	P Removal (kg/t)	K Removal (kg/t)
Winter Barley / Wheat	8.4	10.4
Spring Barley	8.6	11.8
Spring Oats	8.8	17.3
Winter Oilseed Rape	15.1	17.5
Silage	1.7	6
Hay	5.9	18
Grazing *	1.4	1.8

P & K removal

Year	Crop	Yield (t/ha)	P removed (kg/ha)	K removed (kg/ha)
1	Winter Wheat	8	67	83
2	Spring Barley	6	52	71
3	Spring Barley	8	52	71
4	Grass (Grazed)	10	3*	2*
5	Grass (Grazed)	10	3*	2*
6	Grass (Sil 1 cut)	23	42	140
7	Grass (Sil 1 cut)	23	42	140
8	Grass (Grazed)	10	3*	2*
Total Removed			**264**	**511**

P & K Applied

Year	Fertiliser	Rate (kg/ha)	P Applied (kg/ha)	K Applied (kg/ha)
1	0:24:24	312	75	75
2	8:20:30	250	50	75
3	8:20:30	250	50	75
4	25:5:5	250	12	12
5	25:5:5	250	12	12
6	20:5:15 25:5:5	625 125	38	100
7	20:5:15 25:5:5	625 125	38	100
8	25:5:5	250	12	12
Total applied			**287**	**461**
Total removed			**264**	**511**
Balance			**+23**	**-50**

P & K Applied

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Year	Fertiliser	Rate (kg/ha)	P Applied (kg/ha)	K Applied (kg/ha)
1	0:24:24	312	75	75
2	8:20:30	250	50	75
3	8:20:30	250	50	75
	Cattle FYM	25 t/ha	80	200
4	25:5:5	250	12	12
5	25:5:5	250	12	12
6	20:5:15 25:5:5	625 125	38	100
7	20:5:15 25:5:5	625 125	38	100
8	25:5:5	250	12	12
Total applied			**287**	**461**
Total removed			**264**	**511**
Balance			**+103**	**+150**

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Analysis

(Soil, FYM, Slurry)

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Sampling and analysis

- If using any bulky fertilisers regularly, analyse to see what plant nutrients are present
- Take 10 - 12 sub samples, mix them and send 0.5 litre for analysis:
  - pH, soluble salts, plant major/secondary nutrients and trace elements (totals, rather than extractable nutrients)
- Learn how to interpret the results properly or get specialist help!

Slurry Analysis

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Nutrient Kg/m³	Standard Slurry	Sample 1	Sample 2
N	2.6	1.1	2
P	1.8	1.2	1
K	2.4	4.5	3.5
Mg	0.7	.39	.27
Sulphate	1	.36	.26
pH		7.1	6.4

Tend to vary between tanks and farms but not over time

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Get the application rates right!

- Too many farmers are wrongly estimating quantities applied and nutrient content
- In these cases, they often apply ***grossly in excess of crop need*** - can lead to:
  - nutrient leaching and pollution
  - a waste of money and resources
  - nutrient imbalances in the soil and plant
  - increased susceptibility to pests and diseases
  - increased weed problems

Thank You

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