PAAG
Professional Agricultural Analysis Group

Collation of UK Data from Routine Soil Analysis

2010/11

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New members are welcome to join.
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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 2010 to May 31st 2011) results for 178000-185000 samples were available (different numbers for pH, P, K and Mg).

The report for 2008/2009 included a regional breakdown for soil pH, P, K and Mg Indices. This breakdown is not included in the current 2009/2010 report as significant differences were not expected over a two year period.

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.

Mean soil pH decreased in arable samples in 2010/2011 but not in grass samples. Soil pH was <6.0 in 29% of arable samples (12% in 2009/10) and <5.5 in 21% of grass samples (20% in 2009/10). This supports the need for regular soil analysis to maintain pH.

As in previous years, only 28-29% of all samples were at target Indices of 2 for P and 2- for K. 28% of samples were below target Index for P and 36% were below target Index for K. Just 10% of samples were at target Indices for both P and K. This was clear support for the need to base fertilizer use on regular soil analysis.

In the current year, 12% of samples were in Mg Indices 0 or 1 where application of magnesium might be recommended for some crops. This was a decrease from 16% in 2009/2010.

There were statistically significant but weak positive correlations between Olsen P and ammonium nitrate extractable K. Soils with high P Index tended also to have a high K Index.

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 third collation of analytical data provided by participants for the period 1st June 2010 to 31st May 2011. 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, those 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 2010 to May 31st 2011. 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 for 178265 (pH), 184743 (P), 178012 (K) 184654 (Mg) samples were available for the current year.

Mean soil pH was 6.32, 33% of samples were below 6.00 and 39% were between 6.00 and 7.00.

Only 28-29% of samples were at target soil P and K Indices (2 and 2- respectively). Soil P was lower than target Index in 28% of samples and soil K was lower than target in 36% of samples. Soil Mg Index was lower than 2 in 12% 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	10	22	22	17	11	10	6

	Percentage of samples in Index:						
P Index	**0**	**1**	**2**	**3**	**4**	**5**	**>5**
All samples	8	20	28	28	11	3	2

	Percentage of samples in Index:							
K Index	**0**	**1**	**2-**	**2+**	**3**	**4**	**5**	**>5**
All samples	6	30	29	17	14	3	1	0

	Percentage of samples in Index:							
Mg Index	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**>6**
All samples	1	11	31	29	13	8	6	1

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

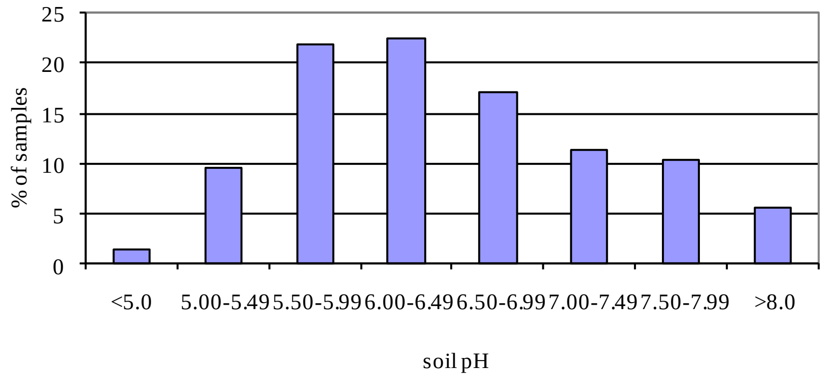


Fig 1b Distribution of soil P Index values
(All samples)

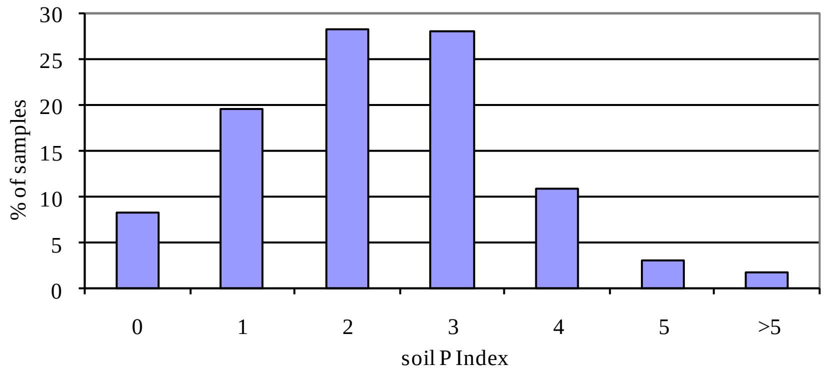
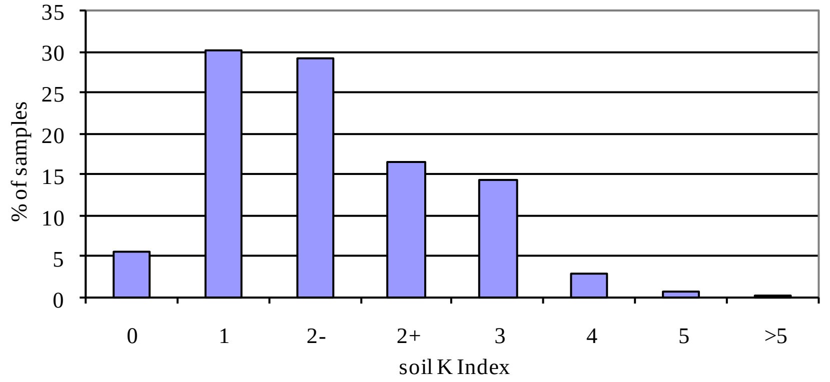
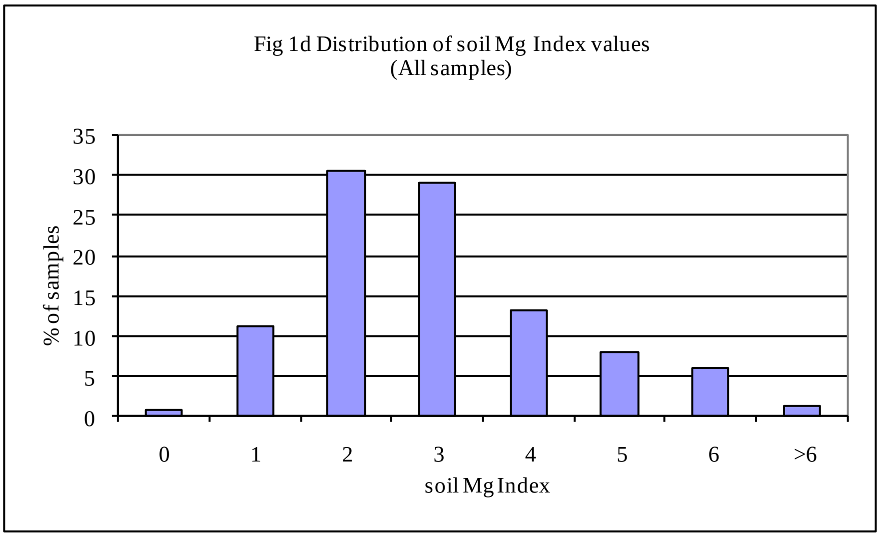


Fig 1c Distribution of soil K Index values
(All samples)





Two laboratories provided large amounts of data for individual samples in both 2008/09 and 2009/10 (>45000 samples each) and three laboratories in 2009/2010 (>45000 samples for A and B, >4500 samples for C). 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 consistently a positive correlation between Olsen-P and ammonium nitrate-extractable K.

Table 3 Correlation coefficients for soil variables

	2008/09		**2009/10**		**2010/11**		
Laboratory:	**A**	**B**	**A**	**B**	**A**	**B**	**C**
pH and P	-0.026	-0.012	0.020	0.037	0.086	-0.043	0.074
pH and K	0.185	0.276	0.209	0.286	0.071	0.207	-0.011
pH and Mg	-0.203	0.022	-0.147	0.028	-0.308	-0.021	-0.410
P and K	0.371	0.290	0.404	0.300	0.289	0.251	0.571
P and Mg	0.012	0.005	0.013	0.083	-0.014	-0.043	-0.019
K and Mg	0.284	0.177	0.251	0.269	0.078	0.207	0.548

5.3 UK Data by Arable and Grass

Some participants provided data where the past crop could be identified as arable or agricultural grass. These data (32000-38000 samples for arable and 19000 for grass) are summarised in Table 4 and Fig 2.

Soil pH tended to be higher in arable than in grass and, as in previous years, 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 6.73 and for grass 5.87.

The distribution of soil P values was similar for arable and grass with mean values of 30 mg/l (Index 3) for arable and 26 mg/l (Index 3) for grass. Distribution of values was slightly skewed with median values of 25 mg/l for arable and 22 mg/l (both Index 2) for grass. Only 29% of arable and grass samples were at target Index 2 with 18% (arable) and 32% (grass) in Indices 0 or 1.

Soil K values also were somewhat similar with means of 178 mg/l (Index 2-) for arable and 168 mg/l (Index 2-) for grass. Distributions were skewed with median values of 151 mg/l (Index 2-) for arable and 139 mg/l (Index 2-) for grass. Only 30% of arable and 26% of grass samples were at target Index 2- and 32% (arable) and 40% (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 (120 mg/l, Index 3) than for grass (166 mg/l, Index 3). Distributions were strongly skewed with median values of 89 mg/l (Index 2) for arable and 130 mg/l (Index 3) for grass. Only 4% of grass, but 20% of arable, samples were in Indices 0 or 1.

Table 4 Soil pH and Indices by Arable and Grass

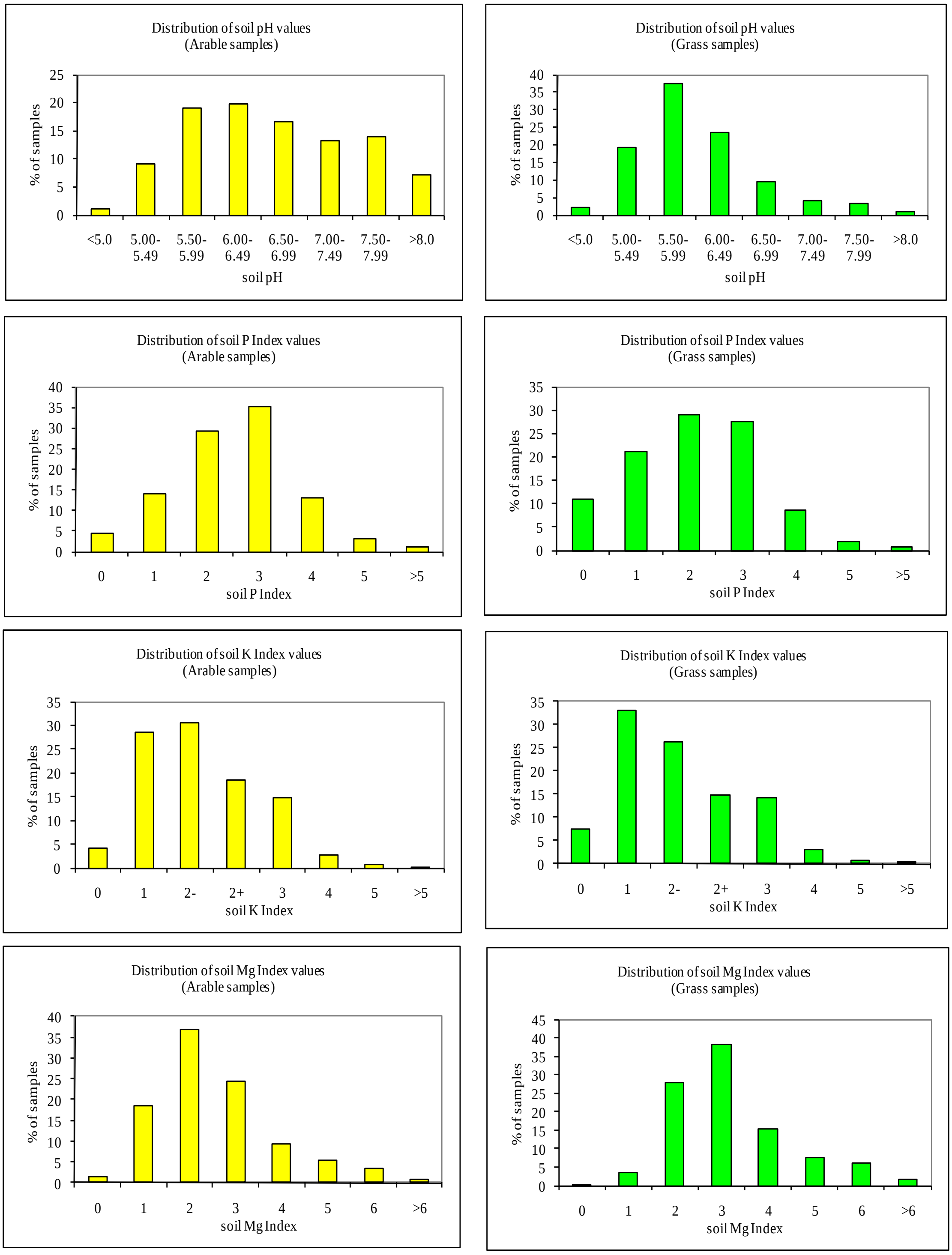
				Percentage of samples in class:				
Soil pH	**<5.0**	**5.00-5.49**	**5.50-5.99**	**6.00-6.49**	**6.50-6.99**	**7.00-7.49**	**7.50-7.99**	**>8.0**
Arable	1	9	19	20	17	13	14	7
Grass	2	19	38	24	9	4	3	1

				Percentage of samples in Index:			
P Index	**0**	**1**	**2**	**3**	**4**	**5**	**>5**
Arable	4	14	29	35	13	3	1
Grass	11	21	29	28	9	2	1

				Percentage of samples in Index:				
K Index	**0**	**1**	**2-**	**2+**	**3**	**4**	**5**	**>5**
Arable	4	28	30	18	15	3	1	0
Grass	7	33	26	15	14	3	1	0

				Percentage of samples in Index:				
Mg Index	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**>6**
Arable	1	19	37	24	9	5	3	0
Grass	0	4	28	38	15	8	6	2

Fig 2 Distributions by arable and grass



5.4 P x K Index Matrices

A matrix was constructed showing percentages of samples falling into different P and K Indices. A summary of results is shown in Table 5 and full results are in Appendix 1.

Only 10% of samples were at target Indices for both P and K.

Table 5 Percentages of samples in P and K Indices
(total 54705 samples)

	P Index		
K Index	**Low**	**Target**	**High**
Low	13	11	11
Target	6	10	14
High	4	9	22

Appendix 1

Percentages of Samples in P x K Indices

K Index	P Index 0	1	2	3	4	>4
0	1	1	1	1	0	0
1	3	7	9	8	2	0
2-	1	5	10	10	3	1
2+	0	2	5	7	3	1
3	0	1	3	6	3	1
4	0	0	0	1	1	1
>4	0	0	0	0	0	0

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