PAAG

Professional Agricultural Analysis Group

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Collation of data from routine soil analysis in the UK

2013/2014

TRIED & TESTED

Professional Agricultural Analysis Group

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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 2013 to May 31st 2014) results for around 200,000 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.

Soil pH was <6.0 in 20% of arable samples (19% in 2012/13) and <5.5 in 21% of grass samples (19% in 2012/13). This supports the need for regular soil analysis to maintain pH.

As in previous years, only around 30% of all samples were at target Index of 2 for P and 30% were at target Index of 2- for K. Just 10% of arable samples and 9% of grass samples were at target Indices for both P and K. Some 90% of samples indicated the need for adjustment of P or K Index giving clear support for the need to base fertilizer use on regular soil analysis.

In the current year 16% of arable samples and 3% of grass samples were in Mg Indices 0 or 1 where application of magnesium might be recommended for some crops. These percentages were unchanged from those in 2012/13.

As in previous years, there were statistically significant but weak positive correlations between Olsen P and ammonium nitrate extractable K and between extractable K and extractable Mg. 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 collation of analytical data provided by participants for the period 1st June 2013 to 31st May 2014.

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. Datasets were constructed for current year UK data and for data broken down into grass and arable where this was possible. Where they could be identified, data from Christmas trees, top fruit, coppice and forage maize after grass were excluded from the arable dataset. Data for amenity grass of all kinds were excluded from the grassland dataset. 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 identifiable grass and arable sample records do not equal the total number for all samples.

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, either directly or from concentrations in mg/l, 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 2013 to May 31st 2014. 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 197181 (pH), 204690 (P), 196873 (K) and 204631 (Mg) samples were available for the current year.

Mean soil pH was 6.59, 31% of samples were below 6.00 and 38% were between 6.00 and 7.00.

Only 29% of samples were at target soil P or K Index (2 and 2- respectively). Soil P was lower than target Index in 29% of samples and soil K was lower than target in 34% 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	9	21	21	17	12	13	6

			Percentage of samples in Index:				
P Index	**0**	**1**	**2**	**3**	**4**	**5**	**>5**
All samples	9	20	29	28	10	3	1

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

			Percentage of samples in Index:					
Mg Index	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**>6**
All samples	0	12	33	30	12	6	4	1

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

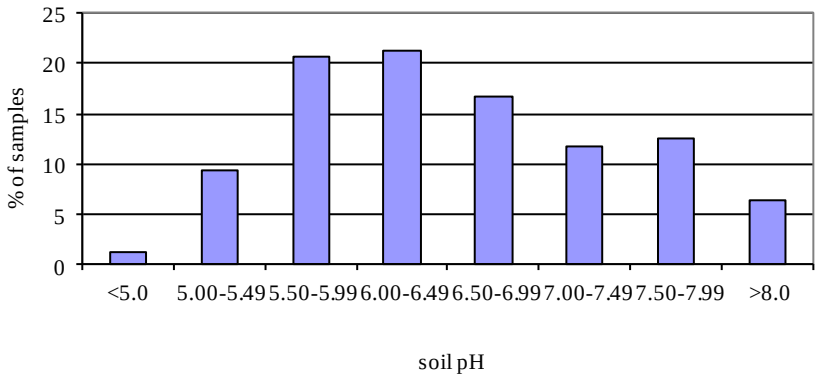


Fig 1b Distribution of soil P Index values
(All samples)

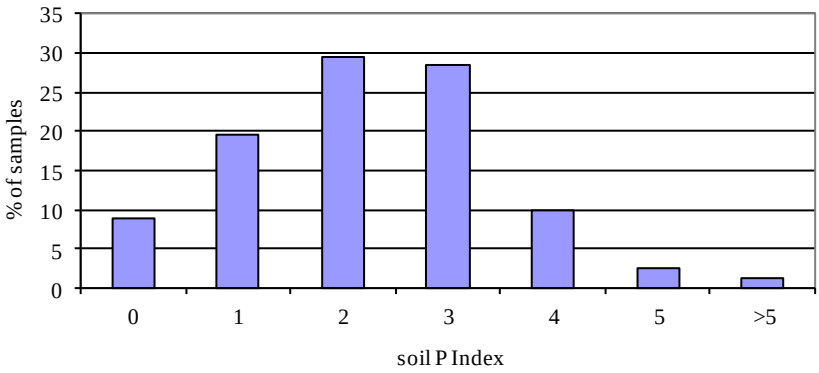
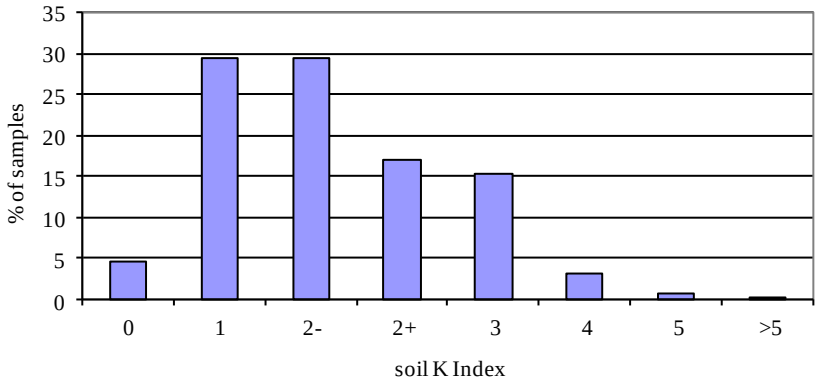
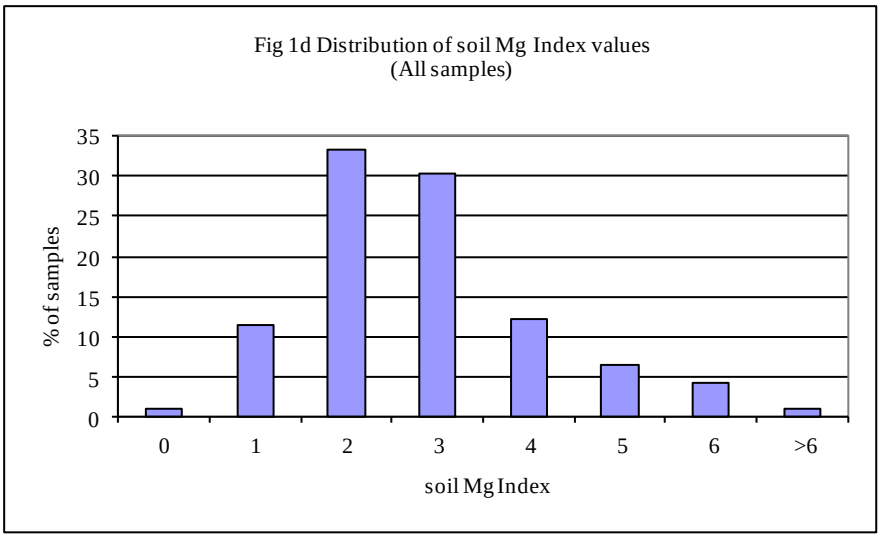


Fig 1c Distribution of soil K Index values
(All samples)





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 (around 135000 samples for arable and 60000 for grass) are summarised in Table 3 and Fig 2.

Soil pH tended to be higher in arable than in grass samples 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 6.80 and for grass 5.84.

The distribution of soil P values was similar for arable and grass with mean values of 29 mg/l (Index 3) for arable and 24 mg/l (Index 2) for grass. Only 29-31% of arable and grass samples were at target Index 2 with 26% (arable) and 35% (grass) in Indices 0 or 1.

Soil K values also were somewhat similar with means of 182 mg/l (just Index 2+) for arable and 165 mg/l (Index 2-) for grass. Only 31% of arable and 27% of grass samples were at target Index 2- and 31% (arable) and 41% (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 (130 mg/l, Index 3) than for grass (169 mg/l, Index 3). Distributions were strongly skewed with median values of 96 mg/l (Index 2) for arable and 135 mg/l (Index 3) for grass. Only 3% of grass, but 16% of arable, samples were in Mg Indices 0 or 1.

Table 3 Soil pH and Indices by arable and grass

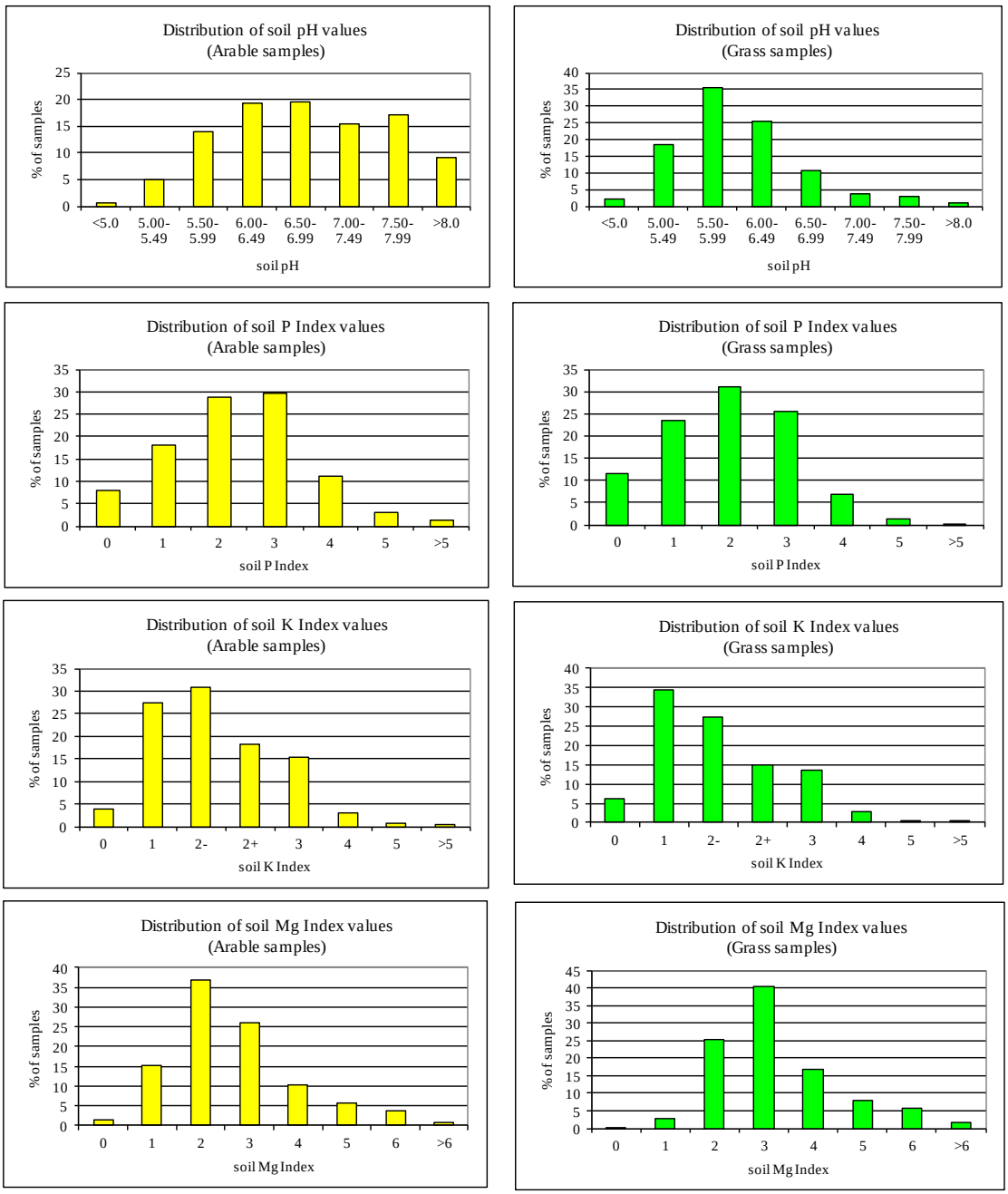
	Percentage of samples in class:							
Soil pH	**<5.0**	**5.00-5.49**	**5.50-5.99**	**6.00-6.49**	**6.50-6.99**	**7.00-7.49**	**7.50-7.99**	**>8.0**
Arable	1	5	14	19	20	15	17	9
Grass	2	19	36	26	11	4	3	1

	Percentage of samples in Index:						
P Index	**0**	**1**	**2**	**3**	**4**	**5**	**>5**
Arable	8	18	29	30	11	3	1
Grass	11	24	31	26	7	1	0

	Percentage of samples in Index:							
K Index	**0**	**1**	**2-**	**2+**	**3**	**4**	**5**	**>5**
Arable	4	27	31	18	15	3	1	0
Grass	6	35	27	15	14	3	1	0

	Percentage of samples in Index:							
Mg Index	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**>6**
Arable	1	15	37	26	10	6	4	1
Grass	0	3	25	40	17	8	6	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 for arable and, separately, for grass samples. A summary of results is shown in Tables 4 and 5 and full results are in Appendix 1.

Only 9-10% of arable and grass samples were at target Indices for both P and K.

Table 4 Percentages of samples in P and K Indices
(total 129806 samples)

	P Index		
K Index	<target	target	>target
<target	12	9	10
target	8	10	13
>target	7	11	20

Table 5 Percentages of grass samples in P and K Indices
(total 59448 samples)

	P Index		
K Index	<target	target	>target
<target	19	13	9
target	10	9	9
>target	7	10	15

5.5 Correlations among soil variables

In previous reports, correlations among soil variables were shown for all samples. In this report, correlations are shown separately for arable and grass samples.

For P, K and Mg, data as mg/l were used and datasets for arable and for grass were constructed for samples where all of these variables and pH were measured.

Owing to the large numbers of samples, nearly all of the coefficients shown in Table 6 were statistically significant ($P<0.05$). None of the correlations was strong but there were positive correlations between Olsen-P and ammonium nitrate-extractable K and a between ammonium nitrate-extractable K and ammonium nitrate-extractable Mg.

Tables 6 Correlation coefficients among variables

	Arable samples (129806 samples)	Grass samples (59448 samples)
pH and P	-0.001	0.092
pH and K	0.183	0.239
pH and Mg	-0.087	0.084
P and K	0.328	0.317
P and Mg	-0.040	-0.002
K and Mg	0.203	0.339

Appendix 1 Percentages of samples in P x K Indices

Arable samples

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

Grass samples

K Index	P Index					
	0	**1**	**2**	**3**	**4**	**4+**
0	2	2	2	1	0	0
1	5	10	11	7	1	0
2-	3	7	9	7	2	0
2+	1	3	5	5	1	0
3	1	2	4	5	2	0
4	0	0	1	1	1	0
4+	0	0	0	0	0	0

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