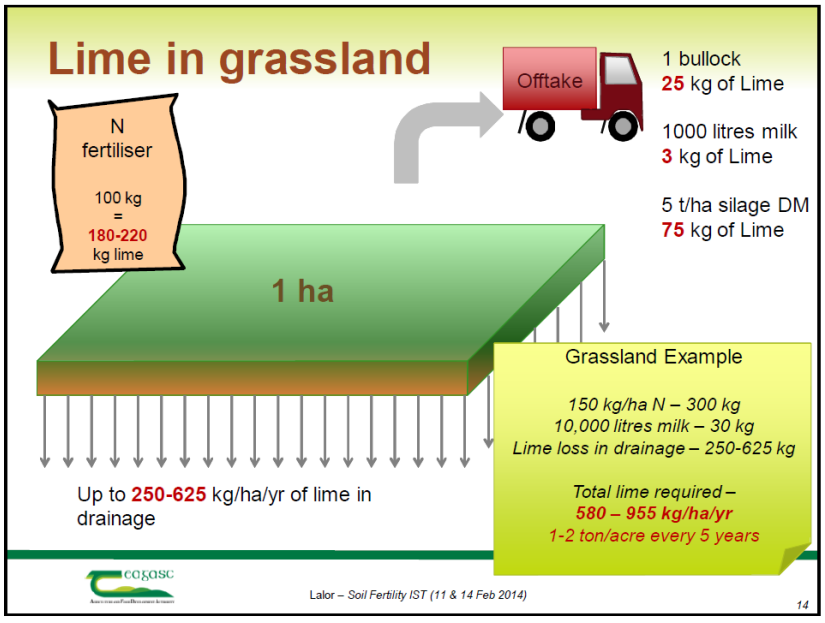
NMP Online – User Update 2 – 15th June 2016

Soil pH & Liming

Soil pH plays a key role in soil fertility. Maintaining the soil pH at the optimum level will increase the microbiological activity of the soil, and result in better soil nutrient recycling and release. Soil pH is also critical for maximising the availability of nutrients (N, P & K) applied in organic and chemical fertilisers.

Lime is continually being lost from the soil and needs to be replaced as part of a nutrient management programme.

- Drainage water can remove approximately 250 – 625kg/ha, depending on the soil type, of lime equivalent each year.
- Light free draining soils will lose lime more quickly than heavier soils. Therefore, light land may need extra attention; particularly in areas limestone is not present in soil parent material or bedrock.
- Crops and livestock remove lime, for example, a crop of first cut grass silage 5t/ha DM) removes approximately 75 kg/ha of lime equivalent. A finished bullock removed approximately 25kg while 1,000 litres of milk removes approximately 3kg of lime. Nitrogen fertilisers also have an acidifying effect.
- Each 1 kg of N applied as CAN or Urea will generate acidity that will require approximately 2 kg of lime to neutralise. Urea tends to require more lime per kg N compared to CAN (27%N) and continuous application of urea will increase soil acidity.



Target soil pH for a range of crops

Soil pH is a measure of soil acidity and lime must be applied on a regular basis to restore a more neutral soil pH which is more favourable for nutrient release and plant growth and development. The target soil pH for a range of crops is shown in Table 1. The aim is to maintain soil pH close to the target level and apply lime as recommended on the soil test report.

Table 1. Optimum soil pH for a range of crops

Crop	Optimum pH
Beet, Beans, Peas and Oilseeds	7.0
Cereals and Maize	6.5
Grassland	6.3
Grassland (High Molybdenum)	<6.2
Potatoes	6.0

Lime Recommendations for Change of Crop

Maintaining soils within the optimum pH range for the crop grown is essential to soil nutrient availability and utilization of applied fertilisers. Soil test results are good for up to five years and nutrient recommendations are formulated on the basis of meeting crop nutrient requirements during the growing season and building soil fertility status to target soil nutrient levels.
Lime advice that appears on the soil test report is for the crop that is entered initially with the soil sample details. Lime applications are generally applied within a year of taking the soil sample. In the situation where the crop changes (Grass to Barley) from that initially entered it may therefore be necessary to generate new lime advice.

Determining New Crop Lime Requirement

Target Soil pH – This is the pH for optimum crop growth. The lime advice increases the soil pH to the target pH for that crop (see page 28 of Green Book).

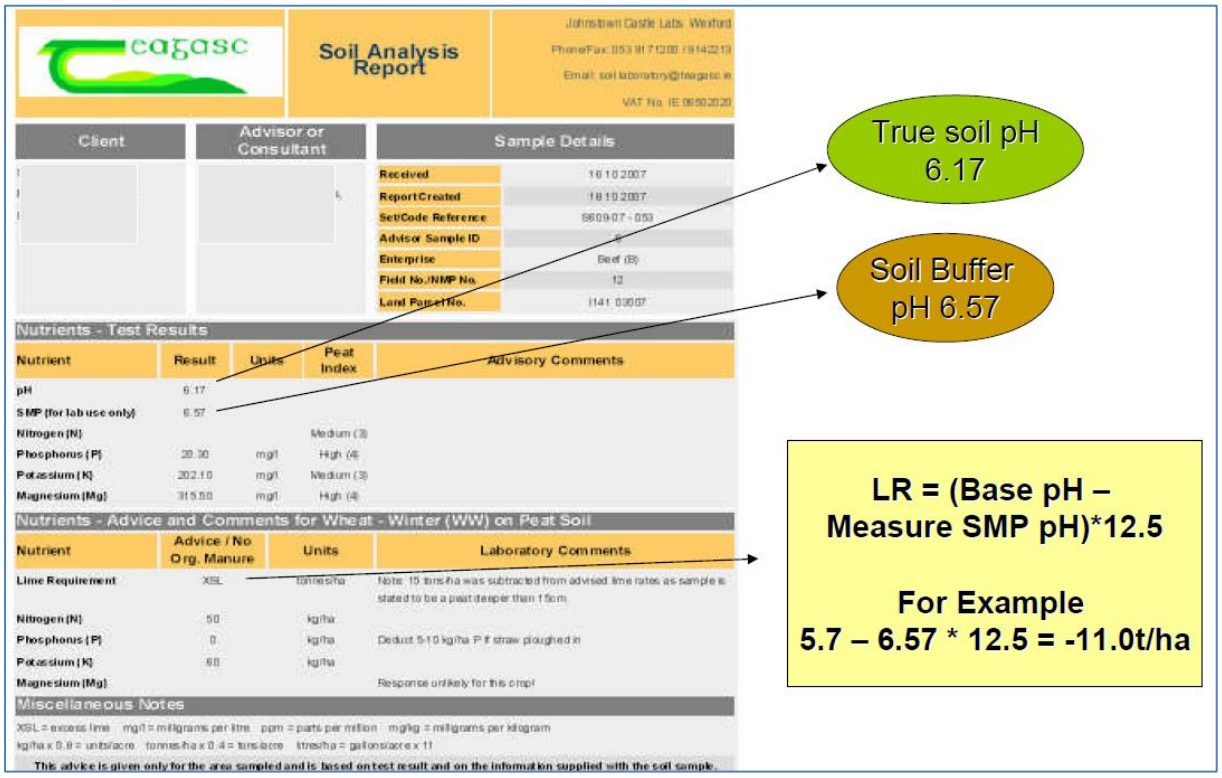
SMP pH – The SMP pH is the soil buffer pH and is the main determinant of soil lime requirement. To calculate the crops lime requirement a base pH is required for each crop group (see table below). This will differ depending on the crop as shown in the table below. The formula for lime requirement is shown in the yellow box below.

Base Soil pH on Mineral Soils	
Crop	**Non REPS**
Grass	6.7
Cereals / Maize / OSR	6.9
Beet / Peas / Beans	7.1
Potatoes / Oats	6.2
Base Soil pH on Peat Soils	
Grass	5.7
Cereals	5.7

Lime Requirement = (Base pH – Measured SMP pH) x 12.5 *(round to nearest 0.5 unit)*

For example where a soil sample for a grass crop has a SMP pH 6.3 and lime advice is for this crop is 5t/ha. Where the crop changes to spring barley in the year of cropping and no lime has been applied it will be necessary to calculate a new lime requirement as follows:-

6.9 – 6.3 x 12.5 = 7.5t/ha (new lime advice)



Timing of lime application

Lime can be applied at any convenient time of the year. For lime sensitive crops such as beet, cereals, maize, apply lime 2 years before sowing. If lime has not been applied it should be spread after spring ploughing so that it can react with the soil and be thoroughly mixed with soils during spring cultivations.

For grassland, it is preferable to apply to fields with very little grass cover (silage fields / after grazing), and to avoid grazing or cutting until sufficient rainfall has occurred to wash the lime off the herbage. For silage swards apply lime before mid-March for first cut. Applying lime to heavy covers of grass intended for silage can reduce the silage quality if the lime is not washed off the grass by rain.

Over Liming

When a soil is over limed, some crops may suffer from lack of plant foods such as boron, iron and manganese. Crown Rot, a disease of beet, and Brown Heart, a disease of turnips are caused by boron deficiency. These diseases generally occur on alkaline or over limed soils. Grey speck in cereals is caused by manganese deficiency and this is brought on by too much lime. In practice, over liming is more likely to be caused by uneven spreading than by applying too much per hectare.

Freshly applied lime may increase the amount of Common Scab on potatoes and this is a serious blemish in potatoes. It is a good practice to lime the soil after harvesting the potatoes. Where a good rotation is followed, at least five years will have elapsed before the next potato crop.

Types of Liming Materials

Limestone rock is formed from the compressed skeletons of dead marine creatures. Limestone rock is a rich source of calcium and soils formed from such rocks contain plenty of lime. In Ireland, our main source of lime is from limestone quarries. Here, the rock is ground to a fine material suitable for spreading on the land

- $CaCO_3$ Ground Limestone (Calcium + Carbon + Oxygen)
- CaO Burnt Lime or Quicklime (Calcium + Oxygen)
- $Ca(OH)_2$ Slaked lime (Calcium + Oxygen + Hydrogen)
- Magnesium Limestone - A mixture of $CaCO_3$ and $MgCO_3$
  (Calcium+Carbon+Oxygen+Magnesium)

Calcium limestone is the most common form of ground limestone available. Magnesium limestone (also called dolomitic limestone) can also be used, and are recommended where soil test magnesium levels are less than 50 mg/L (Index 2).

Lime Quality

Ground Limestone

Ground limestone can range from dust up to particles of 3.35 mm in diameter. Limestone needs to dissolve in the soil before it can be fully utilised and this process can take up to two years for the large particles to break down and adjust soil pH. Smaller limestone particles (<0.15mm) are available much more rapidly and will react with the soil and raise pH much faster than coarse materials.

Lime Standards as per DAFM Specification (SI 248)

1. Product must have a Total Neutralising Value (TNV) of not less than 90 per cent
2. The entire product must pass through a 3.35 mm sieve.
3. Not less than 35% must pass through a 0.15 mm sieve
4. The moisture content must be less than 3.0%

Granulated Lime

Lime which is ground much more finely (< 0.1mm) than ground limestone and then formed into granules is known as granulated lime.

Granulated lime is spread at a rate of 1:1, Ground Limestone to Granulated Limestone. For example, If you require 3 tonnes/acre of ground limestone, therefore this is equivalent to 3 ton of granulated lime . This makes the application of granulated lime cost prohibitive where high rates are required. Granulated lime is best applied as a maintenance type product where soil pH has been corrected to the target pH with ground limestone.

Liming grassland soils

Soils maintained close to the target pH will have benefits of increased grass yields (up to 2t DM/ha/year); more efficient utilisation of applied fertilisers and manures; and better persistence of more productive species in the sward such as perennial ryegrass and clover. Limed soils also tend to release more N from the soil organic matter. Increases in N release of 80 kg/ha/yr of N. This would be worth approximately €80/ha at current fertiliser N prices.

The optimum soil pH for grassland is at or above 6.3. To achieve this, Teagasc advice sets the target pH for grassland at 6.5. This allows for the slow pH changes that occur after liming and the gradual loss of lime after the target is reached. It assumes that the period between lime applications is not long. Short-term leys should be limed to the required level of the most sensitive crop in the rotation.

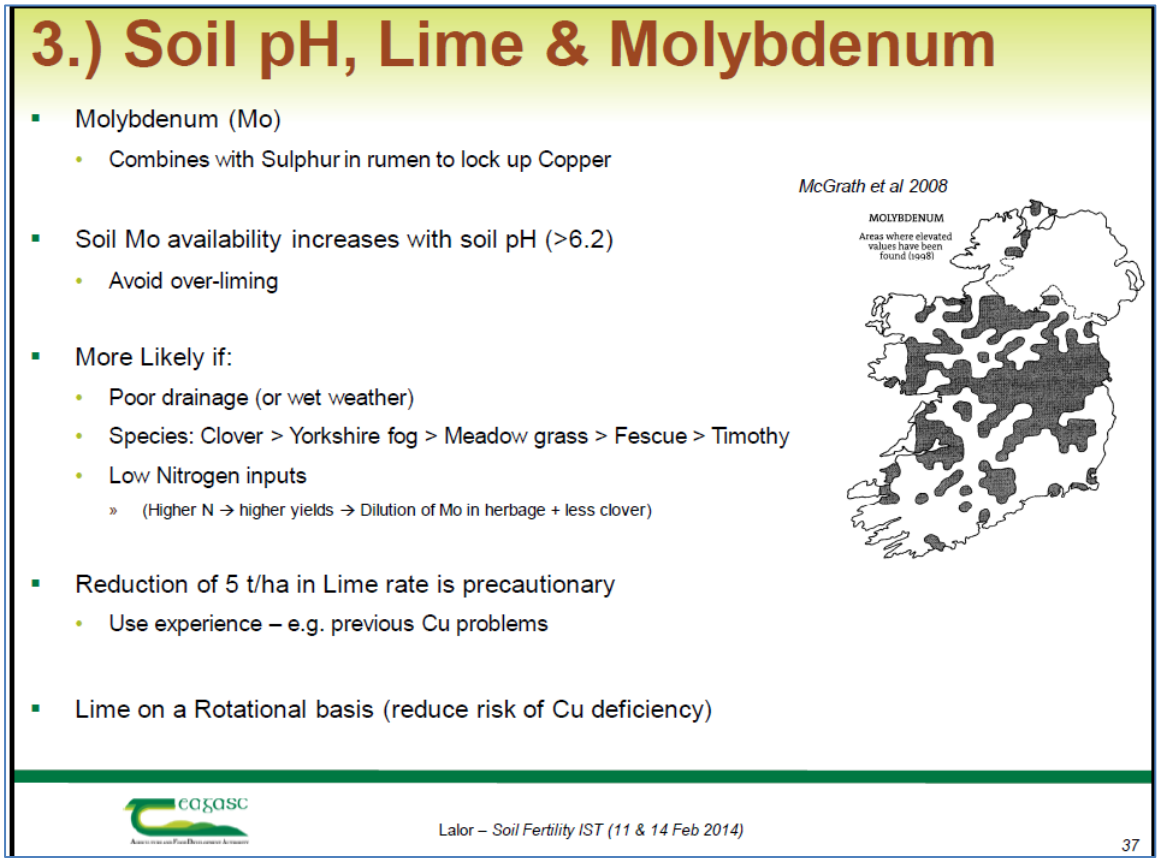
Liming of grassland should be done at least every 5 years. For reseeding pastures, best results are achieved by spreading lime at the time of reseeding, when the lime can be well worked into the soil (Top 7.5 to 10cm).

Surface acidity often occurs in the top 50 mm in grassland soil due to high rainfall and heavy usage of nitrogenous fertilisers; this reduces the availability of fertiliser N, P & K. For this reason it is better to have frequent small applications of lime rather than one large application. Keeping the pH above 6.0 in grassland improves N recycling and reduces total N requirements.

Very acid land should be limed immediately. There is no best time to apply lime, provided it is spread evenly on the surface of the soil. Thus, ground limestone can be spread at any time and pasture fields can be limed in rotation. Grass can be grazed as soon as the lime has been washed off the leaves by rain. If the lime advice for grassland exceeds 7.5 t/ha; initially only this amount should be applied, and the remainder applied after two years.

High Mo Soils & Liming

In grassland soils that are high in molybdenum (Mo), it is important not to raise the pH above about 6.2, as increasing the pH above this level increases the availability of Mo and this in turn induces copper (Cu) deficiency in animals by reducing Cu absorption. High Mo soils often occur on carboniferous black shales and calp limestone.. Therefore, lime application rates on such land should be reduced up to 5 t/ha, depending on soil pH.



Poaching & Liming

Lime breaks down the tough sod of old pastures on very heavy wet soils giving rise to a greater risk of poaching. A 'little and often' approach to liming should be used in such cases. On these soils don't exceed 5t/ha in a single application and apply reminder of recommended lime in 2 years' time.

Liming Tillage Soils

Where high levels are advised for tillage, half should be applied pre-ploughing and the remainder post-ploughing and then worked in. As lime takes up to two years to have its full neutralising effect on soil acidity, it should be applied well before sowing for acid sensitive crops such as beet. However, if a crop is failing due to acidity it is often worthwhile applying a lime top-dressing of 7.5 t/ha where soil and crop conditions permit application. Alternatively, the application of granulated lime at a rate of 3:1 based on lime advice per soil test report . Lime should not be applied within two years preceding a potato crop because it can increase the risk of common scab. At least 4 years should intervene between liming and sowing a seed potato crop.

Although potatoes can grow very well below pH 6.0 it is necessary to maintain the soil at a pH suitable for the rotation. The pH levels to aim for in mineral soils are pH 6.5 for most cereals and pH 7.0 for beet, beans and peas.

Lime can take two or more years for full reaction with soil, and therefore it needs to be applied in good time. Where it is intended to plough pasture fields for tillage, they should be limed about one and a half years before cultivation or immediately after ploughing and worked into the soil. Lime should be applied two years before planting lime demanding crops such as sugar beet, peas, beans, and also wheat or barley.

Where lime has not already been applied, it should be spread after ploughing so that it can react with the soil and can be thoroughly mixed with the soil during cultivation. Where lime is spread to prevent finger and toe in brassicas, it should be spread at least twelve months before sowing the crop.

Over Liming

Over-liming can cause problems mainly in the form of induced micronutrient deficiencies e.g. of managanese (Mn) in sugar beet and oats, boron (B) in root crops, iron (Fe) in fruit plantations, and molybdenum (Mo) induced copper (Cu) deficiency in animals. Too much lime can also prevent plant roots from taking up potassium (K) and other nutrients from the soil. It can also decrease magnesium (Mg) availability.

Commonly Asked Questions about Lime:

Q. How long between spreading lime and closing for grass silage?

A. Leave a minimum of 3 months.

Q. How long between spreading lime and slurry or Urea?

A. Leave a minimum of 3 months

Q. How long between spreading slurry or Urea and Lime?

A. Leave a minimum of 1 week.

Q. What effect will lime have on soil P levels on acidic soils (pH 5.0 to 6.0)?

A. Liming acidic soils will increase the availability of P for plant uptake.

Q. How do I determine the quantity of lime required to correct soil pH?

A. A recent soil report will show the rate of lime required depending on the soil type, soil pH and crop type.

Q. How long will it take lime to work?

A. The fine ground limestone (35%) will work relatively fast, and the course lime particles will react more slowly and help maintain soil pH for a number of years.

Q. What is the maximum rate of lime in a single application?

A. Apply a maximum of 7.5t/ha (3.0t/ac). Where more lime is recommended apply 50% now and the balance after 2 years.

Q. Can slurry and lime be applied at the same time?

A. Firstly, applied lime can increase the loss of N to the air after slurry application. Where slurry applied (before liming) leave an interval of one week before spreading lime. If lime has been applied avoid slurry application for a minimum of 3 months to reduce N losses from slurry.

Q. How long should one leave between spreading 10-10-20 or CAN and lime?

A. There is no need to leave a gap with CAN or N P K compounds.

Q. What is the target pH for grassland where my land is in a high molybdenum (Mo) area?

A. Maintain a soil pH 6.2 on these soils. Alternatively apply lime as recommended and treat animals with copper supplementation.

Q. When is the best time to apply lime to grassland soils?

A. Anytime of the year is a good time to apply lime. Summer and autumn tend to be best as it allows time for the lime to work and reduces issues in early spring with slurry / urea applications.

Q. When is the best time to apply lime to tillage soils?

A. Ideally apply lime to the ploughed / pressed soils and incorporate into the top 7.5 to 10cm of soil.

Q. When is the best time to apply lime to fields target for reseeding?

A. Ideally apply lime as recommended on the soil test report one year in advance of reseeding. Alternatively apply lime at time of reseeding and incorporate (5 to 10cm) into the seedbed before sowing.

More information on Lime and lime requirements:

http://www.teagasc.ie/soil/

Teagasc publication: Major & Micro Nutrient Advice for Productive Agricultural Crops, 2008 (Teagasc 'Green Book')

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