

Major and Micro Nutrient Advice "Green Book" New Developments

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Early Soil Fertility Advice

– An Foras Talúntais

1963: Technical Bulletin

1986: Soil Analysis & Fertiliser Recommendations

Table 1. Source and number of soil and plant samples analysed at Johnstown Castle in 1986

Table 6. Recommended (Conway, 1986) fertilizer application rates assuming soil P and K values at Index 1 (1-3 and 1-50 ppm respectively).

| Nutrient | Pasture | Suggested Fertilizer Rates (kg/ha) | | |
|----------|-------------|------------------------------------|----------|------------|
| | | Winter Wheat* | Potatoes | Sugar Beet |
| N | See table 5 | 185 | 220 | 160 |
| P | 40 | 35 | 150 | 80 |
| K | 75 | 75 | 290 | 315 |

*Grown 3-6 years after good pasture, straw removed

... samples taken at present would



Next generation of Soil Fertility Advice

–Teagasc, Johnstown Castle

Table 8. N application rates for pasture grazed by standard dairy merit cows or cattle

| Rank | Whole Farm Stocking Rate LU/ha | N Fertiliser Advice (kg/ha) | |
|------|--------------------------------|------------------------------------|-------------------------------------|
| | | Pasture 3 years or older No Clover | Pasture Less than 3 years No Clover |
| 1 | Less than 1.2 | 45 | 45 |
| 2 | 1.2-1.5 | 60 | 75 |
| 3 | 1.8 | 80 | 100 |
| 4 | 2.1 | 100 | 125 |
| 5 | 2.4 | 225 | 280 |
| 6 | 2.8 | 320 | 390 |
| 7 | 3.0 | 390 | 400 |



Arrival of Environmental Legislation

Soil Fertility Advice under EU Nitrates Directive

Since 2006 constrained
nutrient use on farms

Coulter & Lalor 2008



Nutrient Management Advice – New Developments

“Green Book 2017”

Large team of people involved!

Approach to developing new Nutrient Advice

- Review the latest soil and fertiliser research
 - New fertiliser types
 - Soil type influence on nutrient cycling
 - Modern grassland and crop nutrient demand
 - Nutrient requirements for livestock systems
- Review of on-farm sustainability research
 - Most sustainable approaches to nutrient mgt.
 - Low emission nutrient application methods
 - Soil type specific nutrient advice
 - Agronomic and environmentally optimum nutrient advice
- Review of current environmental legislation



Nutrient Management Advice – New Developments

Green Book, 4th Edition Summary of Changes

Soil Types and Nutrient Cycling: Information on the major soil types in Ireland and their influence on nutrient cycling and management

Fertiliser Ingredients: Definitions and information on the main fertiliser ingredients available in Ireland

Soil Acidity and Liming: Improved information on soil pH and new information on lime and lime products has been included

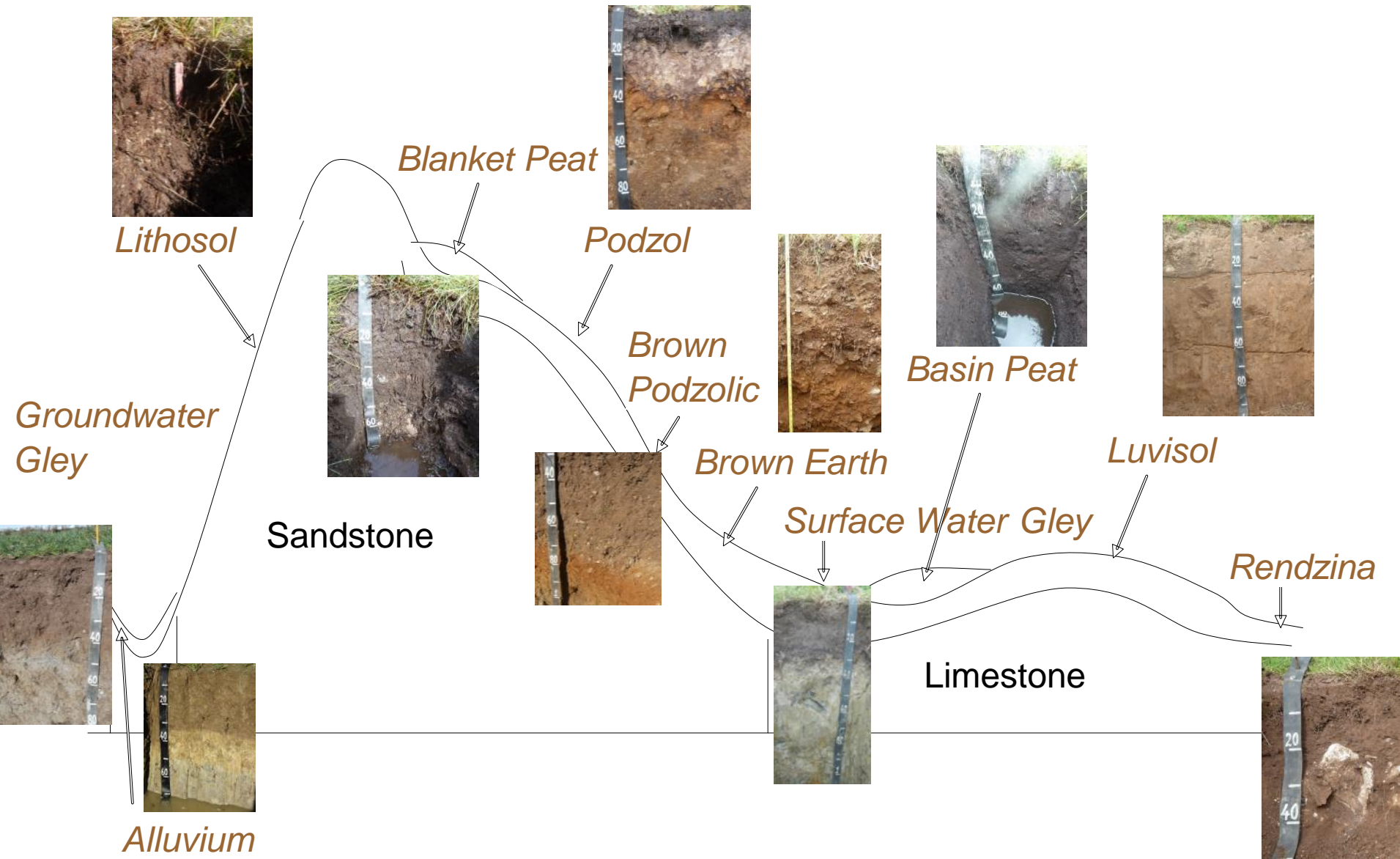
Nutrients in Organic Manures: Updated fertiliser replacement values for slurries and new information on organic manure and biosolid types.

Grassland: New N advice for beef and sheep systems and suggested application timings for fertilisers.

Information on soil test P response to fertiliser P inputs as influenced by varying soil parameters



Understanding Soils and Landscapes



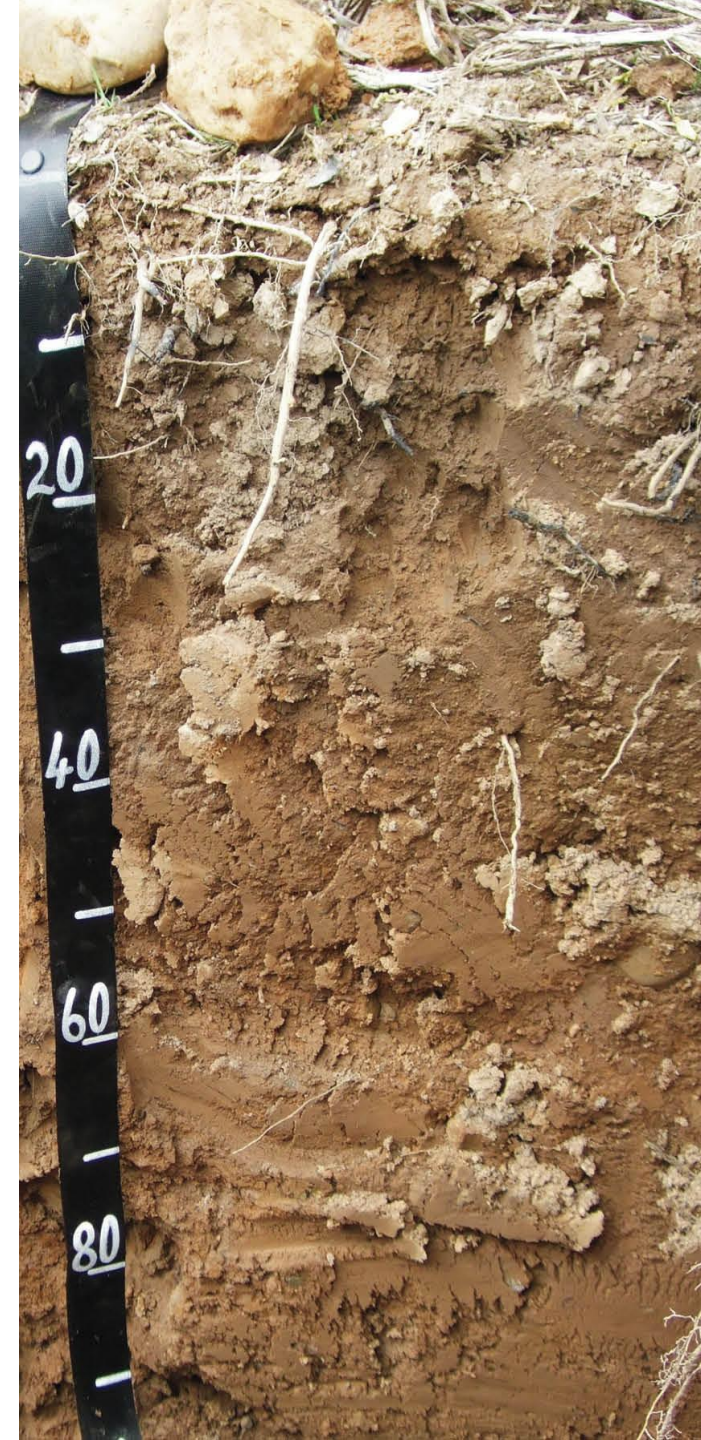
Ombrotrophic Peat soils are rain-fed soils found in lowland (raised bog) and upland (blanket bog) positions. They are rich in organic matter. The depth of the organic top horizon (O) is more than 40 cm.





Surface Water Gleys are soils that are poorly drained due to a slowly permeable subsurface layer. This layer slows down the movement of water through the soil to such an extent that the water backs up and causes waterlogging of the top 40 cm for prolonged periods of the year. This is typically caused by either a higher clay content, or very dense material in the subsoil. Surface water gleys differ from groundwater gleys, as the gleying is due to the slow movement of water down the soil profile, rather than the presence of a high water table (see February for details of Groundwater gleys).



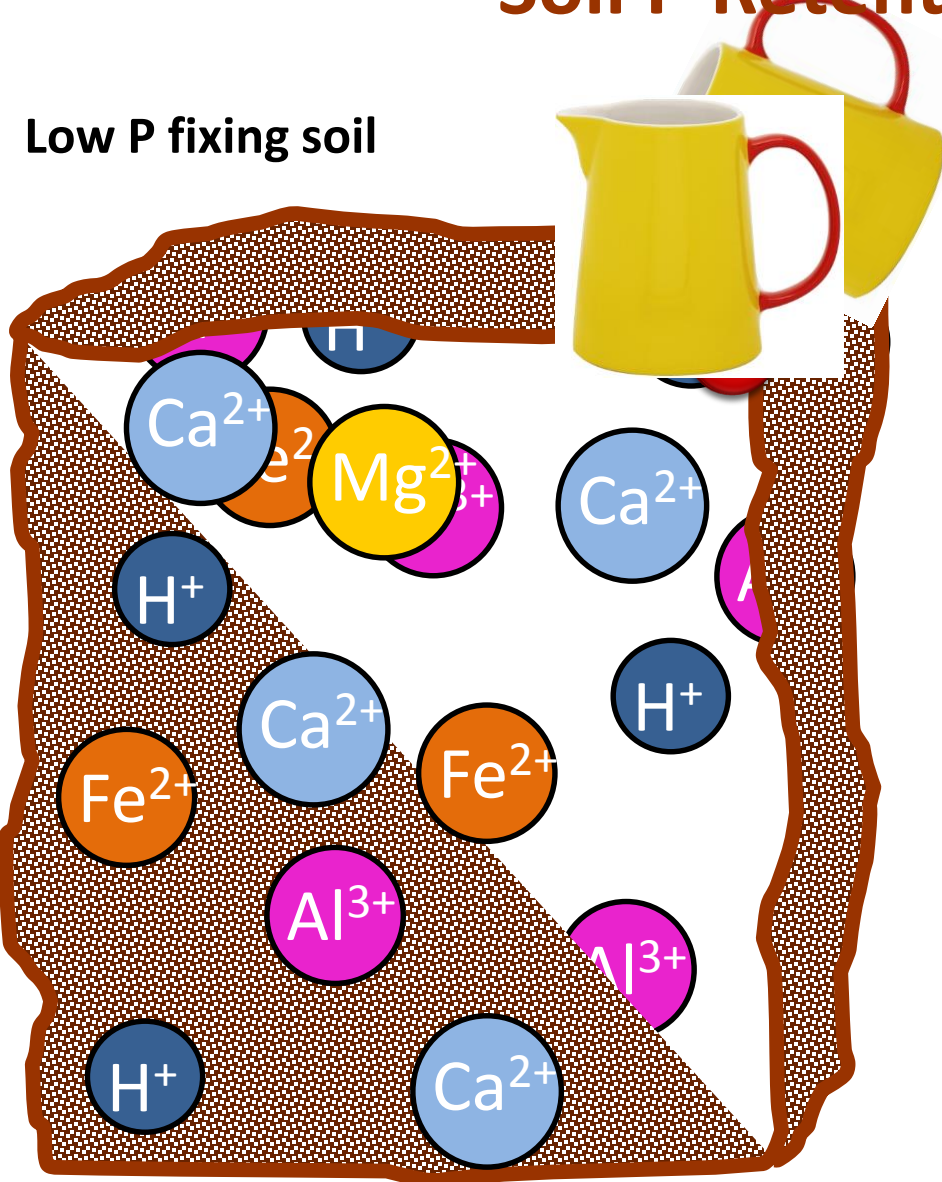


Brown Earths are considered the farmer's friend: these soils are typically free draining, but have good nutrient retention. Brown earths are uniform throughout the profile, showing few, if any, distinct features or layers. The subsoil is generally influenced by the parent rock or glacial drift material on which it is found.



Soil P Retention Capacity

Low P fixing soil



Organic manures section – New Developments

Table 9-1: Dry Matter and N, P and K levels in cattle slurry samples from Irish farms^{1,2}

| Cattle slurry | DM % | N kg/t | NH ₄ -N kg/t | P kg/t | K kg/t |
|-----------------|------------|----------|-------------------------|----------|-----------|
| Average values | 6.3 | 2.4 | 1.4 | 0.5 | 3.5 |
| Range in values | 0.4 - 11.9 | 0.2 -5.2 | 0.2 -3.4 | 0.1 -1.1 | 0.5 – 7.7 |

1. Surveys of cattle slurry (dairy and beef farms) conducted by Berry *et al.*, 2013.

Table 9-2: Nitrogen fertilizer replacement value (NFRV)¹ in cattle slurry according to application timing and method

| Timing | Method | NFRV (%) ² |
|--------|---------------|-----------------------|
| Spring | Splashplate | 30 |
| | Trailing shoe | 40 |
| Summer | Splashplate | 15 |
| | Trailing shoe | 25 |

1. Nitrogen fertilizer replacement values (NFRV) is the percentage of the total slurry N available for plant uptake from Lalor *et al.*, 2014.

2. Refers to the total NFRV in the year of application, and is the sum of the short term NFRV after slurry application and the residual NFRV over the remainder of the year.

Organic manures section

Effect of slurry Dry Matter on N, P, K availability

Table 9-8: Typical available N, P, and K applied (kg/ha)^{1, 2, 3, 4} depending on cattle slurry dry matter content and application rate⁴

| Slurry Application Rate | 4% DM Slurry | | | 6 % DM Slurry | | | 8% DM Slurry | | | 10% DM Slurry | | |
|-------------------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | -----kg/ha----- | | | | | | | | | | | |
| | N ² | P ³ | K ³ | N ² | P ³ | K ³ | N ² | P ³ | K ³ | N ² | P ³ | K ³ |
| 11 t/ha | 5 | 4 | 23 | 8 | 5 | 32 | 10 | 7 | 40 | 12 | 8 | 49 |
| 22 t/ha | 11 | 7 | 47 | 15 | 10 | 64 | 20 | 13 | 80 | 24 | 16 | 97 |
| 33 t/ha | 16 | 11 | 70 | 23 | 15 | 95 | 30 | 20 | 121 | 37 | 25 | 146 |
| 44 t/ha | 21 | 15 | 93 | 31 | 21 | 127 | 40 | 27 | 161 | 49 | 33 | 195 |
| 55 t/ha | 27 | 18 | 116 | 38 | 26 | 159 | 50 | 33 | 201 | 61 | 41 | 244 |

1. Cattle slurry nutrient values are based on Table 9-1 from an on-farm survey of cattle slurry on Irish dairy and beef farms (Berry *et al.*, 2013). Note that total nutrient content in slurry can vary between farms.

Grassland section – New Developments

N Advice for beef and sheep

Nitro

- Suckler
- Suckler
- Calf
- Suckler

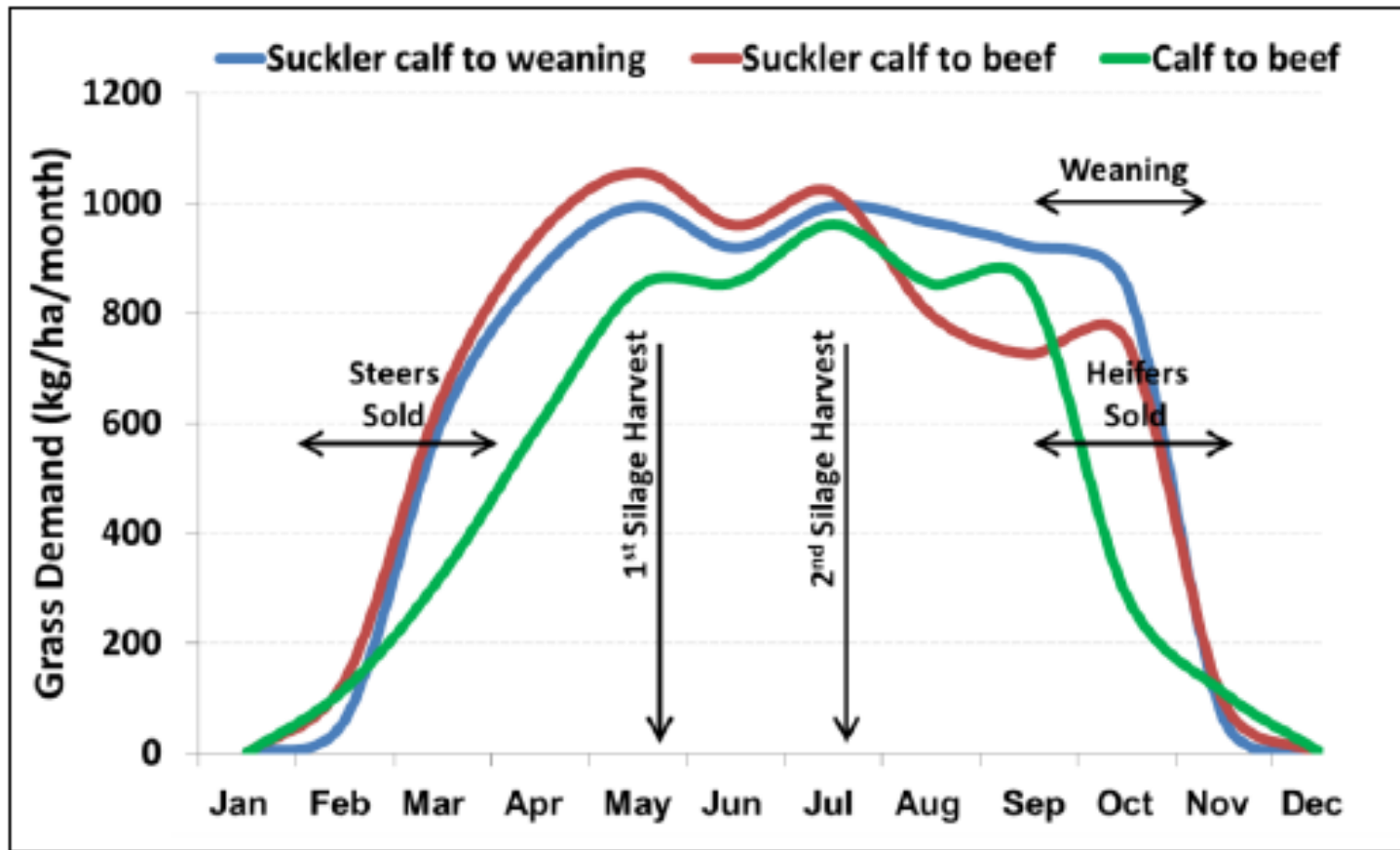


Figure 12-1. Grass demand for different beef systems at a stocking rate of 2 LU/ha over the grazing season.

N advice – Suckler Calf to Beef

Table 12-3: Suggested timing of available N applications for swards grazed by suckler calf to beef production systems (steers finished at 24 months of age and heifers finished at 20 months of age) at various stocking rates

| Stocking rate | | N rates ¹ (kg/ha) for approximate application dates | | | | | | | Total N Rate ^{1,6} (kg/ha) | |
|---------------|------|--|-------|-------|-----|------|------|-----|-------------------------------------|---------------------|
| | | Jan ^{4,5} / Feb | March | April | May | June | July | Aug | | Sept ^{4,5} |
| ≤1.0 | ≤ 80 | | 23 | | | | | | 12 | 35 |
| 1.25 | 99 | | 23 | 15 | | | | | 15 | 53 |
| 1.5 | 118 | | 25 | 23 | | | 10 | | 17 | 75 |
| 1.75 | 138 | | 34 | 25 | 10 | | 15 | | 19 | 103 |
| 2.0 | 158 | | 42 | 30 | 20 | | 20 | | 20 | 132 |
| 2.25 | 176 | 13 | 45 | 32 | 20 | | 26 | | 26 | 162 |
| 2.5 | 196 | 15 | 49 | 36 | 25 | 22 | | 24 | 22 | 193 |
| 2.75 | 215 | 15 | 53 | 42 | 25 | 26 | | 28 | 26 | 215 |
| 3.0 | 235 | 20 | 57 | 46 | 30 | 28 | | 32 | 28 | 241 |

1. Rates shown above refer to recommended application of available fertilizer. Chemical fertilizer rates should be calculated by deducting the available N contained in organic fertilizer applications from the rates shown in the table above.
2. Livestock unit (LU) per ha: suckler cow = 0.9 LU; calf (0-12 months of age) = 0.3 LU; yearling (13-24 months of age) = 0.7 LU; adult cattle (>24 months of age) = 1.0 LU..

Nutrient Management Advice – Crops

Green Book, 4th Edition Summary of Changes

Cereals: New advice on N application timings for cereal crops.

Advice on fertiliser application methods at different soil P and K indices.

Oilseed Rape: New advice on N timing based on density of the crop and leaf area index

Potatoes: New N advice for potatoes, which considers variety group, and haulm longevity and production system type

Vegetable crops: Updated N,P,K and micronutrient advice



Cereals – P fertilizer advice

Table 16-10: Available phosphorus advice for cereals based on crop yield (kg/ha)

| Soil P Index ¹ | Grain yield (t/ha) ² | | | | | |
|---------------------------|---------------------------------|------------------|------------------|------------------|-------------------|-------------------|
| | 6.5 | 7.5 ² | 8.5 ² | 9.5 ² | 10.5 ² | 11.5 ² |
| 1 | 45 | 49 | 52 | 56 | 60 | 64 |
| 2 | 35 | 39 | 42 | 46 | 50 | 54 |
| 3 | 25 | 29 | 32 | 36 | 40 | 44 |
| 4 | 0 ³ | 0 ³ | 0 ³ | 0 ³ | 0 ³ | 0 ³ |

Timing of application

Where P is being applied as organic manure it should be incorporated into the soil before sowing where possible.

For spring sown cereals on low P soils (P Index 1 and 2) it is advisable that fertilizer P be incorporated at or before sowing. Research has shown a consistent benefit of placing P with the seed (combine drilling) for spring crops at Index 1 and 2 (Wall *et al.*, 2013) soils. While benefits to placing P with the seed can be obtained at Index 3 the benefits are likely to be smaller and less consistent than at lower soil P indices. For early sown spring cereals placement of P fertilizers may be more critical where soil and weather conditions are less than optimal.

OSR – N application advice

Nitrogen management for winter oilseed rape

- For backward crops or crops grazed extensively by pigeons a light dressing (30kg N/ha) should be applied at the onset of spring growth (late Feb to early March), a third of the remainder should be applied 10 days later and the final dressing in early April.
- On moderate crops, one third of the N should be applied in mid -March with the rest applied in early April.
- On large crops with lots of leaf area post winter, early N will encourage excessive vegetative growth and applications should be delayed with the first third of the total applied in late March/early April and the remainder applied as late as possible whilst still allowing a uniform spread pattern between the tramlines (before the crop gets too tall).

This approach can be further refined by assessing the extent of green or leaf area development post winter using image analysis (mobile phone apps). A green area index (GAI) of 0.5 or less can be considered 'backward' or grazed. 0.5 to 1.5 would be normal, while anything in excess of 1.5 at the end of February would be considered large.

Nitrogen management for spring oilseed rape

For spring oilseed rape some nitrogen will normally be applied to the seedbed, but no more than 50 kg/ha N should be applied to reduce the risk of poor establishment. The remainder of the nitrogen will be applied between the two true leaf stage and the early stem extension stage.

Potatoes – New Developments

Table 17-1: Classification of varieties according to haulm longevity¹ or maturity

| Group | | | |
|------------------------------------|-------------------------------------|-----------------------------------|--|
| 1 | 2 | 3 | 4 |
| Determinate varieties | Partially determinate varieties | Intermediate varieties | |
| Short haulm longevity ¹ | Medium haulm longevity ¹ | Long haulm longevity ¹ | Very long haulm longevity ¹ |
| Premiere | British Queen | Rooster | Markies |
| Home Guard | Lady Rosetta | Maris Piper | Kerr's Pink |
| | Lady Claire | Golden Wonder | Cara |
| | Nectar, | Record | |
| | Maris Peer | Electra | |
| | Charlotte | | |

1. Haulm longevity assessed from 50% emergence to haulm death.

Potatoes – N Fertilizer advice

Table 17-2: Available N advice for potatoes (kg/ha)²

| Length of growing season | Variety determinacy group | Soil N Index ¹ | | | |
|------------------------------|---------------------------|---------------------------|-----------|-----------|-----------|
| | | Index 1 | Index 2 | Index 3 | Index 4 |
| ----- Available N ----- | | | | | |
| < 60 days | 1 | 100 -140 | 80 -120 | 60 -100 | 40 -60 |
| | 2 | 80 -120 | 60 -100 | 40 -70 | 0 - 40 |
| | 3 | 60 -100 | 50 - 80 | 30 - 60 | 0 - 30 |
| | 4 | N/A | N/A | N/A | N/A |
| 60-90 days Earlies | 1 | 160 - 210 | 140 – 170 | 120 - 150 | 90 - 120 |
| | 2 | 100 – 160 | 70 – 130 | 50 - 110 | 40 - 80 |
| | 3 | 60 – 140 | 50 – 110 | 30 – 90 | 0 – 60 |
| | 4 | 40 – 80 | 30 – 50 | 10 – 40 | 0- 40 |
| 90-120 days Maincrop/Seed | 1 | 220 - 270 | 200 – 230 | 180 – 210 | 150 – 180 |
| | 2 | 150 – 220 | 120 – 170 | 100 – 150 | 80 – 120 |
| | 3 | 110 – 180 | 90 – 110 | 70 – 90 | 40 – 60 |
| | 4 | 80 – 140 | 50 – 70 | 40 -50 | 0 - 40 |
| >120 days Maincrop | 1 | N/A | N/A | N/A | N/A |
| | 2 | 190 – 250 | 160 – 190 | 140 – 170 | 120- 140 |
| | 3 | 150 – 210 | 130 – 150 | 110 – 130 | 80 – 100 |
| | 4 | 100 – 180 | 70 – 90 | 50 – 70 | 20 – 40 |

1. See Tables 6-2 and 6-3 for soil N Index.

2. Note high levels of available N in the soil.

3. The NAD is the NAD for the soil.



Potatoes – N Fertilizer advice

Table 17-3: Example 1. Main Crop Rooster planted into long term tillage land (Index 1)

| Length of growing season | Variety determinacy group | Index 1 | Available N (kg/ha) |
|--------------------------|---------------------------|---------|------------------------|
| >120 days Main crop | 3 | 1 | 170 kg/ha ¹ |

1. Recommended maximum N rate – for Rooster which has high soil N utilisation is not recommended to apply more than 170 kg/ha N.

Table 17-4: Example 2. British Queen planted into long term tillage land (Index 1)

| Length of growing season | Variety determinacy group | Index 1 | Available N (kg/ha) |
|------------------------------|---------------------------|---------|------------------------|
| 90 -120 days Second early | 2 | 1 | 150 kg/ha ¹ |

1. Recommended maximum N rate – for British Queen which has medium soil N utilisation is not recommended to apply more than 150 kg/ha N as a second early.

Vegetable section – New Developments

Table 20-12-: Available N, P and K advice for carrot crops (kg/ha)

| Soil Index | N | P | K |
|------------|----|-----------------|-----|
| 1 | 90 | 65 | 250 |
| 2 | 70 | 45 | 200 |
| 3 | 40 | 35 | 150 |
| 4 | 0 | 20 ¹ | 110 |

1. If soil P is greater than 15 mg/l, no fertilizer P is necessary.
2. If soil K is greater than 250 mg/l, no fertilizer K is necessary.

Nitrogen

Depending on soil fertility, apply 0 – 90 kg/ha N as a base dressing. Top dressings are usually not required.

Potassium

Sulphate of potash is the preferred form of K for carrots.

Boron

The disorder known as ‘5 o’clock shadow’ is caused by a deficiency of B, so the use of a boronated compound is recommended. Alternatively, 11 - 22 kg/ha Solubor DF (17.5% B) can be applied. Monitor crops and apply foliar B during the growing season if required.

Nutrient Management Advice – New Developments

Green Book, 4th Edition Summary of Changes

Adaptive Nutrient Management Planning; NMP-online: Information on the new nutrient management system “NMP-online” and how it can be used to facilitate better nutrient management planning and sustainable outcomes for farmers into the future

Nutrients for Energy Crops: New information and nutrient recommendations for energy crop production



NMP On-line

- Plan Setup
- Import soil test results
- Land parcel and map entry
- Animal info entry
- Concentrate feed usage
- Animal housing info (optional)
- Manure and soiled water (optional)

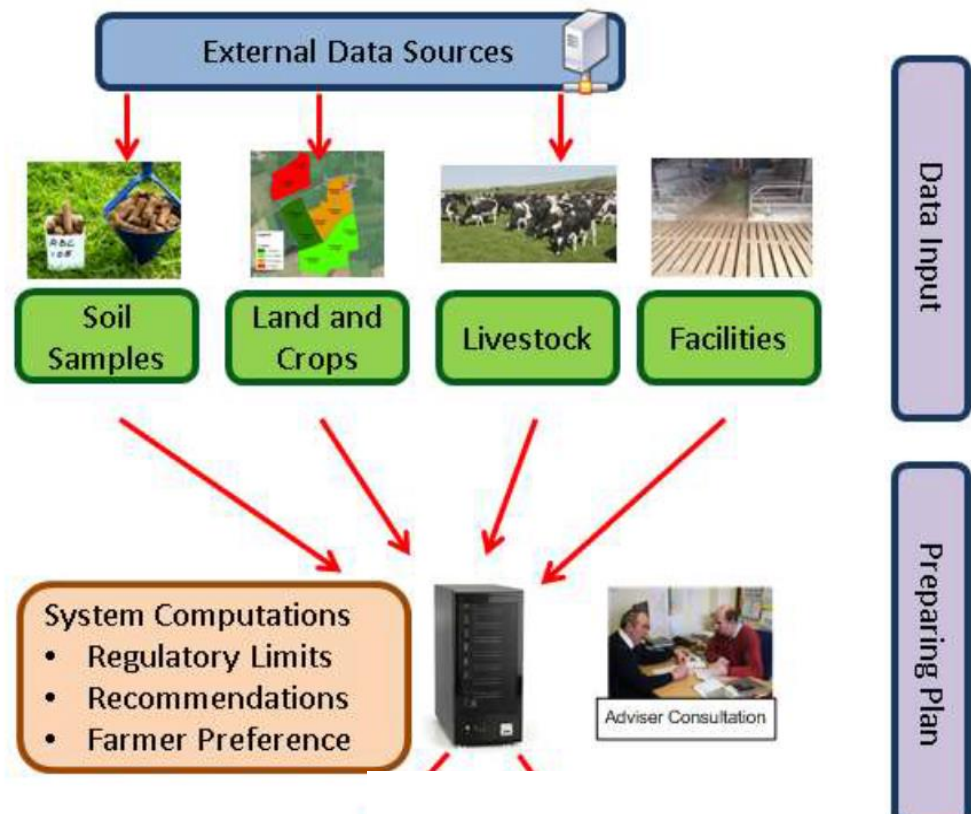


Figure 3-1. Overview of data inputs, plan preparation and outputs using NMP On-line

NMP On-line

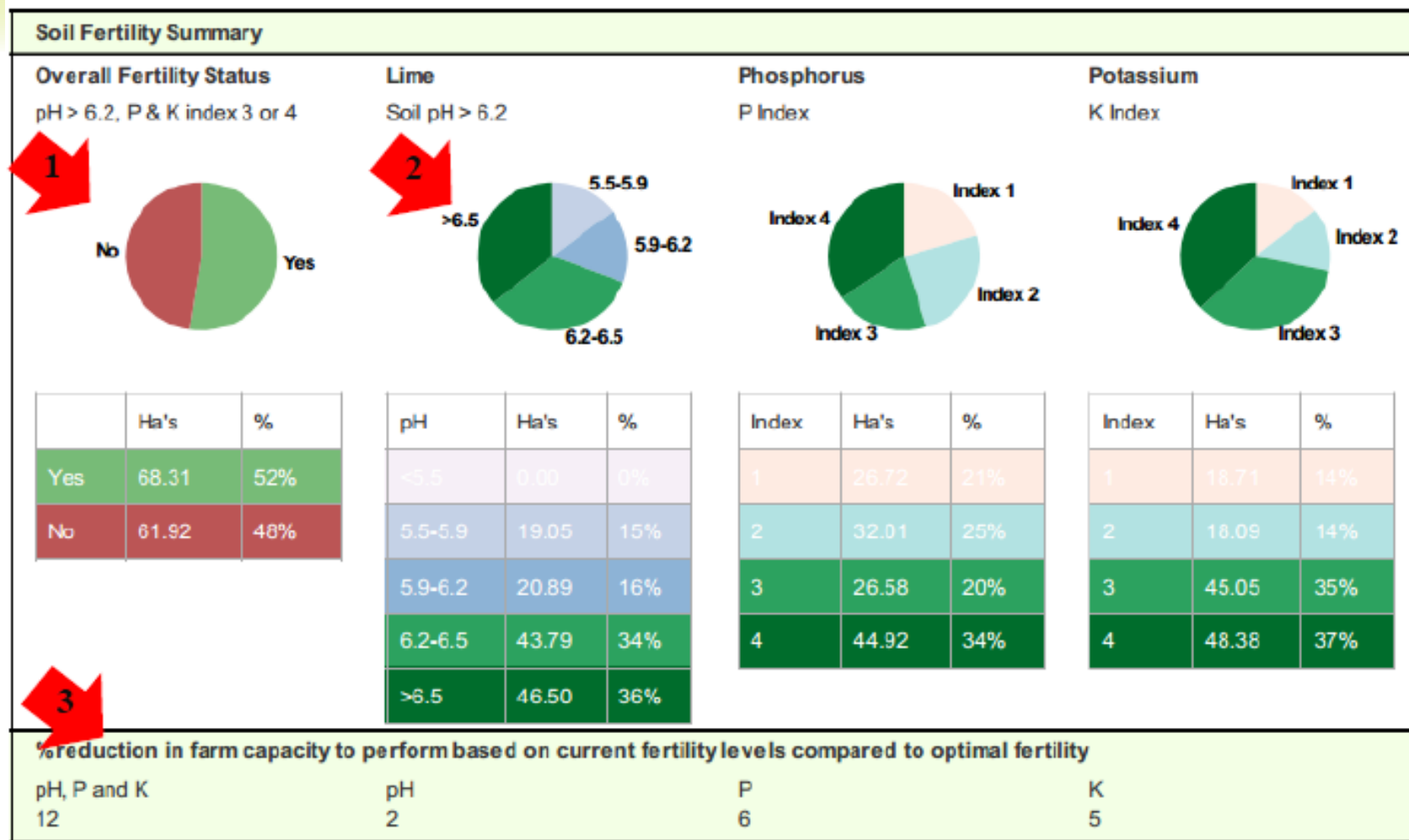


Figure 5-2. Soil fertility summary showing (1) overall soil fertility status, (2) proportions of farm in each index range for lime, P & K and (3) an estimate of the reduction in farm production capacity based on current soil fertility status.

4th Edition Major and Micro Nutrient Advice for Productive Agricultural Crops

- Provides farmers, advisors & industry with most up to date advice
- Latest information to manage soil fertility for efficient grass & crop production
- Supports profitable and sustainable nutrient management & farming
- Helps to protect the environment and aids farmers meet their obligations under environmental legislation (e.g. EU Nitrates Directive – NAP).
- Helps to support our Nitrates Derogation!
- This new Green Book information in tandem with NMP On-line has the potential to help farmers to restore good soil fertility and reverse declining soil fertility trends nationally.

“Green book” available on-line at <https://www.teagasc.ie/crops/soil--soil-fertility/>



4th Edition Major and Micro Nutrient Advice for Productive Agricultural Crops

Acknowledgements

Contributors: Stephen Alexander⁶, William Burchill¹, John Carroll², Barry Caslin², Dan Clavin⁸, Paul Crosson⁵, Philip Creighton⁸, Karen Daly¹, John Finnan², Patrick Forrestal¹, Dermot Forristal², Michael Gaffney⁴, Denis Griffin², Richard Hackett², Michael Hennessy², James Humphreys³, Eamonn Kehoe⁹, Stan Lalor¹⁰, Brian McCarthy³, Michael McLaughlin¹¹, Pat Murphy¹, John Pettit⁹, Shay Phelan², Mark Plunkett¹, Robert Prendiville⁵, John Spink², David Wall¹.

The editors wish to acknowledge the considerable help given by many people, both within and outside Teagasc in the preparation of this edition of the nutrient advice manual. Many Teagasc staff gave time and encouragement to the work, and helped greatly by contributing new data, reviewing texts and suggesting ways of improving the information content and clarity of the text and tables. Stan Lalor of the Fertilizer Association of Ireland provided much useful information on fertilizer ingredients and organic manures. This book also drew on the knowledge and experience of many former staff members of Teagasc and its forerunner, An Foras Talúntais. Their contribution is acknowledged.