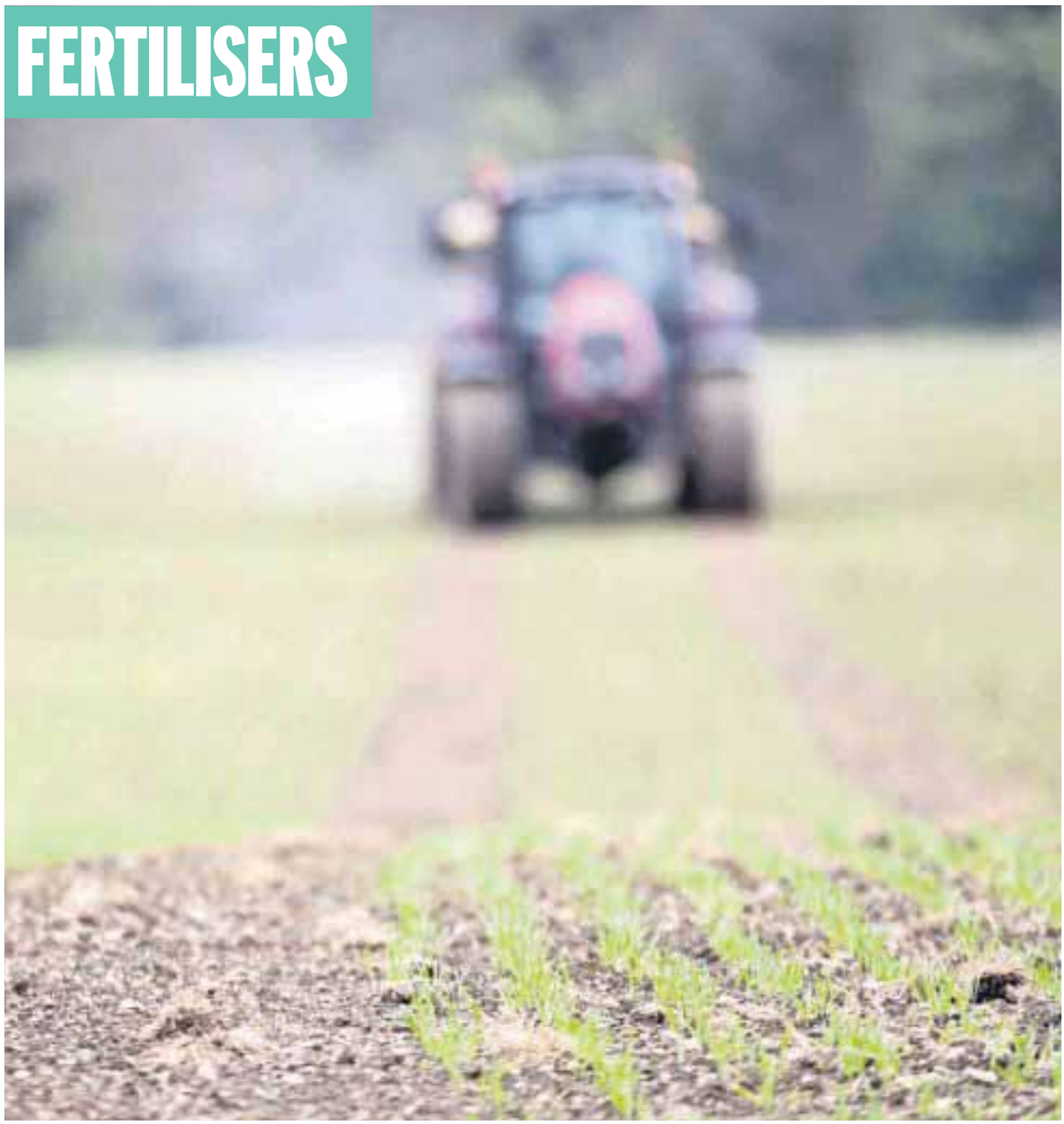
FOCUS

FERTILISERS



INTRODUCTION

Soil fertility remains the top priority

President of the Fertilizer Association of Ireland **PJ Browne** introduces this year's Focus supplement and outlines the challenges and goals for 2017

Welcome to the Fertilizer Association of Ireland's annual spring supplement. This year, we feature a range of articles including a synopsis of the papers delivered at our annual spring seminar held at the The Horse & Jockey Hotel last Tuesday.

The challenge for the agri-industry in Ireland to improve our soil fertility remains a priority. According to Teagasc, our soils are still approximately 50% below where they need to be for each of the fundamental properties of phosphorus (P), potassium (K) and soil pH. Even more alarming is that only approximately 10% of soil samples being analysed are showing optimum levels for all three. That means that 90% of them were somewhat deficient in one or a combination of these key soil fertility properties.

While chemical P levels spread last year are up (37,000t) compared to the lows of 2009 (20,000t), we still have a long way to go to achieve optimum soil fertility and fully unlock the full yield potential of our soils, grassland and crops. It is vitally important to regularly soil-test your land and manage soil fertility. Make proper and maximum use of your slurry by spreading where it will be most effective, in particular on silage fields where off-takes are high.

The Department of Agriculture has launched 2017 as being "The year of Sustainable Grass" with a calendar of events being held during the year in conjunction with The Fertilizer Association of Ireland, Teagasc, AFBI, Irish Grassland Association and Bord Bia. This initiative supports the goals of Foodwise 2025 and aims to raise awareness of the role that grass plays in supporting competitive dairy and livestock production.

Continued p52

Soil fertility challenge

Continued from p51

Please keep an eye out for these events during the year as they promise to be very worthwhile. Optimum grassland management can make a big difference to your bottom line when it comes to feeding costs.

Last year was another very busy year for the Fertilizer Association of Ireland.

We had a group of members travelling to Northern Ireland last June visiting the very impressive and modern dairy facility at Greenmount Agricultural College near Belfast. There, we got a very interesting and informative tour by Ian McCluggage and his team.

We then went on to the very scenic Glenarm, Co Antrim, to visit the lime quarry and brand new lime granulating plant of Omya UK Ltd, where we got to see the process of turning limestone rock into granules ready for spreading. Our last visit was to the suckler and sheep enterprise of John Milligan and his son Joe near Castlewellan, Co Down, where we got an overview of how they achieved significant annual profit increases by following good advice from their agricultural adviser Francis Breen to include grassland and soil fertility management, feeding regimes and targeted slaughter ages and weights.

In October, we relaunched our Nutrient Offtake Calculator in both its physical wheel and smartphone app forms. The app is available for free download for Apple or Android devices from their respective app stores. The calculator is also available as a working tool directly from our website at www.fertilizer-assoc.ie/p-k-calculator/calculator/. A word of thanks to KS UK & Eire Ltd for all their help in the design, print and provision of the physical wheel version and also to the council members who played no small part in developing and designing these handy tools.

This calculator is now widely used by advisers, consultants and agri-sales personnel as an accurate tool for giving good nutrient on-farm advice.

We also launched the second of a series of technical advice bulletins in October, once again in conjunction with Teagasc at its annual soil fertility conference.

This bulletin is a very comprehensive technical booklet on everything to do with soil pH and liming and is also available for download from our website. Other bulletins on soil testing and analysis and all our historic Spring Seminar proceedings are also available from our website www.fertilizer-assoc.ie. This is an invaluable source of information for everything to do with soil fertility and agronomy. Please feel free to browse.

If you want to find out more about our organisation or have any enquiries, please drop us a line on our email address at info@fertilizer-assoc.ie. A final word of thanks to all our contributors to this year's supplement, and to the ongoing support of the *Irish Farmers Journal*. We hope you enjoy reading it. **– PJ Browne**

Lime a key priority for heavy soils

Seven farms with heavy soils are participating in a monitoring programme contributing key data. **Ger Courtney** and **David Wall** of Teagasc report

There has been a notable decline in soil fertility nationally and the impact is even more serious on farms with heavy soil types. On heavy soils, there is the potential to increase annual grass production by 30% where soil pH, phosphorus (P) and potassium (K) status is optimised.

Seven dairy farms farming on heavy soil types are participating in a monitoring and development programme and contributing key data on farm performance. The farms are deemed heavy (ie, predominately clay mineral soils) and are located in high rainfall areas of the southwest of Ireland. The Heavy Soils Programme (HSP) has been operating since 2010.

The programme is focusing on all aspects of profitable and sustainable dairy farming on heavy soil types. Soil fertility is a key focus for the programme in order to enhance the underlying production potential of these, often more challenging, soil types.

The importance of soil pH and appropriate liming strategies has emerged as a key target for boosting overall soil fertility and farm productivity.

Changes in soil fertility 2013-2016

It has been firmly established in research that soil pH must be corrected as a first step in overall improvement in soil fertility status. HSP farms embarked on a programme of soil fertility improvement in 2010.

The low initial soil pH on these farms was due in part to a trend of low usage of lime nationally, with higher nitrogen usage masking the impact of low pH on grass growth. Fertiliser plans prepared in 2013 indicated a lime requirement of, on average, 90t of ground limestone per annum. A comprehensive soil-testing programme takes place across all the heavy soils farms in December each year. The impact of these lime applications over time on the soil pH across the milking block area of the HSP farms is summarised in Table 1.

Average soil pH has increased from 5.8 to 6.3. All of the seven farms showed a pH increase. The farms continued to focus on applying lime in 2016 to bring all paddocks to target pH of 6.3. No noticeable change in soil trafficability has been observed by the farmers largely due to quantities applied being limited to 2t/acre (5t/ha) in any one application.

Average fertiliser costs in 2015 were 3.3c/l on the heavy soils farms, with lime accounting for 0.42c/l of that cost. Phosphorus status increased on four farms and decreased on three farms (Kiskeam, Doonbeg and Listowel).

Higher offtake issues combined with high fixation capacity remain the key factors militating against improved P status on these farms. Potassium status remained static between 2015 and 2016, with only two farms recording an improvement in K status.

Lime and loss through drainage/rainfall losses

The HSP farms are in high rainfall areas. Therefore, lime losses are estimated to be high, at up to 625kg/ha/year. This equates to a loss through drainage alone of 1.2t/acre over a five-year period. In addition, lime required to counteract acidity from chemical N use and loss in milk/meat means a maintenance requirement of 2t/acre every five years is required on these farms. In effect, any lime applied in 2011-2014 was only keeping pace with the maintenance requirement and was not having an impact on lifting farm soil pH.

Timing of lime application

The experience of the HSP farms shows that lime can be applied at any time of year when ground conditions are suitable. Outside of the normal application peaks at reseeding and late autumn, monthly lime usage statistics suggest that very little lime is applied in the

Table 2: Financial returns from lime application on HSP farms

Year	1	2	3
Soil pH	5.5	5.8	6.3
Lime applied (t/ha)	5		5
Extra grass DM grown (t//ha)	0.5	1.5	2
Cost of lime (€/ha)	€125		€125
Annual financial benefit from additional grass (€/ha)*	€81	€242	€322
Cumulative Cost of Lime (€/ha)	€125	€125	€250
Cumulative value of extra grass (€/ha)	€81	€323	€645
€ Return per € spent on Lime	€0.65	€2.58	€2.58
*assumes each additional t of DM is worth €161			

The experience of the HSP farms shows that lime can be applied at any time of year when ground conditions are suitable.

spring. April can be an ideal time to apply lime when ground is well grazed out. June/July is another suitable time after silage has been harvested or as surplus bales are taken out (stubble available) and when ground conditions are good for spreading.

Impact of lime application observed on HSP farms

➲ Paddocks that were at soil pH 5.5 on HSP farms in 2013 and are now at soil pH 6.3 and grew an additional 2t/ha of grass DM in 2016.

➲ Farms that are now at target pH notice a much faster response to applied fertilisers. When soil temperatures are good, paddocks are easily achieving the 21-day pre-grazing target cover of 1,500kg/ha of grass DM. This had taken 26-28 days to achieve previously. This has led to more surplus silage of high quality being harvested during the main growing season, which gives a significant boost to the winter feed supply – an invaluable resource on farms with heavy soils and longer winters.

➲ In 2016, the Athea farm had an average soil pH of 6.5. As well as supporting a dairy herd stocking rate of 2.5 cows/ha, the farm also produced an additional 70t of silage DM in the form of 390 surplus bales of silage equivalent to 10 bales/ha (almost four bales per cow). The farm grew 11.4t/ha and utilised 9t/ha of grass DM.

➲ Paddocks are better grazed out by the herd and palatability of grass has improved.

➲ Grass has a better root structure, better tillering and less open swards.

➲ Good progress is being made in increasing soil pH to target. The challenge for these farms is to put a strategy in place to maintain lime status in the years ahead.

➲ Farmers aware of the risk of excessive lime use reducing soil trafficability have split the lime applications over time (max 2t per single application). This has worked well for building soil pH without negatively affecting soil structure.

Financial benefits of lime application on HSP farms

An evaluation of the cost of lime application compared with benefits of the additional grass production is shown in Table 2. This analysis assumes that increasing the soil pH from a starting point of 5.5 up to the target of 6.3 will improve grass production by 2t/ha of DM. This increase in pH will initially require 10t/ha (4 t/acre) of lime, half in year one and the balance in year three. After the initial high lime application, an average application per year of 1t/ha is assumed to maintain the soil pH thereafter.

The analysis shows that the increased grass production brings a return on investment in and after year two. However, it is worth noting that the benefits of lime will show grass production responses in the year of application, especially with lime applied in late autumn or winter in advance of the following year. In just three years, the return from applying lime is €2.58 for every €1 spent on lime. By the end of year nine, this return increases to €6.44 per €1 spent on lime.

Table 1: Soil fertility status summary across the milking block on the seven farms in the Heavy Soils Programme from 2014 to 2016

Year	2014	2015	2016
Average soil pH	5.8	6.1	6.3
Phosphorus-P (mg/l)	7.2	5.9	5.8
Potassium -K (mg/l)	123	102	102

	4	5	6	7	8	9
	6.3	6.3	6.3	6.3	6.3	6.3
	1	1	1	1	1	1
	2	2	2	2	2	2
	€25	€25	€25	€25	€25	€25
	€322	€322	€322	€322	€322	€322
	€275	€300	€325	€350	€375	€400
	€967	€1,289	€1,611	€1,933	€2,255	€2,577
	€3.52	€4.30	€4.96	€5.52	€6.01	€6.44

IRISH FARMERS JOURNAL
Saturday 11 February 2017

More nitrogen for winter barley?

Richie Hackett from Teagasc Oak Park outlines research there into whether more N fertiliser should be applied earlier in the growing season than was previously advised

Recent research into nitrogen fertilisation of winter barley in the UK has indicated that a greater proportion of the total N fertiliser should be applied earlier in the growing season than was previously recommended. Research over the last few seasons at Oak Park set out to determine if similar recommendations should be made for Irish conditions.

The work at Oak Park compared the grain yield of crops that received their first application of fertiliser N in late February/early March (the early treatment) with crops that received the first N in mid-March (the mid treatment), shortly before GS30. A third treatment where the first N was not applied until much later than is recommended (early April – the late treatment) was also included to see how crops would react to delaying the first N.

For the purposes of the experiment, all N was applied as CAN (ie P and K were applied independently of the N according to soil test results). A total of 180kg N/ha was applied to all treatments. As well as altering the timing of the first application of N, the proportion of the total amount to be applied in the first application was varied, with either 30%, 50% or 70% of the total being applied in the first application.

The trial also considered two and three split programmes. For two split programmes, the remaining N for each treatment was applied approximately 15 to 20 days after the first application; for the three split programmes, 20% of the total was retained and applied between just before GS37, the flag leaf emerging stage. The results of three of the experiments are presented in Figure 1.

There were very obvious visual differences between the different treatments during the season; the treatments that got the early nitrogen were visually greener and denser throughout April and much of May than the crops that got their first N in mid-March. It would have been difficult to imagine during this period that there would not be a yield difference between the two timings at harvest. The crops that got their first N in early April looked very poor during this period.

However, once the crops had headed out, visual differences between the timing treatments were much smaller and it was difficult to pick out the different treatments. When it came to harvest, there were generally only small and statistically insignificant differences in grain yield between the late February/early March treatment and the mid-March start dates for N application.

Indeed, even where the first N was delayed until early April, when the crops were approaching GS31, grain yield was often unaffected compared with where the first N was applied earlier, although delaying until this late is not recommended due to the risk of stimulating late maturing tillers at harvest.

As regards the proportion of N applied in the first application, there was no advantage, and in some cases a slight reduction in yield, from increasing the percentage of the total N applied in the first application above 30%. The work also indicated that there was usually no advantage, in terms of yield, to using three splits compared to two splits.

However, where unfavourable conditions occur after application, particularly of the main split, retaining some of the nitrogen for a third split may be advantageous. In terms of quality, there was little difference in hectolitre weights between the late February/early March dates and the mid-March dates irrespective of how much was applied in the first application.

So what are the practical implications of this work? The work indicates that there is some flexibility regarding when the first N is applied to winter barley and that although early N may make crops look better early in the season, crops that get their first N later catch up during the season. Therefore, where ground conditions are poor in late February/early March, N can be delayed until the crop is approaching GS30 without loss of yield.

While this is suitable for situations where P and K have been applied beforehand, where the first N is being applied as a compound with other nutrients, particularly P, it should be applied as soon as conditions allow in late February. Obviously the calendar date at which winter barley reaches GS30 will vary depending on site and sowing date but at Oak Park GS30 typically occurs for late September/early October-sown barley sometime around or soon after St Patrick's Day.

It will occur earlier further south and for earlier drilling dates and so in these areas, for early sown barley, GS30 could well occur in the first half of March or in very early regions in late February. In the current season, there are some reports of much more advanced than normal winter barley crops (approaching GS30 already) and some are questioning if there is a need to apply nitrogen earlier than normal to these crops.

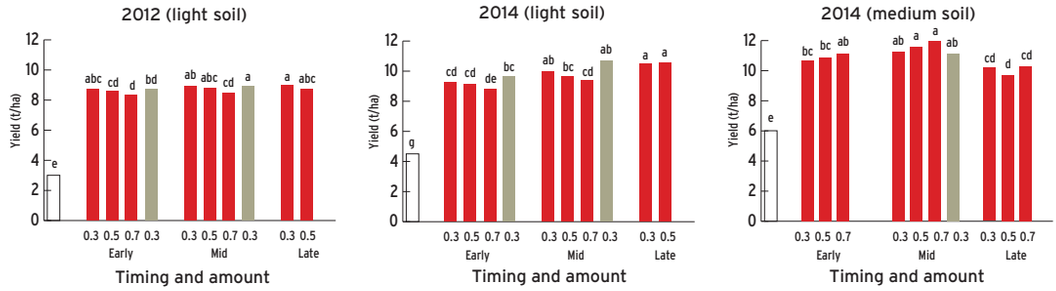
In short, there would seem to be no advantage to applying N to winter barley before late February in any season as the crop will not be growing very much and therefore it will have a very low N requirement. In addition, very early applications of N to winter barley are known to increase the risk of lodging later on and will also promote mildew, which is widespread on many crops.

In terms of what proportion of the total to apply in the first split, the work at Oak Park indicated that there is no benefit to applying any more than a third of the total N in the first split. This makes sense as uptake of N by the crop will be relatively slow during March, particularly early March, as temperatures are normally low and the crop is still growing slowly.

The main split should be applied to winter barley at or before GS31 and, combined with what was applied in the first split, at least 75% of the total should have been applied by this stage.

While the work at Oak Park didn't show any consistent benefit of using a third split, many growers will opt to use a third split, mainly to avoid having to make a very large second application, some of which could be lost if unfavourable conditions occur after application. Third splits should be considered where in excess of a total of 150kg N/ha is being applied. If a third split is being applied, it should be applied between GS32 and GS37.

Figure 1



Effect of timing and size of the first N application (30 – 70% of total N) to winter barley (cv. Cassia). Total N was applied in two (solid bars) or three (hatched bars) applications in late February/early March (early), mid-March (mid) or late March/early April (late). Bars with the same letter are not significantly different (P<0.05).

Winter barley.

Updating nutrient recommendations for Irish farms

David P Wall and **Mark Plunkett** of Teagasc Johnstown Castle summarise updates in the Teagasc *Green Book*

Teagasc fertiliser advice is reviewed is on an ongoing basis in light of new national and international research findings, changes in farm practices, nutrient regulations and the onset of new grass and crop varieties with different nutrient requirements.

Prior to now, the latest nutrient advice for grassland and tillage crops was available in the third edition of the Teagasc *Green Book* (Coulter and Lalor, 2008).

In 2016, a full revision and update of nutrient advice was conducted incorporating the latest scientific research and knowledge to produce the present volume (fourth edition) published by Wall and Plunkett (2016).

Some of these updates in the new *Green Book* are summarised as follows.

What's new

➲ Soil types and nutrient cycling – information on the major soil types in Ireland and their influence on nutrient cycling and management, including links to further information of Irish soils.

➲ Fertiliser ingredients – definitions and information on the main fertiliser ingredients available in Ireland.

➲ 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.

Revised sections

➲ Soil acidity and liming – improved information on importance of soil pH correction and new information on lime and lime products has been included.

➲ Nutrients in organic manures – updated the fertiliser replacement values for slurries and provide new information on nutrient constituents in a range of organic manure and biosolid types. Information on tools to measure slurry variability and how to maximise slurry efficiency.

➲ Grassland – new nitrogen (N) advice for beef and sheep systems and suggested application timings for fertilisers.

➲ Cereals – new advice on N application timings for cereal crops.

➲ Potatoes – new N advice for potatoes, which considers production system and haulm longevity.

➲ Oilseed rape – new advice on N timing based on density of the crop and leaf area index.

➲ Vegetable crops – update of N, phosphorus (P) and potassium (K) advice for vegetable crops based on best available information has been included.

Fertiliser advice from Johnstown Castle has always been based on a combination of agronomic and economic factors. In recent decades, environmental sustainability has been given increased prominence and is advocated by adherence to codes of good agricultural practice, by taking account of nutrients in organic manures and by applying no more nutrients than were necessary to achieve optimum yields of crops.

As more scientific studies are conducted with the aim of increasing the technical and environmental efficiency of Irish farm production systems, new advice must be developed and effectively disseminated to achieve practice adoption by advisers and farmers. The new *Green Book* of nutrient advice is an example of this process and aims to provide the agricultural industry with the latest knowledge to manage our most important resource "our soils" for the future.

The new *Green Book* is available as a free download at: https://www.teagasc.ie/media/website/publications/2016/soil-fertility-green.pdf. To receive a printed copy, please contact Ms Sarah Lacey, Teagasc, Johnstown Castle, 053-9171200 or email: sarah.lacey@teagasc.ie.

IRISH FARMERS JOURNAL
Saturday 11 February 2017

P & K for cereal crops – protect the bottom line

Mark Plunkett of Teagasc Johnstown Castle on how farmers must focus on effective nutrient programmes to drive crop yield potential

Currently, there are a number of external factors, outside of our control, putting downward pressure on grain prices. The instant reaction is to cut fertiliser inputs where possible to protect the bottom line.

As fertilisers represent a significant cost in producing one tonne of cereal grain, there is much discussion to reduce or omit phosphorus (P) and potassium (K) applications for the 2017 crop. Currently, fertiliser prices (P and K) are back on 2016 prices and represent approximately 27% of total production costs.

Profitable crop production depends on three pillars; cost per tonne, grain yield and price per tonne. Soil fertility is a key driver of grain yield. Therefore, now more than ever, the focus must be on tailoring effective nutrient programmes to drive crop yield potential while keeping a close eye on our costs per tonne to deliver a positive crop margin at harvest time.

Soil pH, P and K fertility

Recent results from Johnstown Castle show that 85% of tillage soils are deficient in one or more of the major soil nutrients (pH, P or K).

For example, 55% of tillage soils require lime, while 59% of soils have very low to low levels (Index 1 or 2) of P and K. Twenty-one percent of fields have optimum P and K (Index 3) levels for cereal production, while 20% of soils are Index 4 for P or K and offer an opportunity to reduce costs in the current year.

This highlights the importance of knowing the soil's fertility status and working from a recent soil test report to make best use of applied nutrients.

Target levels

Soils will have different levels of available P and K which have been built up from the application of fertilisers and manures over time. The level of available soil P and K at which yield response plateaus is known as the critical soil P and K level (see Table 1).

Below the critical level, there is a decrease in yield and a financial loss (Index 1 and 2). Above the critical level (Index 4), there is no justification to further increase soil P and K through fertiliser/manure applications and doing so can be an unnecessary financial cost.

It is generally understood that the critical level will not change, but there may be differences in grain yield depending on seasonal factors (weather) between growing seasons. Soils supplied with adequate (Index 3) soil P and K will generally not show a yield response in cereals to additional P and K either in manure or fertilisers.

When soils are maintained at the critical levels (Index 3) for that soil type, then the amount of P and K applied should replace crop off-take (see Table 2). When soils are below the critical level, additional P and K above that removed in crop off-takes needs to be applied to build soil reserves close to critical levels (see Table 3).

Advice

P and K advice for cereals needs to be adjusted to take account of higher yields. Over the last two years, grain yields have exceeded the national average for winter and spring cereals crops by up to 2t/ha.

The extra yield will have removed more P and K at harvest time and will need to be taken into account in order to maintain the soil's yield potential.

Phosphorus is critical for rooting and tillering in both winter and spring cereal crops, especially on low to very low fertility soils. The majority of P is removed in the grain at harvest time, while a small proportion of P is removed in straw.

Now more than ever we must focus on tailoring effective nutrient programmes to drive crop yield potential while keeping a close eye on our costs per tonne to deliver a positive crop margin.

Cereal crops have a large seasonal demand for K and significant amounts are removed in high-yielding cereal crops. At harvest time, 50% of the crop K is in the grain, while the remaining 50% is in the straw. Where straw was not removed from fields in 2016, K rates should be adjusted to take account of K returned in chopped straw.

Maintenance rates

Table 2 shows the rates of P and K required to produce a cereal crop depending on the target grain yield. Phosphorus rates are the same for all cereal crops with a base grain yield requiring 25kg P/ha to produce a grain yield of 6.5t/ha. For every extra 1t above the base yield, an additional 3.8 kg/ha of P is required.

Potassium rates are different, depending on the cereal type. For example, oats and spring cereal crops remove more K than either winter barley or wheat.

The rates shown in Table 2 will replace the P and K removed at harvest time depending on the grain yield. Where soil P and K fertility is at Index 3, these rates will maintain soil fertility at the optimum index for grain yield.

When deciding on the rate to apply, take the highest grain yield in any one of the last three years and use this as your target grain yield to calculate your P and K crop requirements for 2017.

Build-up rates

Building soil P and K levels requires additional nutrient to increase soils at Index 1 or 2 to the optimum Index 3. The rate of soil build-up will depend on the soil type and assumes soils are at the optimum soil pH (6.5).

Index 3 soils have a higher grain yield potential, as these soils have a higher supply of P and K, thereby producing higher grain yields. Nutrient advice for Index 3 soils is aimed at replacing P and K removed at harvest time in grain and straw and don't require build-up rates.

Applying build-up rates of P and K results in building the soil fertility and yield potential of your soils over time.

The yield potential of winter wheat, for example, is very much related to soil

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Table 3: P and K build up rates (kg/ha) for cereals

Soil index	P	K
1	20	30
2	10	15

fertility index. Recent research shows that an Index 3 soil will yield up to 1.75t/ha more than an Index 1 soil.

For spring cereals, P placement on low-fertility soils will increase the crop P utilisation and ensure that P is available at an early stage to develop the crop's yield potential.

For example, spring barley develops yield potential in the first three to six weeks after sowing and having an available supply of nitrogen (N), P and K close to the seed/rooting zone is critical to develop the crop's yield potential in terms of tiller production.

Winter wheat is different in that it develops its yield potential over a longer period and has good ability to compensate for yield by producing more grains per ear.

Table 3 shows the additional P and K required for building soil fertility. Building soil fertility is a long-term investment and it will pay dividends in terms of extra grain yield. Maintaining a soil pH 6.5 is a critical factor to improving soil P and K levels and should be a priority consideration when aiming to build soil fertility.

Table 4 shows the recommended rates of P and K for a 7.5t/ha (3t/ac) spring barley crop on P and K Index 2 soils, while Table 5 shows the recommended rates of P and K for an 11t/ha (4.5t/ac) winter wheat crop on P and K Index 2 soils.

Table 1: Soil nutrient index, response and soil test range for P and K

Index	Nutrient Response	P (mg/l)	K (mg/l)
1	Definite	0 - 3.0	0 - 50
2	Likely	3.1 - 6.0	51 - 100
3	Unlikely / tenuous	6.1 - 10	101 - 150
4	None	>10	>150

Table 2: P and K maintenance (Index 3) rates (kg/ha) for spring and winter cereals

Yield t/ha	Cereals	Spring barley / Spring wheat	Winter wheat / Winter barley	Winter oats / Spring oats
	P	K	K	K
6.5	25	74	65	98
7.5	29	85	75	112
8.5	33	97	85	128
9.5	36	108	95	142
10.5	40	120	105	156
11.5	44	131	115	172

kg/ha x 0.8 = to units/ac; t/ha ÷2.471 = t/ac

Table 4: P and K advice for 7.5t/ha spring barley

Soil test P & K	Maintenance	Build-up	Total P & K advice	Suggested fertiliser programme
P Index 2	29	+ 10	= 39	39 x 0.8 = 31 units/ac 100 x 0.8 = 80 units/ac Fertiliser req 3.8 bags/ac 12:8:20
K Index 2	85	+ 15	= 100	

Table 5: P and K advice for 11t/ha winter wheat

Soil test P & K	Maintenance	Build-up	Total P & K advice	Suggested fertiliser programme
P Index 2	42	+ 10	= 52	52 x 0.8 = 42 units/ac 125 x 0.8 = 100 units/ac Fertiliser req 4.0 bags/ac 10:10:20 Apply one bag/ac 50%K every third year
K Index 2	110	+ 15	= 125	

IRISH FARMERS JOURNAL
Saturday 11 February 2017

Spreading: the machine is critical

Fertiliser is a hugely important and expensive input. The role of the fertiliser spreader in applying fertiliser evenly is often underestimated, writes **Dermot Forristal**

Uneven spreading is not uncommon. Crop or grass yield is impacted long before any visual striping is seen. In the lifetime of a fertiliser spreader working on a 100ha tillage farm, poor spreading could cause a crop loss of €40,000. To avoid these losses, three critical factors must be considered:

➲ The correct choice of machine for the fertiliser being used at the chosen bout width.

➲ The use of fertiliser with good physical quality characteristics.

➲ Correct setting of the machine for fertiliser and bout width and proper maintenance.

The challenge

Todays' spreaders have a huge challenge, with farmers using bout widths from 6m to 36m. Broadcast spreaders rely on forming an overlapped pattern (Figure 1) to give an even spread.

Some 12m spreaders will spread fertiliser 24m, with fertiliser visible in the next tramline. This is challenging in perfect conditions, but in the field with bumpy ground and wind, it's much more difficult.

Machine design

Not all fertiliser spreaders are equal. While many will judge a fertiliser spreader on how robust it is or the quality of its paint, the most important characteristic is how evenly it spreads fertiliser.

Machine design has a huge impact on how evenly the fertiliser is spread. The only way to assess a particular model is to have a spread test report where evenness of application is measured.

While the major fertiliser spreader manufacturers have their own test facilities capable of giving very accurate test results, they only put the best results in their brochure.

Results from independent test halls are of far more value, but these tests are increasingly rare. You should look for an independent test result and always favour a manufacturer who provides one.

What to look for in a test result

The evenness of spread is frequently summarised by a single figure; the coefficient of variation (CV) – the lower the CV percentage the better the spread pattern. A CV value of less than 15% would be acceptable in the field, but figures of 5% to 10% should be demanded from a test hall where perfect conditions prevail.

But the CV does not tell the full story. The shape of the basic spread pattern determines how likely good spreading will be achieved in the field. A triangular shape, like that in Figure 1, tells us that the spread will be a little less sensitive to wind or fertiliser variation than the more shouldered pattern of Figure 2.

The spreader producing a pattern like Figure 2 would need to be very carefully set to suit the fertiliser characteristics and spreading conditions. Better spreaders should have both a low CV and a good basic spread pattern – and these should be verified by an independent test.

Fertiliser quality

The physical characteristics of the fertiliser will affect how evenly it spreads and the settings required. The key factors are:

➲ Density of the fertiliser – low-density fertiliser such as urea (80% normal density) is more difficult to throw.

➲ Size of the granules – generally larger particles will throw further. Particle size distributions with the majority of particles (80%) in the 2mm to 4mm range will usually allow a good spread to be achieved, but larger diameters (3mm to 4.5mm) will probably make it easier achieve wider spread widths. The component parts of blends should have similar size distributions.

➲ Shape of the granule – rounded particles will roll off the disc more predictably than irregular granules.

➲ Strength of granule – strong particles will resist break-up on the disc.

When purchasing fertiliser, always take physical quality into account when making choices.

Urea

Urea will be more widely used across all farm types in the future. Its lower density presents a greater spreading challenge and it usually will not spread as wide as denser material. Look for a urea product with larger particle sizes by asking the supplier for the size distribution figures.

Even with a good-size distribution, it is vital that the correct spreader setting is used and that the limitations of the spreader with urea are observed (maximum bout width, etc).

Wind will affect urea more than ordinary fertiliser, so spread in calm conditions if possible. Blends of urea and conventional-density fertiliser need to be considered very carefully.

Proper size-matching of particles (larger urea with smaller dense fertiliser particles) can help even spreading, but the onus is on the fertiliser supplier to show that this can be achieved.

Machine setting

Spreaders need to be correctly set/adjusted for specific fertilisers spreading at specific bout widths. Some spreader models require very careful setting. The components that are adjustable vary between manufacturer and model but include one or more of the following:

While many will judge a fertiliser spreader on how robust it is or the quality of its paint, the most important characteristic is how evenly it spreads fertiliser.

➲ Disc type.

➲ Pto/disc speed.

➲ Vane type and position/angle on disc.

➲ Position of fertiliser drop point.

➲ Disc height over crop/soil.

➲ Spreader/disc angle.

The setting is determined by fertiliser type (density, particle size distribution, shape, strength) and bout width. Setting information is usually available in detailed setting charts provided by the manufacturer, but increasingly is more easily accessible on the internet or as a smart phone app.

While some manufacturers provide setting information for specific fertiliser brands, increasingly a simple sieve test and visual type test are used to identify fertiliser type and consequently the settings required. It's vital to follow the setting procedure.

Rate setting

Getting the correct rate of fertiliser out (kg/ha or bags/acre) is also important and while manufacturers' setting guides are a starting point, some level of field calibration is usually needed.

Some makers have very useful setting aids and of course on-board weighing systems make it very easy. Whatever system is used, it is important to establish the correct rate setting before field-scale errors are made.

Field use

Correct attachment to the tractor to make sure it's level from right to left and at the correct angle front/back and height over the crop is essential, as is a working rev counter.

Driving at accurate bout widths is essential; tramlines facilitate this in cereals and GPS guidance systems can help when there are no tramlines. However, there is no shame in measuring and marking the bouts! Wear on the spreader components: fertiliser outlet, disc, vanes or spouts must be monitored.

Headland

To avoid uneven spreading on the headland and the loss of fertiliser into headlands/drains, most spreaders have a headland setting mechanism which adjusts the spread pattern.

Matching the in-field runs with the headland runs requires the spreader to be turned on and off at exactly the correct times as the tractor approaches and leaves the headland – on high tech spreaders, this can be automatically controlled by GPS, but careful manual operation is possible once the distances are known.

Participants in the 2016 Teagasc crops nutrition management course, facilitated by Mark Plunkett and in association with the Fertilizer Association of Ireland, which has become an industry standard for soil and fertiliser training. The six-day course is run in Nov/Dec each year and includes both technical and practical modules delivered at the Teagasc research centres at Johnstown Castle and Oak Park and at Kildalton College. Contact Mark Plunkett, Teagasc, for details of the 2017 course.

Figure 1
Basic (shaded area) and overlapped (line) spread pattern at 18m: Good pattern

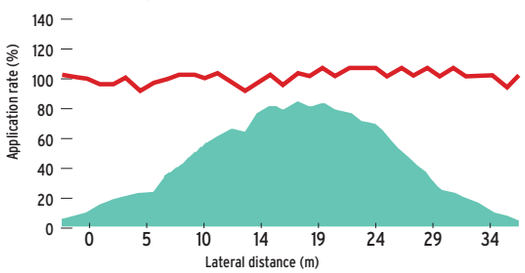
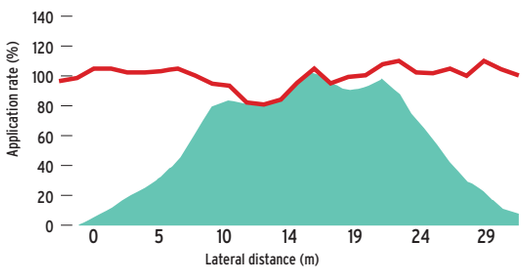


Figure 2
Basic (shaded area) and overlapped (line) spread pattern at 18m: Shouldered pattern



IRISH FARMERS JOURNAL
Saturday 11 February 2017

Soil fertility underpins grassland potential

Teagasc's **John Maher** explains it is now more important than ever to exploit the potential of grazed grass during the entire grazing season

Ireland's competitive advantage in livestock production is based on the efficient production and utilisation of pasture. Grass production will be maximised on farms where soil fertility status is high, adequate nitrogen fertiliser is being applied and pastures are predominantly perennial ryegrass/white clover based. It is now more important than ever to exploit the potential of grazed grass during the entire grazing season. It is obvious from National Farm Survey Data and PastureBase Ireland data that most farms have the capacity to grow more grass. This data broadly demonstrates that for every additional tonne of grass utilised/ha, net profit increases by about €180/ha on dairy farms and €105/ha on drystock farms.

However, high fertiliser prices and enhanced regulation under the Nitrates Directive have led to a decrease in soil fertility levels. Approximately 90% of the soils sampled in Ireland are limiting in one of the three major factors that affect soil fertility (pH, P and K). This results in a significant reduction in grass production particularly at the shoulders of the grass-growing season. Poor soil health also lowers the efficiency of nitrogen fertiliser application. Therefore, farmers must place a greater emphasis on soil fertility management.

Table 1: Converting soil results to indexes – target Index 3

Soil test P (mg/L)	0 - 3.0	3.1 - 5.0	5.1 - 8.0	+ 8.1
Soil test K (mg/L)	0 - 50	51 - 100	101-150	+ 151

Trying to plan fertiliser application strategies without information on soil fertility levels is impossible. Therefore, soil test results for the whole farm are essential. Although it costs money to increase fertility levels on low fertility soils, the returns in terms of grass production can be considerable, which can increase livestock carrying capacity, increase the provision of winter feed (silage) and enable ryegrass to persist in the sward.

Improving soil fertility

The first step is to take soil samples. This should ideally happen in November, December or early January. Many milk processors have incentivised soil sampling and analysis, so every dairy farmer should take advantage of this. About €150 to €200 will get 10 samples taken and analysed on a 100-acre (40ha) farm.

So the first step to grow more grass is to look below the surface. To do this, we need to carry out a soil test. We need to ensure that a good representative sample of the field is taken for the soil test. It is recommended that one sample box is taken for every eight to 10 acres (about 4ha) and that the box is full (a minimum of 20 cores).

The next step is to study the results and identify what each paddock/field needs in terms of P, K and lime. The starting point when building soil fertility is to apply lime according to the soil test recommendations. Soil pH affects the availability and crop uptake of both macro and trace elements. The ideal pH for grass growth is 6.3. This maximises the availability of nitrogen (N), phosphorus (P) and potassium (K). Applying lime to increase the soil pH, will increase nutrient uptake and DM yield and improve the long-term persistency of perennial ryegrass and clover in the sward.

Recent research illustrates that 5t/ha of lime applied to a soil with low pH (5.3) increased grass production by approximately 1.5t DM/ha in the following two-year period. Previous research on a soil with very low soil pH (5.3) and old permanent pasture indicated that the application of 7.5t of lime/ha increased the stock-carrying capacity by 20% by the end of the first year and by 100% in the fourth year. The impact on grass production was attributed to the effect of lime on soil organic matter breakdown. Liming was estimated to be equivalent in benefit to using approximately 60 units/ac (72kg/ha) of N fertiliser per year. It is also important to remember that liming acidic soils to correct soil pH will increase the availability of soil P and K.

Grass requires a continuous and balanced nutrient supply from the soil to achieve its production potential. Some well-managed and fertile farms are capable of growing in excess of 16t grass DM/ha annu-

ally. This level of grass production requires large quantities of nutrients, such as the major nutrients nitrogen (N), P, K and sulphur (S).

Current trends in soil P and K status indicate a movement from higher and more productive Index 3 and 4 down to low fertility Index 1 and 2. The target for both P and K needs to be Index 3 (targeting high values within Index 3).

Upgrading soils with poor fertility status is essential to prevent an overall reduction in soil fertility below that required to grow productive grass swards in time. Increasing soil fertility of Index 1 and 2 soils up to Index 3 is vital to maintain high grass DM production across the farm. Recent research has shown that soils with P Index 3 will grow approximately 1.5 DM/ha per year more grass than soils with P Index 1.

A longer-term study on the effect of P fertiliser on grass production on two sites with low soil P showed that low inputs of P (15kg/ha per year or 12 units/acre/year) resulted in grass production benefits of close to 1t DM/ha per year. Most of the grass production response in these experiments took place in spring and early summer. So, most P application should be targeted in the first half of the year.

Fixing a deficiency in soil K also increases grass production. There are no regulatory restrictions on the application of potassium (K) and it is about half the cost of P fertiliser, yet Irish soils are also very deficient in K. Unlike P, most K application should be targeted towards the latter half of the year.

Slurry is a valuable source of nutrients on every farm. The fertiliser value of slurry translates to approximately five units of P and 30 units of K per 1,000 gallons (similar to one bag of 0:7:30). Slurry should be targeted at the paddocks with lowest soil index. To maximise the nutrient response from slurry, application should take place during spring. Slurry alone will not be adequate to maintain P and K in silage paddocks and these two nutrients must also be applied in the form of chemical fertiliser.

The slurry that is on your farm is the cheapest form of fertiliser you can have. So make use of it.

Finally, sulphur (S) is also a key nutrient that needs to be applied in fertiliser, especially on light, free draining soils. Deficiency of S in swards will reduce grass production by up to 14% and also reduces the response to N fertiliser. Sulphur application should be carried out in April/May and about 15 to 20 units/acre of S is required to be applied before July 1st.

Moving from Index 1 to 3 for soil P and K and having pH (lime status) right (pH 6.2) will increase grass production by an extra 3t grass DM/ha/year. This is worth over €300/ha/year additional profit on a farm.

THE FERTILIZER ASSOCIATION OF IRELAND SOIL SCIENCE AWARD: PJ Browne, president of The Fertilizer Association of Ireland, presents BAgrSc (animal science) stage three student Nigel Kennington with his award at the UCD School of Agriculture and Food Science annual prize-giving awards ceremony.

IRISH FARMERS JOURNAL
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FARM SAFETY

SAFE FAMILY FARMS

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Put safety first on your farm

Teagasc health and safety specialist **Dr John McNamara** outlines practical actions in 2017 to prevent injury or death through farm accidents

In 2016, 21 people lost their lives in farm accidents. This represents tragedy for the farm families affected. While it is a reduction on the horrendous 30 farm deaths in 2014, there were three more deaths than in 2015 when 18 people lost their lives in farm accidents.

The farm workplace death statistics are far from satisfactory. One death or serious injury is one too many. We must all take practical actions throughout 2017 to prevent injury.

Last year, one child under 16 years old died compared with four in 2015. Nine were aged 65 years or over compared with five for the previous year. The young and older farmers deserve particular care. The farm death level made up 47% of all workplace deaths while just 6% of the workforce is employed in the sector.

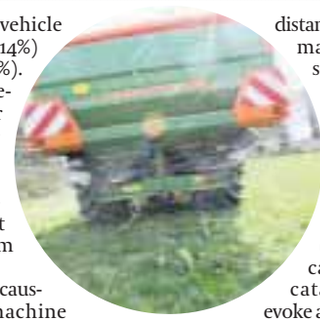
Causes of accidents

A HSA/Teagasc study indicates that farmers predominantly see farm safety with tractors and machines as involving PTO and machine entanglements, whereas in reality most fatal vehicle accidents occur due to being "struck, crushed or a fall". While keeping the risks of entanglement to the fore, we need to communicate the full range of causes of vehicle accidents among farmers.

Consistently, about 50% of accidents are attributable to machinery use. Ten-year data show the following trends:

➲ For vehicles, being crushed (67%) is the most frequent cause of death, followed by falling from the vehicle (12%), overturning (14%) and being struck (7%).

➲ For machinery, being crushed (38%) or struck (35%) are the most frequent causes of death followed by PTO (11%) and machine entanglement (11%) and falls from machines (3%).



The most frequent causes of tractor and machine deaths are tractor crushing, being struck by or falling from a vehicle. This happens most often in the farmyard and involves relatively slow-moving vehicles. With larger modern tractors near-distance visibility can be reduced making it much harder to see persons near the vehicle such as children or older adults. Safe parking is crucial to prevent accidents due to tractors rolling forwards or backwards.

The psychology concept of "dread risk" indicates that humans dread catastrophic events which evoke a fear response such as PTO entanglement leading to gruesome injury. In contrast, who dreads the movement of a relatively slow-moving vehicle? Nonetheless, these are causing most accidents.

> The most frequent causes of tractor and machine deaths are tractor crushing, being struck by or falling from a vehicle

Prevent musculoskeletal disorders

The major health-related problem among Irish farmers is a musculoskeletal disorder (MSD) with 56% being injured each year. Frequently, MSDs are painful and long-lasting.

Research in this area has been conducted by Dr Aoife Osborne, FBD lecturer in farm safety at the School of Agriculture and Food Science, UCD. The most commonly experienced MSDs are back injury (37%), neck and shoulder pain (25%) hand/wrist/elbow (10%), knee (9%), ankle/foot (9%) and hip pain (8%).

International research indicates that heavy lifting is a major cause of MSDs. The Irish study indicated that working long hours increases MSDs. The message is clear: to prevent MSDs, cut heavy lifting and organise work to limit exposure.

Good farmyard layout

A good farmyard layout allows delivery and storage of fertiliser and adequate space for vehicles to turn. When fertiliser is being stored and spread at a location which is away from the farmyard, thought should be given to how the fertiliser is stored and filled into the fertiliser spreader.

Keeping fertiliser spills to a minimum cuts the risk of slipping or falling. Some fertiliser products are inherently slippery while others are oil-based or absorb moisture so they can get slippery when spilled.

Loading-up with fertiliser requires concentration. The safety of bystanders, particularly children and older farmers, should be given first priority. The majority of childhood and older farmer farm deaths are due to tractor and machinery movement in farmyards.

Choosing bags

The options of bulk spreading, and half-tonne bags are now widely available. Gone are the days when 50kg bags were the only option regarding handling fertiliser. Also, the level of mechanisation on farms gives more options than in the past.

Bulk

The bulk option takes the "weight off your shoulders" and also frees up work time for important farm management tasks. There are many excellent contractors available to spread bulk; having good communications, however, is essential if fertiliser needs to be spread in your absence.

Big bags

The following safety controls have been devised for big bags generally, but always follow any instructions given for individual products. Always beware of overhead electrical cables.

➲ Before lifting, check that lifting loops are not worn or cut. The forks or hooks being used should be smooth.

➲ Bags should not be pulled along the ground.

➲ Bags should not be allowed to swing against handling equipment or be left suspended for any length of time.

➲ When cutting the big bag, never stand underneath the bag or cut the underneath of the bag.

➲ When emptying, suspend the bag over the spreader and cut an "X" on the side of the bag 15cm above the base, with a long-handled knife.

Small bags

Small bags require lifting and to minimise this, lift off a trailer at waist height or by drawing along a trailer to the spreader. This prevents lifting from ground level. If lifting a bag, stand the bag upright, adopt a shoulder-wide boxer stance with your feet firmly on the ground, bend your knees and keep your back straight and lift with your thigh muscles. Keep the bag close to your body and grip it firmly. Point in the direction of the fertiliser spreader and never twist your spine by having your back to the spreader. Training should be undertaken and alternatives should be considered to minimise lifting.

Fertiliser spreading on sloping ground

Fertiliser spreading on sloping ground needs particular attention due to the risk of tractor overturn. Driver competence and experience is crucial for this task.

The following points should be considered.

➲ Consider your alternative land-use options for steep slopes.

➲ Make sure that you are familiar with the slope by walking it before driving it. Slopes that are very wet or dry ground on which rain has fallen are particularly dangerous. Drive up and down a slope, not across it.

➲ Make sure that the tractor is in sound condition, and preferably use a four-wheel drive tractor.

➲ Select the right gear before approaching the slope to avoid gear change on the slope.

➲ Keep as much weight uphill as possible and use front-end weights.

➲ Use wide turning circles and turn uphill if driving across a slope for access.