PAAG
Professional Agricultural Analysis Group

Collation of Data from Routine UK Soil Analysis

2009/2010

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Summary

Results are reported for statistical collation of soil analytical data provided by participants in the Professional Agricultural Analysis Group. For the current year (June 1st 2009 to May 31st 2010) results for 190000-208000 samples were available (different numbers for pH, P, K and Mg).

Some participants provided data that could be broken down by arable and grass as the current crop and datasets were constructed to allow collation within this breakdown.

Conclusions should be drawn cautiously as the data were not necessarily representative of all UK fields and data collations were not statistically rigorous.

In the current year, as in 2008/09, only 29% of samples were at target Indices of 2 for P and 2- for K. 26% of samples were below target Index for P and 35% were below target Index for K. This was clear support for the need to base fertilizer use on regular soil analysis.

In the current year, 16% of samples were in Mg Indices 0 or 1 where application of magnesium might be recommended for some crops.

The percentages of samples in the different soil pH and classes and Indices were similar for arable and grass in 2009/2010 and 2008/09. This consistency between consecutive years should be expected and lends support to the validity of the findings.

There were statistically significant but weak positive correlations between pH and ammonium nitrate extractable K, between Olsen P and ammonium nitrate extractable K and between ammonium nitrate extractable K and Mg.

1. Background

The Professional Agricultural Analysis Group (PAAG) was established in 2009 to help ensure a common quality standard amongst participating laboratories and to promote the benefits of soil analysis for efficient nutrient management. One of the early actions agreed by the PAAG was the collation of their UK soil analytical data to show breakdown by pH class and by P, K and Mg Indices.

This report covers the second collation of analytical data provided by participants for the period 1st June 2009 to 31st May 2010. Identities of farms or advisers who had submitted soil samples for analysis were removed before PAAG participants sent their data to Ecopt for collation.

2. Data Provided

Data comprised results of soil analyses - Olsen for P, ammonium nitrate extraction for K and Mg and 2.5:1 water:soil for pH. The amount and breakdown of data varied among participants. Data provided by some participants derived from several tens of thousands of samples, that from others derived from a few hundred samples. Some provided data that could be broken down by arable and grass. Some provided individual sample data, others aggregated data. Where they could be identified, data from amenity grass were excluded from the collation. Datasets were constructed for current year UK data and for data broken down into grass and arable. Data from every participant were allocated to the various datasets to the greatest extent possible. Consequently, sample record numbers vary among datasets and the sums of grass and arable sample records do not equal the UK total.

3. Dataset Classes

For every dataset, numbers of sample records in different pH classes and soil Indices (Table 1) were counted and expressed as percentages of the total number of samples in that dataset.

Table 1 Classes used for the collation

pH	P Index	K Index	Mg Index
<5.00	0	0	0
5.00-5.49	1	1	1
5.50-5.99	2	2-	2
6.00-6.49	3	2+	3
6.50-6.99	4	3	4
7.00-7.49	5	4	5
7.50-7.99	>5	5	6
>7.99		>5	>6

Only data that could be allocated to these classes (and to the June 1st to May 31st year) were used in the analyses.

4. Interpretation of the Data

Particular care is needed when drawing conclusions from the data. Firstly, soil samples submitted to laboratories are not randomly selected from the total population of fields. Technically aware farmers probably are more likely to use soil analysis in decision-making and their soils may be maintained at higher levels of available nutrients than are present in the population mean. Secondly, amounts and sources of data differed between the various datasets used. Several laboratories contributed to the collation of total samples for the UK. Fewer provided data for grass and arable soils separately. The collation of the data therefore was not statistically rigorous. Nevertheless, broad trends can be identified and some conclusions drawn.

5. Collation of Data

5.1 Datasets

The current year was June 1st 2009 to May 31st 2010. Data sets were established for:

UK data across all crops and grass
UK data for arable samples
UK data for grass samples

5.2 UK Data Across All Crops and Grass

Results of 202920 (pH), 208427 (P), 201872 (K) 190482 (Mg) samples were available for the current year.

Mean soil pH was 6.58, 28% of samples were below 6.00 and 37% were between 6.00 and 7.00.

Only 29% of samples were at target soil P and K Indices (2 and 2- respectively). Soil P was lower than target Index in 26% of samples and soil K was lower than target in 35% of samples. Soil Mg Index was lower than 2 in 16% of samples (Table 2, Fig 1).

Table 2 Soil pH and Indices - all samples

	Percentage of samples in class:							
Soil pH	**<5.0**	**5.00-5.49**	**5.50-5.99**	**6.00-6.49**	**6.50-6.99**	**7.00-7.49**	**7.50-7.99**	**>8.0**
All samples	1	8	19	20	17	13	14	7

	Percentage of samples in Index:						
P Index	**0**	**1**	**2**	**3**	**4**	**5**	**>5**
All samples	8	18	29	29	11	3	2

	Percentage of samples in Index:							
K Index	**0**	**1**	**2-**	**2+**	**3**	**4**	**5**	**>5**
All samples	6	29	29	17	15	3	1	0

	Percentage of samples in Index:							
Mg Index	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**>6**
All samples	1	15	32	26	12	7	5	1

Fig 1a Distribution of soil pH values
(All samples)

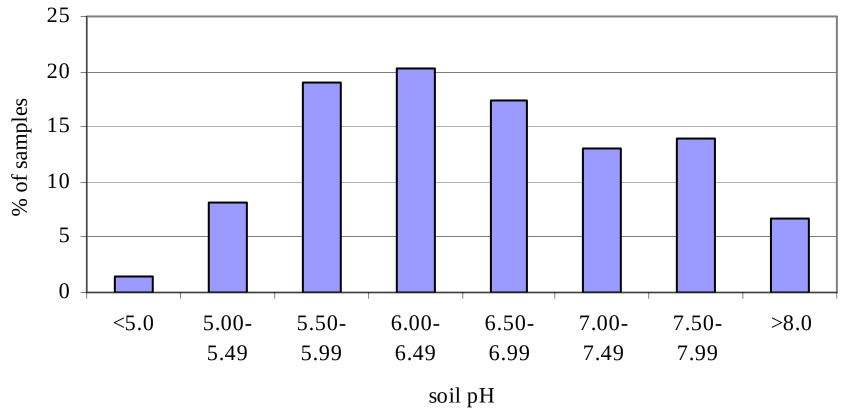


Fig 1b Distribution of soil P Index values
(All samples)

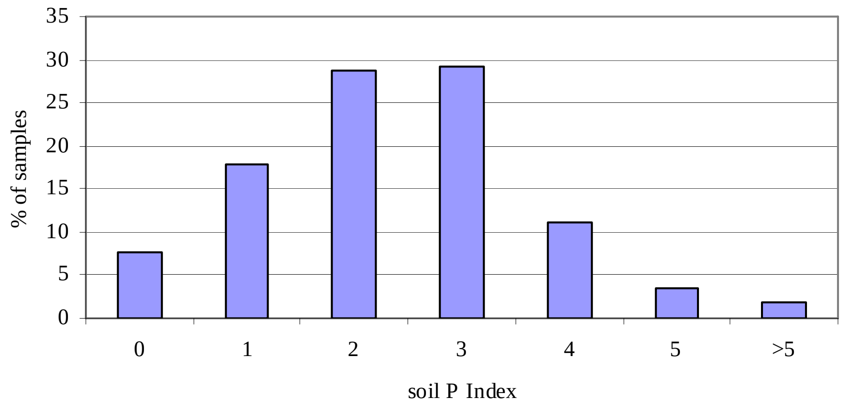


Fig 1c Distribution of soil K Index values
(All samples)

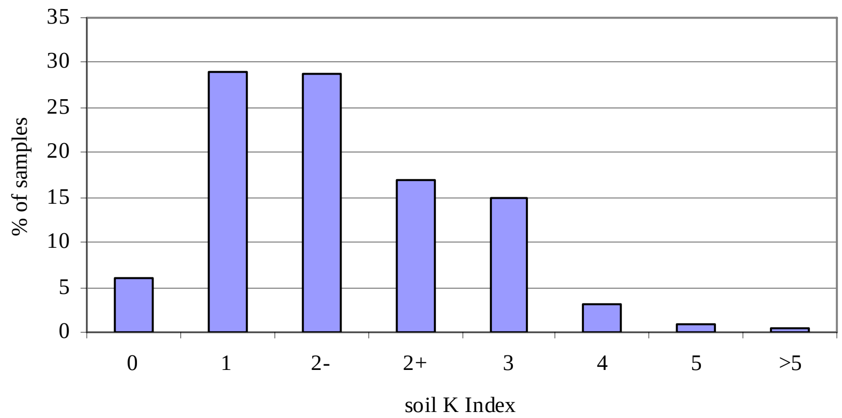
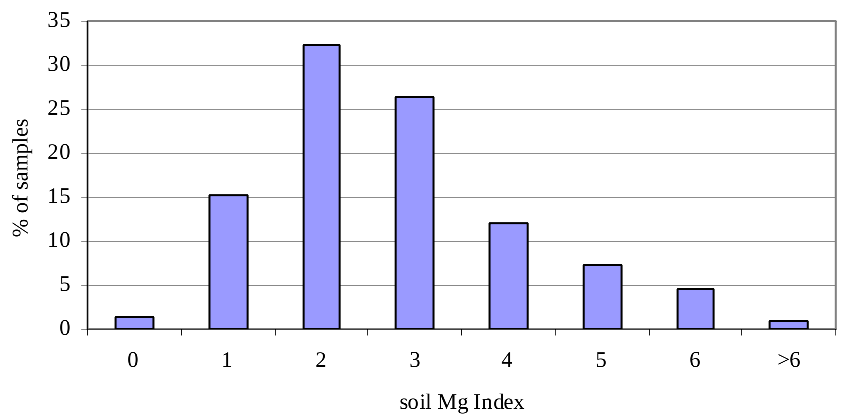


Fig 1d Distribution of soil Mg Index values
(All samples)



Two laboratories provided large amounts of data for individual samples in both 2008/09 and 2009/10 and these were used to calculate correlation coefficients between pairs of measured variables (Table 3). For P, K and Mg, data as mg/l were used. Owing to the large numbers of samples, all of the coefficients shown in Table 3, except that between P and Mg in laboratory B data for 2008/09, were statistically significant (P<0.01). None of the correlations was strong but there was reasonable consistency between laboratories and between years.

Table 3 Correlation coefficients for soil variables

	2008/09		**2009/10**	
	Laboratory A	**Laboratory B**	**Laboratory A**	**Laboratory B**
Number of samples	45462	56858	110415	64564
		Correlation coefficient		
pH and P	-0.026	-0.012	0.020	0.037
pH and K	0.185	0.276	0.209	0.286
pH and Mg	-0.203	0.022	-0.147	0.028
P and K	0.371	0.290	0.404	0.300
P and Mg	0.012	0.005	0.013	0.083
K and Mg	0.284	0.177	0.251	0.269

5.3 <u>UK Data by Arable and Grass</u>

Some participants provided data where the past crop could be identified as arable or agricultural grass. These data (30055 samples for arable and 18468 for grass) are summarised in Table 4 and Fig 2.

Soil pH tended to be higher in arable than in grass and there was an indication of a double population in arable samples with peaks at 6.0-7.0 and at 7.5-8.0. This could be due to samples from calcareous soils that probably were predominantly arable. Mean pH for arable was 6.94 and for grass 5.99.

The distribution of soil P values was similar for arable and grass with mean values of 32 mg/l (Index 3) for arable and 27 mg/l (Index 3) for grass. Distribution of values was slightly skewed for grass with a median value of 23 mg/l (Index 2). Median was 27 mg/l for arable. Only around 30% of arable and grass samples were at target Index 2 with 17% (arable) and 28% (grass) in Indices 0 or 1.

Soil K values also were somewhat similar with means of 180 mg/l (Index 2-) for arable and 157 mg/l (Index 2-) for grass. Distributions were skewed with median values of 156 mg/l (Index 2-) for arable and 130 mg/l (Index 2-) for grass. Only 33% of arable and 26% of grass samples were at target Index 2- and 29% (arable) and 45% (grass) were in Indices 0 or 1.

There was a more noticeable difference between arable and grass in soil Mg. Mean value was lower for arable (111 mg/l, Index 3) than for grass (151 mg/l, Index 3). Distributions were strongly skewed with median values of 77 mg/l (Index 2) for arable and 123 mg/l (Index 3) for grass. Only 4% of grass, but 26% of arable, samples were in Indices 0 or 1.

Table 4 Soil pH and Indices by arable and grass

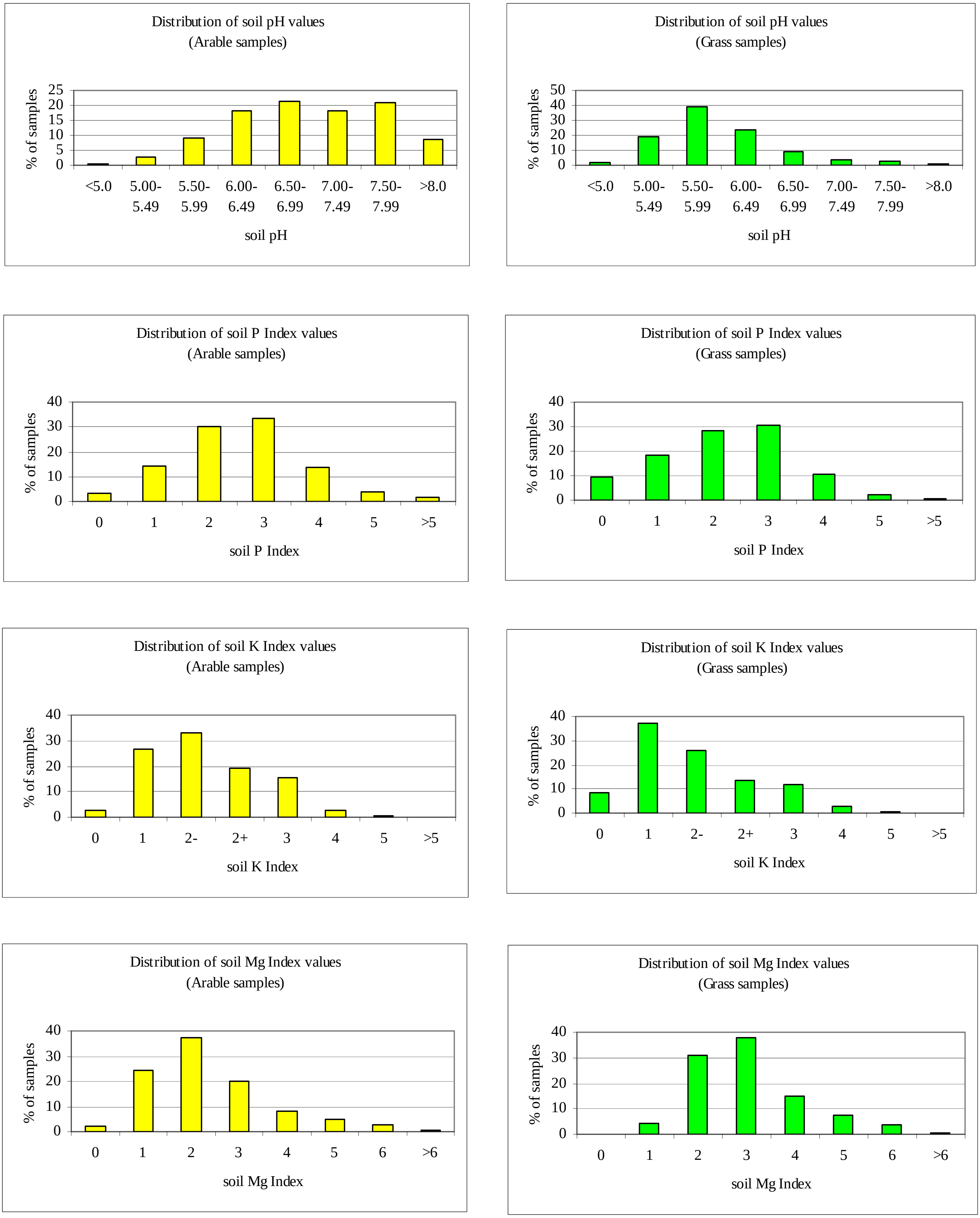
				Percentage of samples in class:				
Soil pH	**<5.0**	**5.00-5.49**	**5.50-5.99**	**6.00-6.49**	**6.50-6.99**	**7.00-7.49**	**7.50-7.99**	**>8.0**
Arable	1	3	9	18	22	18	21	9
Grass	2	19	39	24	9	4	3	1

				Percentage of samples in Index:			
P Index	**0**	**1**	**2**	**3**	**4**	**5**	**>5**
Arable	3	14	30	34	14	4	2
Grass	9	19	29	31	10	2	0

				Percentage of samples in Index:				
K Index	**0**	**1**	**2-**	**2+**	**3**	**4**	**5**	**>5**
Arable	3	26	33	19	15	3	1	0
Grass	8	37	26	14	12	3	0	0

				Percentage of samples in Index:				
Mg Index	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**>6**
Arable	2	24	37	20	8	5	3	0
Grass	0	4	31	38	15	8	3	1

Fig 2 Distributions by arable and grass



5.4 P x K Index Matrices

Matrices were constructed showing percentages of samples falling into different P and K Indices. This was done separately for samples for which the previous crop could be identified as arable and for those where the previous crop was grass. A summary of results is shown in Table 5 and full results are in Appendix 1. The percentages shown do not total 100 exactly due to rounding.

In arable samples, high (above target 2) P Index tended to be associated with high (above target 2-) K Index. In grass samples, there were relatively large percentages in high/high and low/low P and K Index categories.

Table 5 Percentages of samples in P and K Indices
(total 30055 arable and 18468 grass samples)

			P Index	
	K Index	**Low**	**Target**	**High**
Arable	**Low**	8	10	11
	Target	6	11	17
	High	3	9	23
Grass	**Low**	18	14	13
	Target	7	8	11
	High	4	6	18

Appendix 1

Percentages of Samples in P x K Indices

K Index	P Index 0	1	2	3	4	5	>5
Arable							
0	0	1	1	1	0	0	0
1	1	6	9	8	2	0	0
2-	1	5	11	12	4	1	0
2+	0	2	5	7	3	1	0
3	0	1	4	5	3	1	1
4	0	0	0	1	1	0	0
5	0	0	0	0	0	0	0
>5	0	0	0	0	0	0	0
Grass							
0	2	2	2	2	0	0	0
1	5	9	12	9	2	0	0
2-	2	5	8	9	2	0	0
2+	1	2	4	5	2	0	0
3	0	1	2	5	3	1	0
4	0	0	0	1	1	0	0
5	0	0	0	0	0	0	0
>5	0	0	0	0	0	0	0