Straw for Biomass
Implications for soil and nutrient management

Edward Downing

Southern Fertiliser Technical Manager

Frontier Agriculture Ltd

edward.downing@frontierag.co.uk

Nutrient Management

- **Target soil indices for P & K**

	Soil P	Soil K
Arable and forage crops, grassland	Index 2 (16-25 mg/litre)	Index 2- (121-180 mg/litre)
Vegetables	Index 3 (26-45 mg/litre)	Index 2+ (181-240 mg/litre)

Soil indices

Index	Phosphorus (P)		Potassium (K)	Magnesium (Mg)
	Olsen's P	Resin P	Ammonium nitrate extract	
	mg/litre			
0	0-9	0-19	0-60	0-25
1	10-15	20-30	61-120	26-50
2	16-25	31-49	121-180 (2-) 181-240 (2+)	51-100
3	26-45	50-85	241-400	101-175
4	46-70	86-132	401-600	176-250
5	71-100	>132	601-900	251-350
6	101-140		901-1500	351-600
7	141-200		1501-2400	601-1000
8	201-280		2401-3600	1001-1500
9	Over 280		over 3600	over 1500

Appendix 4 - Fertilizer Manual

Nutrient Management

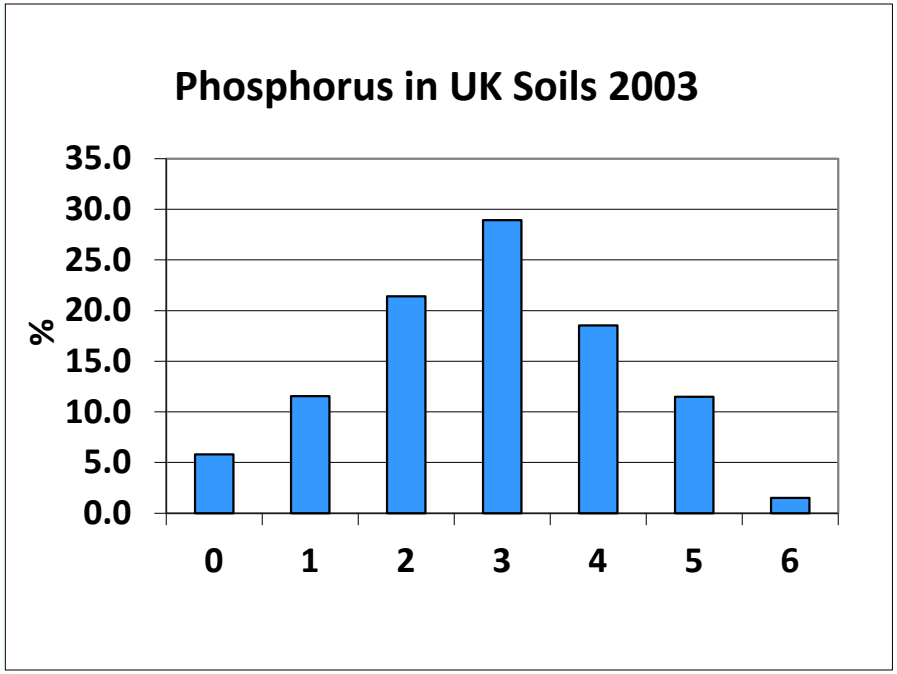
- **Target soil indices for P & K**

	Soil P	Soil K
Arable and forage crops, grassland	Index 2 (16-25 mg/litre)	Index 2- (121-180 mg/litre)
Vegetables	Index 3 (26-45 mg/litre)	Index 2+ (181-240 mg/litre)

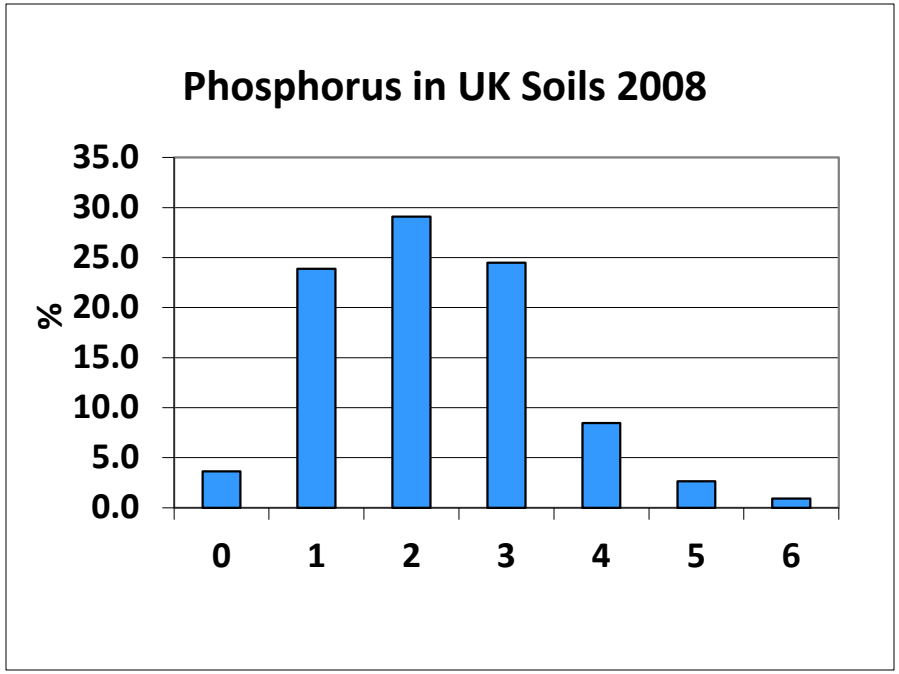
- **Takes time to raise /lower a soil index**
  - **move soil P by 10 mg/l may need 400 - 600 kg/ha of phosphate**
  - **increase soil K by 50 mg/l may need 300 - 500 kg/ha potash**
- **Depends on the crop removal and application rates**
- **Need to sample <u>every</u> field regularly**

Shift in soil indices

2003 Sample size = 45,000



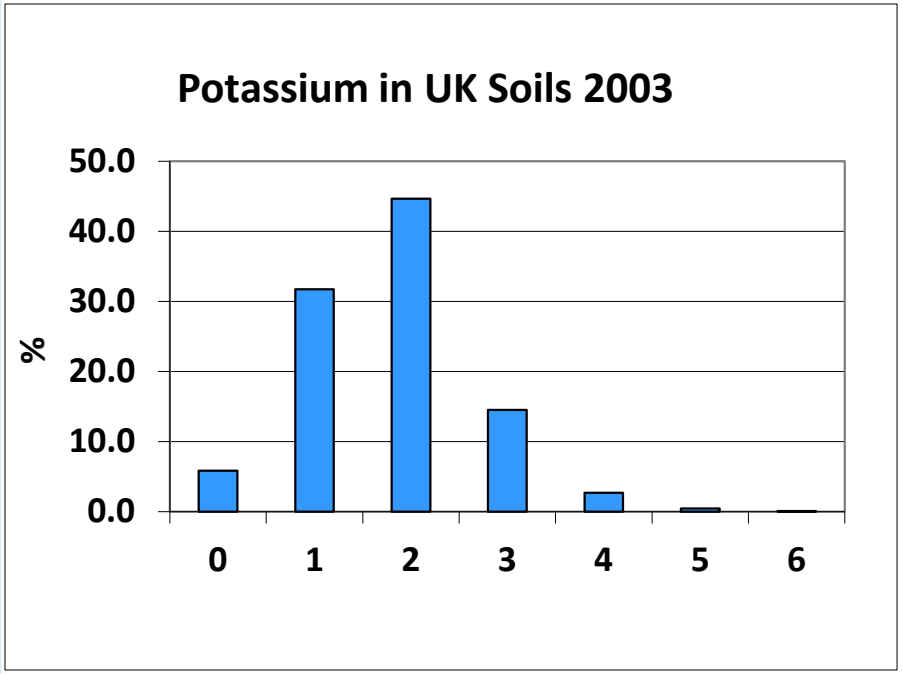
2008 Sample size = 90,000



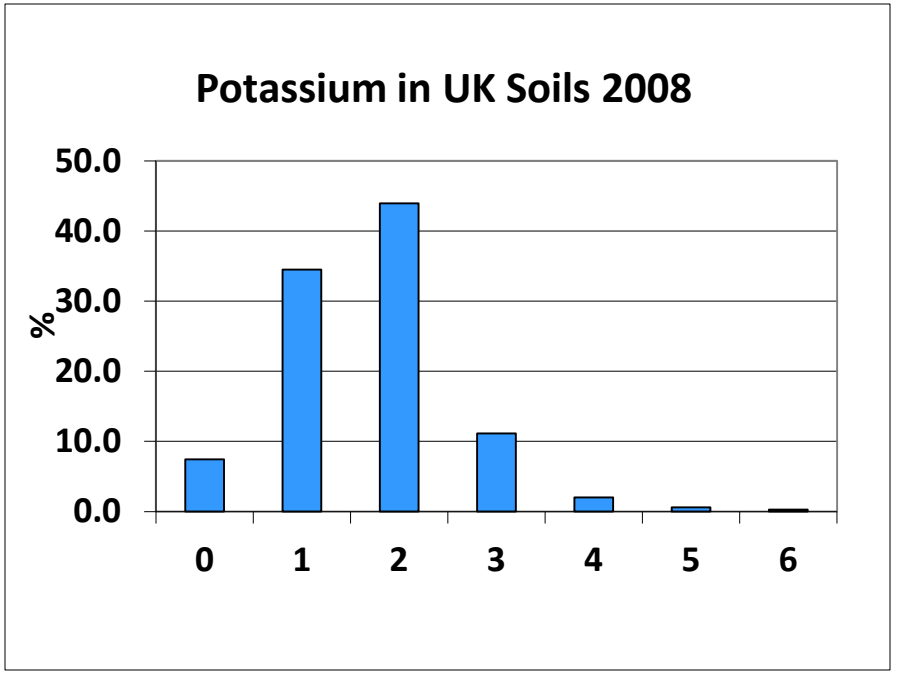
A further 18% of soils have moved into a high risk of Phosphate deficiency

Shift in soil indices

2003 Sample size = 45,000



2008 Sample size = 90,000



A further 5% of soils have moved into a high risk of Potash deficiency

P & K fertiliser applications

Table 2: Overall rates of fertiliser usage, Great Britain

			kg/ha				
			2004/05	2005/06	2006/07	2007/08	2008/09
Arable	**Total Nitrogen**		150	147	148	144	139
	Compound N	N	20	18	15	16	14
	Straight N		130	129	133	128	125
	Total Phosphate	P_2O_5	40	35	34	31	23
	Total Potash	K_2O	54	49	47	43	33

Area of arable land receiving manufactured P & K

early 1990s	**75-80%**
early 2000s	**65%**
2009	**40%**

AIC Fertiliser Stats 2010

P & K removal by crops

kg P_2O_5 / K_2O per t of fresh material

		Phosphate (P_2O_5)	Potash (K_2O)
		kg/t of fresh material	
Cereals	Grain only (all cereals)	7.8	5.6
	Grain and straw		
	- winter wheat/barley *	8.4	10.4
	- spring wheat/barley *	8.6	11.8
	- winter/spring oats *	8.8	17.3
Oilseed rape	Seed only	14.0	11.0
	Seed and straw *	15.1	17.5
Peas	Dried	8.8	10.0
	Vining	1.7	3.2
Field beans		11.0	12.0
Straw**	Winter wheat, winter barley	1.2	9.5
	Spring wheat, spring barley	1.5	12.5
	Oilseed rape	2.2	13.0
	Beans	2.5	16.0
	Peas	3.9	16.0
Potatoes		1.0	5.8
Sugar beet	Roots only	0.8	1.7
	Roots and tops	1.9	7.5

Appendix 5 - Fertiliser Manual

P & K Removal by crops

Examples		**P**	**K**
10t/ha Wheat	grain removal	78kg	56kg
	grain + straw	84kg	104kg
	straw only	**6kg**	**48kg**
5t/ha wheat straw		**6kg**	**47.5kg**
Straw nutrient value		**£5.52**	**£26.13**
(P at 0.92p/kg K at 0.55p/kg)			**£31.65**

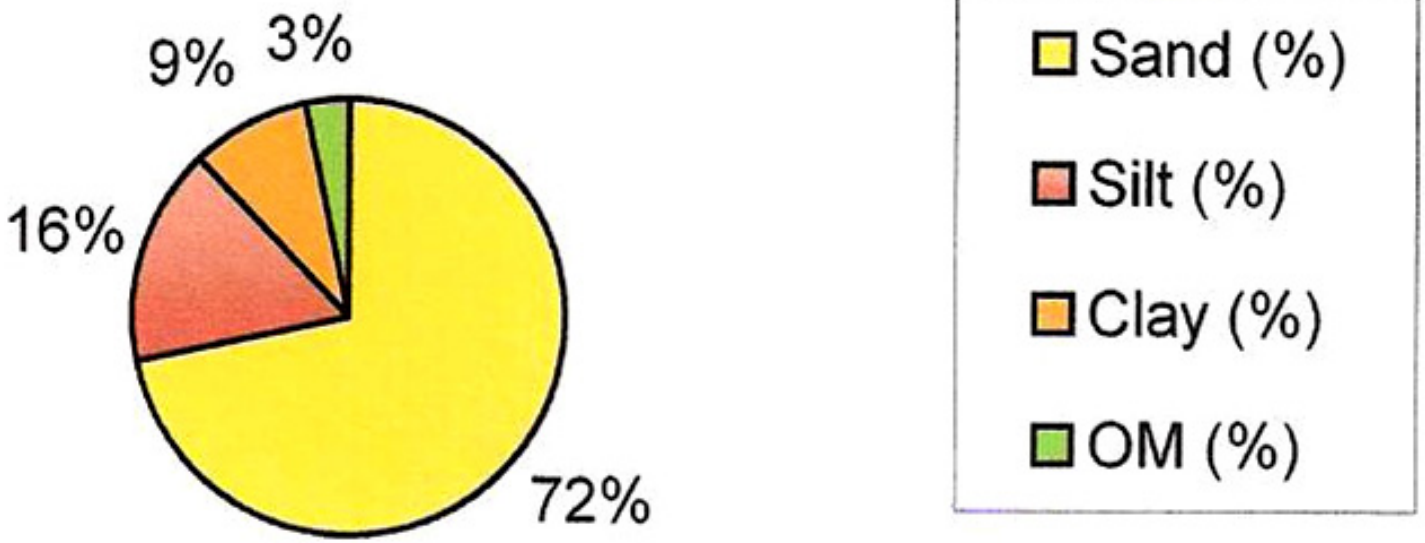
P & K Removal by crops

Example		P	K
7.5t/ha Spr Barley	grain removal	58.5kg	42kg
	grain + straw	64.5kg	88.5kg
	straw only	**6kg**	**46.5kg**
3.75t/ha Spr Barley straw		**5.6kg**	**46.9kg**
Straw nutrient value		**£5.15**	**£25.80**
(P at 0.92p/kg K at 0.55p/kg)			**£30.95**

- **Small amounts of magnesium also removed in straw (OSR)**
- **Must calculate and replace the extra nutrients removed**

Soil Organic Matter

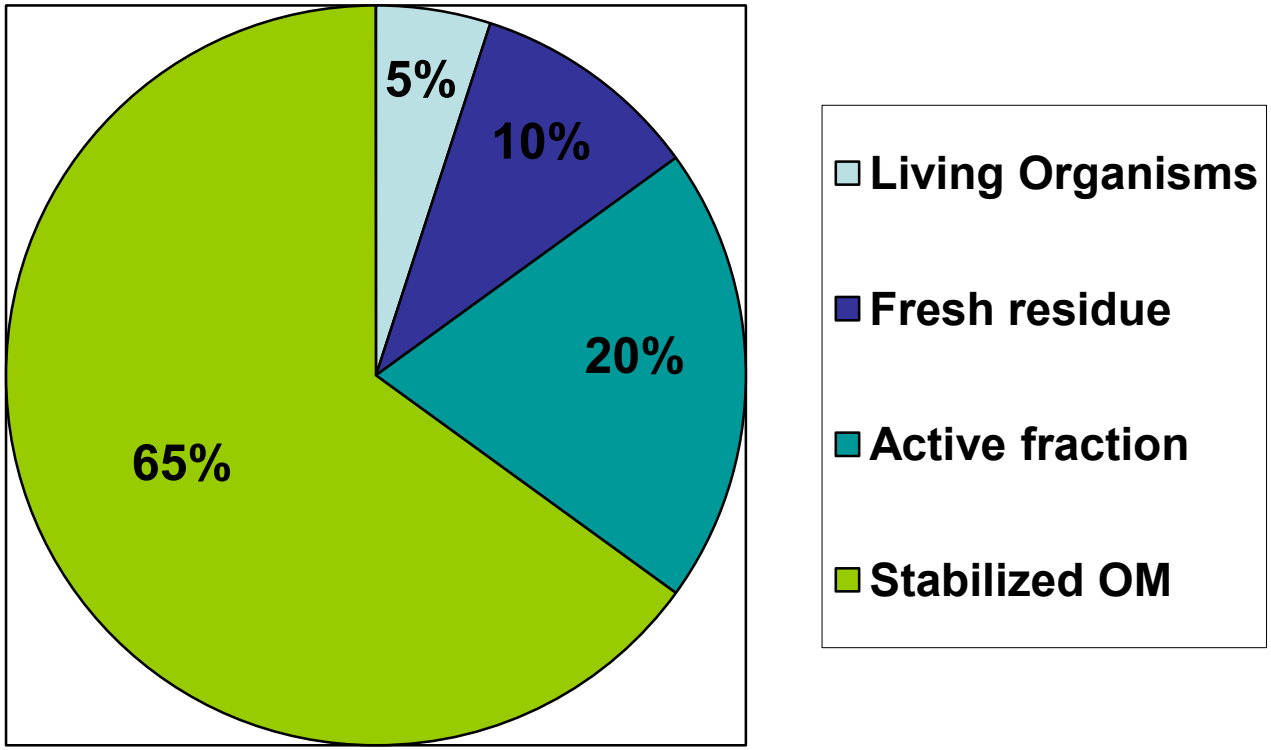
- Soil result from our Gressenhall Light Land demonstration site



Soil Organic Matter

- Has a large surface area and high cation exchange capacity
- 14 times the holding capacity of clay particles
- Important for moisture and nutrient retention
- Improves the structural integrity of soil
- Levels have been declining sharply since 1940s
- Very slow to increase soil levels
- Returning crop residues, reducing cultivations and applying organic manures and composts

Forms of Organic Matter in soil



Soil Management

- Impact of adding various organic material

Carbon : Nitrogen ratios	Soil Organic matter c. 10 : 1

Ratio	
< 10 : 1	Nitrogen released for current crop (Mineralisation)
< 20 : 1	Little effect on soil nitrogen availability
> 20 : 1	Nitrogen locked up (Immobilisation)

Typical C:N Ratios

Poultry Litter	8–10 : 1
Farm Yard Manure	10–15 : 1
Compost	10–20 : 1
Straw	60–80 : 1
Shavings/paper	400 : 1

Impact on OM levels

Soil volume to a plough depth of 20cm (8”)

2000 m^3 at density of 1.3 t/m^3 = 2600t

- 5t/ha of straw incorporated = 0.2% fresh residue
  resulting in roughly 0.02 to 0.04% stable OM
- 20t/ha of compost incorporated = 0.8% fresh residue
  resulting in roughly 0.16 to 0.24% stable OM
- An application every 5/6 years would replace the lost OM

Summary

- **Removing straw clearly affects soil & nutrient management**
- **Regularly test soils for nutrient status**
- **Accurately measure the nutrient removal**
- **Fully replace removed nutrients unless indices are above target**
- **Baseline test fields for soil organic matter status**
- **Replace the reduction in organic residues from baling the straw**
- **Account for the nutrient content of organic manures/waste**

Thank you

Straw for Biomass
Implications for soil and nutrient management

Edward Downing

Southern Fertiliser Technical Manager

Frontier Agriculture Ltd

edward.downing@frontierag.co.uk