



## Introduction to Fertilizers



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# Introduction to Fertilizers

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## Fertilizers For Turf - An Introduction to N-P-K

In very general terms, fertilizers are products that improve the levels of available plant nutrients either directly to the plant or via the soil.

There are a number of nutrients that are classified as Essential Nutrients. These Essential Nutrients are required by the plant in order to complete its life cycle and/or are directly involved in plant metabolism or required in a metabolic reaction.

The reason that some turf areas do not need these nutrients applied on a regular basis is because they are either already present within the rootzone, or already supplied via top dressing treatments or other means. These nutrients (shown with their chemical symbol) can be classed as Macro and Micro (or trace) nutrients. Macro nutrients are needed in far higher quantities than micro nutrients, but all are equally important. If there is a deficiency of one nutrient then the plant will suffer:

### Macro

Carbon (C)  
Hydrogen (H)  
Oxygen (O)  
Nitrogen (N)  
Phosphate (P)  
Potassium (K)  
Calcium (Ca)  
Magnesium (Mg)  
Sulphur (S)

### Micro (Trace)

Iron (Fe)  
Zinc (Zn)  
Copper (Cu)  
Manganese (Mn)  
Molybdenum (Mo)  
Boron (B)  
Chlorine (Cl)

Carbon, Hydrogen and Oxygen are derived from Carbon Dioxide in the air, absorbed by the leaves, and in water, absorbed by leaves and the roots. The remaining elements are mainly taken in by the roots, but may also be absorbed by the leaves if fertilizers are applied.

### What Do Essential Nutrients Do?

It's very difficult to make a definitive list of the role nutrients play in growth because they're all involved with many physiological responses within the grass plant. However, the following list highlights some of the primary functions that each nutrient is responsible for:

- **Nitrogen** – vegetative growth, colour
- **Phosphate** – root development and energy transfer
- **Potassium** – plant metabolism and water regulation
- **Magnesium** – part of chlorophyll and root growth
- **Calcium** – cell structure, chlorophyll content (also important in soil structure)
- **Iron** – chlorophyll constituent
- **Manganese** – protein, N availability



## So Why Does Turf Need Feeding?

The soil is the grass plant's nutrient resource and the aim is to balance the nutrients within it. The uptake and availability of certain nutrients can be restricted by excesses or insufficient quantities of other nutrients. For example high amounts of Potassium can restrict the uptake of Magnesium. A soil analysis can help to determine the nutrient balance within the rootzone.

Regular maintenance is key to producing premium quality turf. When turf is mown, nutrients are removed in the clippings and must be replenished. Fertilizers assist in the production of uniform surface condition. They help keep turf healthy and aid its recovery from wear and tear. In addition to benefiting the health of the plant, they also enhance the appearance of turf. Whilst this is a long list of tasks, all are achievable with the right planning and implementation. Today's modern fertilizers have a lot to offer the turf professional and can play an important part in an Integrated Turf Management (ITM) programme.

## What Differences Will I See?

The most obvious effects on turf are colour and growth. Less obvious are improved rooting, wear tolerance and drought tolerance, if the appropriate fertilizer is selected.

## If I'm Using Fertilizer, What Is A 'Good Result'?

Strong, healthy turf that looks good and is tolerant to various stresses (environmental and disease). For sportsturf, the surface will meet the expected playing standard.

## Fertilizer Types

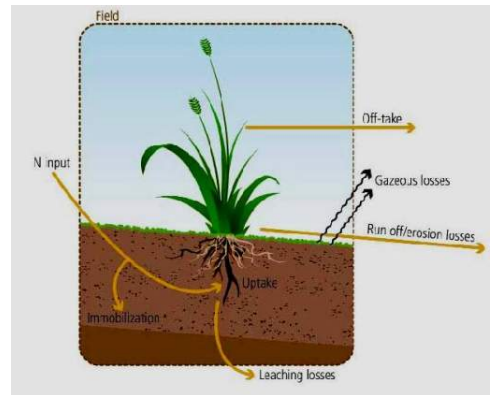
There are lots of ways of applying nutrients to turf, it's really a case of using what works best for you on your particular turf area. Some people prefer granular applications and some prefer liquids. Many turf professionals use a combination of fertilizer types to achieve good growing conditions. The most ideal fertilizer programme is one that maintains consistent root and vegetative growth throughout the growing season without flushes of vegetative growth. Using Scotts products as an example, the fertilizer types available are:

- **Conventional release** – Greenmaster Pro-Lite and Sportsmaster
- **Slow release (SRFs)** – Sierraform GT
- **Controlled Release (CRFs)** – Sierrablen and Sierrablen Plus
- **Organic** – Greenmaster Organic and Sportsmaster Organic
- **Liquid** – Greenmaster Liquid water soluble (WSFs) - Sierrasol



In order to make an informed choice of what type of fertilizer to choose, it is important to understand some of the key features/benefits of the different types.

Some fertilizers release all of their nutrients immediately after application (conventionals, liquids, WSFs). These products will produce a quick turf response in terms of colour and growth, but care should be taken as they may increase nutrient losses out of the system. These losses may be via a flush of growth (clippings removal), surface run-off, leaching or gaseous losses.



Slow release, controlled release and organic fertilizers deliver their nutrients over a certain period, with SRFs and CRFs doing this in the most consistent and reliable way. By delivering nutrients in a gradual way over 6-8 weeks (SRFs, i.e. Sierraform GT) or from 3 months up to 9 months (Sierrablen and Sierrablen Plus) then losses out of the system can be greatly minimised and nutrient use efficiency greatly improved.

Turf benefits include:

- Safe and consistent feeding
- Nutrient release based on turf needs
- Efficient use of nutrients
- Environmentally friendly
- Better turf quality

The following example demonstrates how a high analysis fertilizer with CRF technology reduces nutrient loading compared to a conventional fertilizer with a low nutrient analysis.

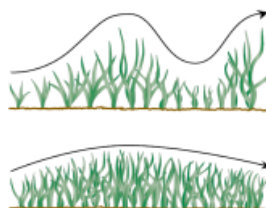
## Minimise nutrient losses

Product	N	P	K	Rate (L/Ha or g/m <sup>2</sup> )	Kg N/Ha
Conventional release	8	0	0	35	28
5M controlled release	24	5	8	45	108

28 / 1 week release =  
**28Kg N available week 1**

108 / 28 week release =  
**<4Kg N available week 1**

- Speed of nutrient release?
- Nutrient loading after application:
  - Leaching / surface run-off
  - Gaseous loss
  - Excess growth
  - Clipping (nutrient) removal

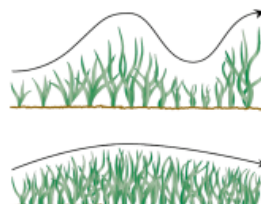


The example below demonstrates how a CRF will reduce the number of applications to turf over a certain time period compared to a conventional fertilizer. Turf quality is also improved through the use of CRF technology.

## Minimise nutrient inputs

Product	N	P	K	Rate (L/Ha or g/m <sup>2</sup> )	Kg N/Ha	# applications /YR	Kg N/Ha/ YR
Conventional release	8	0	0	35	28	4	112
5M controlled release	24	5	8	45	108	1	108

- Longevity of nutrient release:
  - Number of applications?
  - Cost of spreading fertilizer (Hrs & £)
  - Total nutrient inputs?



## All Fertilizers Are Not The Same – What To Look Out For

Simply looking at the nutrient analysis of a fertilizer will only give you limited information about the product. Other factors to be aware of include:

### **Longevity**

The longevity of a product will affect the performance (see earlier points) and also the real cost of a fertilizer. For example, a product that only needs to be applied once in a season may appear expensive compared to a fertilizer that needs to be applied four or five times when compared per kg, but is likely to be cheaper when compared over the whole season.

### **Granule Size**

The size of the granule is key for turf cut at low heights (golf and bowling greens).

Small granules are essential for dispersing into the turf sward, to avoid mower pick-up and disruption to play. It is possible to use larger granules on grass that is left longer.



Uniform granule size is important for even distribution using rotary spreaders and for blended products (not recommended for close cut turf), to ensure there is no segregation of the components in the bag or spreader.

### **Nutrient Source**

The Nitrogen source should be declared on the label. Other nutrient sources may not be. Turf safety can be compromised by use of fertilizers high in chlorides with a high salt index – this can cause direct burning on the leaf or increase salt levels in the soil contributing to a physiological drought on the plant.

## Number Crunching – What Do The Numbers Mean?

N-P-K. Depending on which country you're in, these have to be declared as oxides (UK), i.e. N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, or as Elemental, i.e. N, P, K. The number that appears on the bag is % weight/weight.

So a bag of fertilizer with analysis of 24-5-8 contains:

- 24% N
- 5% P<sub>2</sub>O<sub>5</sub>
- 8% K<sub>2</sub>O

So if your bag of fertilizer weighs 25kg, then:

- 6kg N
- 1.25kg P<sub>2</sub>O<sub>5</sub>
- 2kg K<sub>2</sub>O

As this adds up to 9.25kg, you've probably wondered what other materials make up the bag. Some will be non-declarable constituents of the nutrients that are declared on the label.

The remainder consists of fillers and conditioners including anti-dust and anti-caking additives and fertilizer technologies such as controlled-release coatings. Pure granular nutrients are unsuitable for application to turf because of the problem of how to safely and evenly spread nutrients across an area.

To calculate the amount of nutrients applied per area, you simply multiply the application rate (Kg/Ha) by the % nutrient content. It is standard practice to state nutrient application rate in kg/Hectare (Ha). For example:

A 24-5-8 fertilizer with 5 months longevity applied at 45g/m<sup>2</sup>.  
45g/m<sup>2</sup> = 450kg/Ha

450 x 24% = 108 kg N/Ha

450 x 5% = 22.5 kg N/Ha

450 x 8% = 36 kg N/Ha

For liquids, nutrients are also declared on a % weight/weight basis. To calculate nutrients applied per application, you need to know the specific gravity or density of the liquid.

A litre of water will weigh 1kg, other liquids may weigh more or less. For example:

12-4-6 liquid fertilizer applied at 60l/Ha

Specific Gravity (SG) = 1.18 Kg/L (i.e. 1 litre of product will weigh 1.18kg)

First, calculate weight of liquid applied per Ha.

60 x 1.18 = 70.8kg/Ha

Then follow same procedure as for granules:

70.8 x 12% = 8.5 kg N/Ha

70.8 x 4% = 2.8 kg N/Ha

70.8 x 6% = 4.2 kg N/Ha



## It's All In The Timing

An important aspect of managing sports turf is understanding how turf naturally grows through the season and what stresses it endures at different times of the year. If we can optimize turf growth and minimize the stresses it faces, you are half way there to producing a great playing surface.

In general, grasses grown in the UK (cool season grasses) all follow a very similar natural growth pattern. From Spring until early Summer there is the first growth peak of the year, followed by a slowing down of growth during the height of the Summer. As temperatures cool in later Summer/early Autumn the second (smaller) growth peak occurs followed by a real slowing down in the late Autumn/Winter where the grass goes into dormancy.

In order to achieve great sports turf we have to provide it with light, water and nutrients. There is little we can do about light levels, apart from redesigning stadia, moving geographic location or using lighting rigs, but there are now many tools available for managing turf nutrition.

The essential nutrients discussed earlier need to be present in order for the plant to survive. There will be a certain reservoir of nutrients in the soil but for the rest, they will need to be applied via fertilizer applications. In order to have a great performing sports surface you have to have grass that does more than just survive. It must be tolerant to the stress of demanding match schedules and resist wear and tear for the full duration of the playing season.

### How To Apply

The fertilizer industry recommends the following Best Management Practice:

- **Right product** – Select the right fertilizer for your application
- **Right rate** – Match the right fertilizer with crops and soil/growing media conditions
- **Right time** – Match the fertilizer availability with the crop demand
- **Right place** – Position the fertilizer near the plant for efficient use

Earlier on in this document we looked at the different types of fertilizers and how to calculate application rates. Now let's look at timing.



## Matching Nutrient Inputs According To Growth Phases

The nutritional requirements of a sports surface can be met if fertilizers are applied in certain ratios at particular times during the season. Fertilizer should be applied to match the natural growth pattern of grass, while at the same time having an awareness of the other interactions such as climates, diseases, water resources and players!

### **Winter**

In the middle of Winter minimal nutritional inputs are required as the grass is likely to be in dormancy or growing very slowly. However, in milder Winters when the turf is growing, some low level feeding will help maintain a healthy plant.

Nutrient inputs at this time of the year should be kept to a minimum using either:

- Low application rate of liquids
- Low analysis conventional fertilizers, or
- Slow release fertilizers that can only release nutrients when the conditions are suitable for turf growth

Using these types of fertilizers will help harden the turf and ensure there is no excess soft growth.

Very low Nitrogen inputs are required during this growth stage whilst high Potassium levels can enhance turf hardening. Use of Iron containing fertilizer can help give a turf colour response without excess growth.

### **Spring**

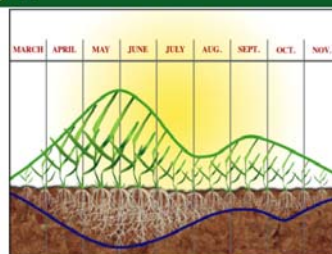
As turf comes out of its Winter dormancy with the onset of Spring, it's important to match this natural growth peak with appropriate fertilizer inputs.

A liquid fertilizer can be a good option as the first application of the season. When soil temperatures are low, liquids provide nutrients direct to the plant, bypassing the roots altogether. Certain nutrients such as Phosphorus are actually unavailable when soil temperatures are low so foliar feeding is essential.

Alternatively, a low Nitrogen content granular product such as Greenmaster 6-5-10 can give a good start in early Spring without giving too much growth, at the same time hardening the turf at this early stage in the season.

## ANNUAL GROWTH GRAPHIC

Fig 1.



As temperatures increase, an application of a high Nitrogen NPK controlled-release fertilizer (such as Sierrablen Plus 24-05-13) will ensure a healthy sports pitch during the main growth period. In general terms, the majority of the annual Nitrogen application should be applied during this main growth peak.

As grass is naturally entering a growth peak, the nutrients removed in clippings need to be replaced. The steady delivery of nutrients from controlled-release fertilizers prevent a feast/famine cycle and encourage better rooting to help deal with the potential stresses of Summer drought.

Controlled release fertilizers increase the efficiency of nutrient application. They don't just promote better turf quality, but can also help reduce cost by reducing the number of applications required each season. One of the most cost effective fertilizers to apply nowadays is one that releases over 8-9 months. In terms of price per kg, this can appear to be expensive, also in term of cost per application since it applied at up to 60kg/Ha, but as only one application is required per season, it can be the most economical, along with additional savings on labour time and costs. If this single application option is chosen (it's only suitable for winter sports field turf) then ignore the rest of this article!

### ***Early Summer***

As temperatures increase through the Summer, the pitch should receive sufficient Nitrogen and Potassium to maintain growth, where possible, and to help the plant store carbohydrates in its roots ready for upcoming stresses. The application of Potassium during the Summer, such as a 19-5-18 with three month longevity, enables the turf plant to better regulate water losses and so will help it cope with heat and drought stress.

If you maintain Winter games pitches, this is the time of the year when end of season renovations take place. At this point, an over-seeding/renovation growth phase programme should be used as discussed later.

### ***Late Summer***

As turf comes out of Summer stress, it is important to provide adequate Nitrogen to match the second (smaller) natural growth peak of the season. A balanced NPK fertilizer is ideal during this time to help aid recovery and replace nutrients lost in clippings, while at the same time hardening turf ready for the Autumn. If you use a controlled release fertilizer with a three month longevity in early Summer as described above, sufficient nutrients will be delivered for this time of year as well.



## **Autumn**

As grass growth slows down coming into Autumn, Nitrogen inputs should be reduced while Potassium inputs should increase. Potassium plays many important roles within the turf plant. One of the most crucial for sports pitches is that it can harden the plant for the cooler season as well as making it more resilient to wear from play. Remember, the aim at all times throughout the year is to only apply what is need by the plant and no more, but as grass growth slows down it is even more crucial to get the balance right.

Too much nutrient (primarily Nitrogen) can create soft growth that is susceptible to wear and disease attack. Too little Nitrogen will result in unhealthy, yellow turf that is unable to utilize low light levels efficiently coming into one of the most stressful times of the year for the grass. This also has a big impact on how the turf performs the following Spring.

## **Overseeding & Renovation**

There are sufficient nutrient reserves within the seed for germination and initial root and leaf growth. However, for seedlings to establish successfully, and to develop a good root system, there should be adequate (but not excessive) nutrients available within the soil. Seed sends out a root in search of food, so it's important to maintain an adequate supply of nutrients. The challenge turf professionals face is getting the balance right. Grass seed can be vulnerable to high levels of nutritional input with salt damage inhibiting germination and slowing establishment, so your choice of fertilizer during renovation is critical.

The use of controlled and slow release products can be beneficial as they are extremely safe, while ensuring a continuous delivery of nutrients to the seedlings. Traditionally, pre-seeder fertilizers used to have very low Nitrogen contents for plant safety reasons but through the latest slow and controlled release technologies, it is now possible to have fertilizers with high Nitrogen levels because they're delivered gradually over a period of 2-3 months, i.e. Sierrablen Plus 20-20-08. Phosphorus is an important component in a pre-seeder as it encourages good rooting and helps speed up establishment. If a soil analysis indicates that the level of Phosphorus levels is sufficient, it may not be necessary for a high P fertilizer. Alternatively, if you prefer to use conventional fertilizers, ensure it contains nutrients with a very low salt index, such as Sportsmaster Pre-Seeder 8-12-8.

## **Who Can Give Me More Advice?**

For more detailed nutrient advice specific to your individual situation, consult with your agronomist, ideally someone who is FACTS (Fertilizer Advisers Certification and Training Scheme) qualified. The FACTS Fertilizer Certificate of Competence is the recognised standard of competence for those advising on the use of fertilizer products on sports and amenity surfaces.



It is certificated by BASIS and advisers holding the certificate become members of the BASIS Professional Register and the FACTS Annual Scheme. Through ongoing training, they are best placed to offer advice on fertilizer types, plant nutrition, environmental issues and relevant legislation. Around 2,000 UK advisers are members of FACTS. You can obtain more information from [www.factsinfo.org.uk](http://www.factsinfo.org.uk).

*The next section tackles common problems with fertilizer application and advises on selecting and calibrating your spreader.*



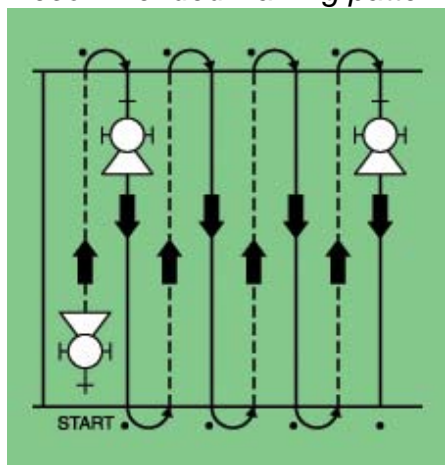
## Fertilizer Application

### Spreader Types

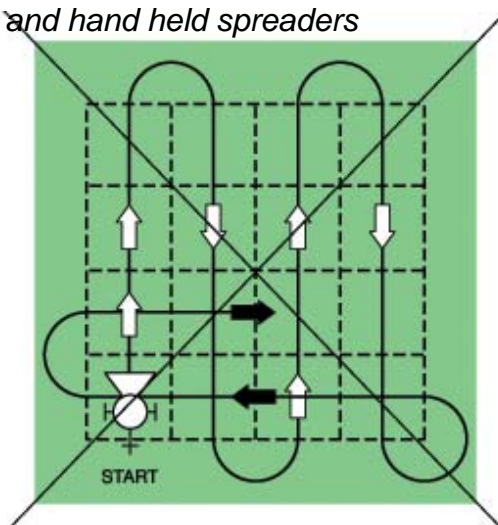
There are basically two main types of granular fertilizer spreaders, drop and rotary. Drop spreaders, as the name suggests, drops the fertilizer granules through holes along the bottom of the hopper. Altering the spreader setting will in turn alter the size of these holes and the flow rate of fertilizer and therefore the application rate. These types of spreader are best for precision application over smaller areas and for this reason they are perhaps not the best choice for larger areas such as sports fields.

Great care needs to be taken with the walking pattern and getting the correct amount of crossover on each return run, since fertilizer is either applied at 100% rate or 0%. This means that if the walking pattern is not correct, you will either have small stripes where no fertilizer has been applied resulting in yellow turf or where fertilizer has been applied at twice the desired rate, stripes of very dark turf and possibly scorching and safety issues with the wrong fertilizer type.

### *Recommended walking pattern for drop and hand held spreaders*



Optimum distribution at half rate and double pass



Rotary spreaders are more suitable for applying fertilizer to larger areas and are more commonly used in the maintenance of sports fields. Instead of the fertilizer dropping straight down from the hopper onto the turf, the granules will first hit a spinning disc(s) that propels the granules over a wide distance and so speeds up the application process. Accurate swath widths are also very important with rotary spreaders but are less critical than with drop spreaders. This is because the amount of product applied gradually decreases at the edges of the swath width, so there is no on/off line as with drop spreaders making misapplication errors less visible. Rotary spreaders may be tractor mounted or pedestrian propelled. The choice depends on the desired accuracy and the total area to be covered, combined with your fitness and enthusiasm!

## Selecting A Spreader

There are many factors that contribute to a well-designed and constructed fertilizer spreader, but for turf professionals there's only one aim; the accurate application of your selected fertilizer. So what is important?

The most important thing is the compatibility of your spreader with your selected fertilizer.

From a practical perspective, they should be comfortable to operate and well constructed for longevity. Wheels should have floatation tyres to minimize the impact to turf, especially when using it with a full hopper.

The best rotary spreaders have some kind of mechanism that can alter the spread pattern according to the different physical characteristics (particle size and bulk density) of the available granular fertilizers. If your spreader does not have this feature, they can only accurately apply one type of fertilizer.

Within the turf industry, the most popular type of rotary spreader that can be adapted to accommodate a wide variety of fertilizers with different physical properties, uses a helical cone to adjust the spreading pattern. The Scotts AccuPro 2000 and SR-2000 models are popular examples of this patented technology. By adjusting the helical cone, the location of the fertilizer coming from the hopper to the spinning disc can be adjusted and therefore fine-tuned to give a consistent spread pattern and left/right swath width.

## How Fertilizer Selection Can Affect Spreader Performance

The characteristics of your selected fertilizer can have a big impact on the performance and reliability of your spreader.

Bulk density will affect the weight of product flowing through the aperture. Denser material will require less granules to flow through versus a product with the same particle size that are less dense.



Granule size is very important. Larger, heavier granules will travel further once propelled by the spinning disc of the rotary spreader and therefore altering swath width. Conversely, smaller, lighter granules will not travel so far and the swath width will be reduced. Different settings would be required for fertilizers with different particle sizes.



If the fertilizer you have selected has a wide particle size range, some granules will travel a long way from the centre line while others will not. If these different sized granules are also sources of different nutrients (i.e. some Nitrogen and Potassium) then it is possible that striping could occur following application, even if the overall rates are correct so a narrow particle size range is essential for the uniform application of nutrient across an area.

Dusty fertilizers affect application rates and also affects how the operator uses the spreader and when, for example in windy conditions or when other people are in the vicinity.

### Calibrating Your Spreader

Spreaders should be calibrated prior to use. Even if there are recommendations on the bag or in brochures and on websites, it is important that you calibrate your spreader with the products that you are using. The advice in literature or on the bags are guideline recommendations only and you need to calibrate your spreader and setting to your individual equipment and conditions.

The calibration process is relatively simple:

- First, check your spreader over visually to ensure all parts are present and correct and in good working order
- Work out your walking speed by timing yourself over a set distance, do this three times to get an average
- Set out calibration trays to catch the full width of fertilizer as it spreads. Walk through the trays at the correct speed with the spreader applying fertilizer
- Weigh the fertilizer from the trays and assess the spread pattern, this will tell you how wide apart you should walk
- Put a known quantity of fertilizer into the hopper and spread it in a straight line. You can then measure the distance you have covered and work out your application rate
- Adjust the spreader apertures to the required setting for your required application rate

If you prefer, you can get a specialist company to calibrate your spreader for you. Companies such as Spreader and Sprayer Testing Ltd offer an MOT-style check and calibration of your application equipment.



## Application Advice

Fertilizer application still needs some human intervention, and with this another variable is added.

Walking speed will have a big impact on application rates so it is important to note what speed is advised per spreader. Guideline settings are normally based on 5km/h (3mph) which is considered normal walking speed. Increasing walking speed will mean that for a given time a greater distance will be covered, but since the flow rate does not change according to speed, this also means that the application rate per m<sup>2</sup> decreases. This is further compounded by the fact that with increasing walking speeds the spinning disc will also increase in speed, and with this the distance that the granule is thrown from the spreader increases. The result is that the same quantity of material is being spread over a wider distance (and also forward distance) meaning a reduction in application rate. The reverse is true if you decrease your walking speed so if you're doing a lot of spreading in one day, remember to re-calibrate yourself regularly!

It's important to try and keep the spreader parallel to the ground so that an even spread pattern is achieved. Tilting the spreader too far forwards results in the application of a lot of material in front of the machine, creating a band of over-application within the centre of the spread pattern.

To increase the uniformity of application, it is best to apply the fertilizer in two passes at half rate as this minimizes the risk of over/under applying due to incorrect spreader spacings. These two passes should run at half spacings, run parallel to each other to ensure the best spreader pattern over-lap. Double passes with the second pass conducted at right angles is also practiced however, incorrect overlap can still occur on both passes resulting in a 'checkerboard' effect.

## Aftercare

Always empty the remaining fertilizer out of the spreader and return it back into its original bag, sealing it tightly to prevent moisture entering.

Clean the spreader in an appropriate area using either compressed air or water to ensure that the aperture, helical cone and spinning disc are all clean with no remaining debris. If the cone or spinning disc is not cleaned following application, it can alter the spreading characteristics for the next application. Ensure the spreader is dry before using it again to avoid the product forming clumps.



## Some Common Fertilizer Problems & Causes

**Problem:** Dark stripes

**Cause:** Swath widths too narrow/close

**Problem:** Light stripes

**Cause:** Swath widths too far apart

**Problem:** Checkerboard' effect

**Cause:** Double pass at right angles used with incorrect spacings (too near/too far apart)

**Problem:** Tiger stripes in turf

**Cause:** Walking too slowly with rotary spreader causing a curved band of fertilizer to be applied

**Problem:** Spotting on turf

**Cause:** Application rate too low (various reasons for this)

If you'd like advice on your choice of fertilizer or guidance on applying it, contact your distributor rep who will be pleased to advise you. A list of Scotts distributors and the contact details of the Scotts Turf & Amenity technical team can be found on the website at [www.scottspromotional.co.uk](http://www.scottspromotional.co.uk).



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