Fertiliser Prills or Granules: which spread best?

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The physical form or quality of fertiliser can have a huge impact on how evenly it spreads, particularly at wider bout widths. But what are the important factors? Is it the manufacturing process or particle density, size or shape? This article examines how the physical quality of fertiliser can impact on how evenly it spreads.

Today’s fertiliser spreaders are all broadcaster type which spread fertiliser over a fairly wide bout width (6m to 36m wide) from a disc or spout that is directly behind the tractor. All broadcast spreaders produce a wide tapered spread pattern that must overlap the previous run to give an even distribution. A 12m spreader will frequently spread fertiliser more than 24m with fertiliser visible in the next tramline. Depending on the spreader and bout width, individual particles of fertiliser may have to be thrown between 12 and 30m from the spreader and land in the right place; a huge challenge often compounded by wind and bumpy fields.

Factors determining spreading width

The following factors determine the spread pattern of a fertiliser spreader:

- The design of the spreading disc and its vanes (length, shape, angle etc) and of the delivery point of the fertiliser to the disc/vane.
- The physical characteristics of the fertiliser (size, shape, density, strength of granule)
- The setting of the machine (choice of disc, disc speed, vane, vane angle, fertiliser drop point, spreader height and angle.
- Field conditions, particularly wind.

How it works

So how does the fertiliser get thrown this distance? Basically the spreader vane has to transmit enough energy to the fertiliser particle to allow it travel through the air, in the correct direction, for the required distance. Disc and vane design is focused on accelerating the fertiliser particle and causing it to leave the vane in the correct flight path, typically at very fast peripheral vane speeds. Flat trajectories (flight paths) are stable but require an adequate clearance over the crop. Some spreaders use an upward trajectory to make the distance, but throwing fertiliser upwards leaves it prone to wind as it drops with less energy at the outer part of the spread width.

Settings.
To spread evenly at different bout widths with different fertilisers frequently requires careful setting or adjustment of the machine. Vane type and position, disc speed, fertiliser drop point etc can be used to modify the way the fertiliser is thrown to optimise the pattern with different fertilisers and at different target bout widths (e.g. 18m rather than 12m).

**Fertiliser quality and the machine**

Fertiliser quality can play a huge role in achieving even fertiliser spreading. The effect of fertiliser depends on the type (including specific model) of fertiliser spreader and the bout width used. Some spreaders are very ‘forgiving’ having a strongly over-lapped, tapered spread pattern that gives even spreading at widths up to 15 or 18m with a range of fertilisers. Other machines struggle with anything other than very good quality fertiliser and require very careful setting even at modest 12 to 15m bout widths and may not be able to spread poorer quality fertiliser at wider bout widths. Where fertiliser is been spread at 24m or more, all spreaders performance is affected by fertiliser quality.

**What’s important in fertiliser?**

The four factors that are important are:

- Density of the fertiliser.
- Size of the granules
- Shape of the granule
- Strength of granule

**Dense fertilisers** are easier throw. Think of a golf ball which is relatively dense and a table tennis ball which is of similar size but a fraction of the density. We can transfer a lot of energy into the golf ball, allowing us to throw it some distance, where its weight and speed easily overcomes the wind resistance for quite a distance. But with nothing to capture the energy in the table-tennis ball, wind resistance soon stops it. With fertiliser, in simple terms urea products are at a disadvantage being about 80% of the density of most other types of fertiliser. They are not impossible to throw by any means, but they are more of a challenge to throw a distance requiring a good fertiliser spreader set correctly. But even low density products spreading ability can be improved by having a good size distribution; i.e. bigger urea granules will spread better than smaller ones.

**The size of the fertiliser particle** is also important. At the extreme it is impossible to throw dust. For material of a common density, larger particles will be easier to throw further as each individual particle can capture more energy when accelerated by the disc; and consequently is capable of being accurately thrown a distance. In practice there is a limit to useful size as large particles may not flow very well; and would result in less granules spread per m$^2$ of field. Particle size distributions with the majority of particles (80%) in the 2-4mm range will usually allow a good spread to be achieved. Less of the smaller size (e.g. most
from 3-4.5mm diameter) would usually make it easier achieve wider spread widths provided the individual particles are strong. Where fertilizer blends containing more than one element are used, the size distribution and density of the components should be similar to avoid segregation across the spread width, resulting in elements of the blend being unevenly spread. Simple hand-held sieve boxes available from manufacturers can indicate a fertiliser’s size distribution. A fertiliser supplier should also have a spec sheet that includes size distribution.

**Fertiliser particle shape** will affect the movement of fertiliser along the disc and vane and its flow through the air. Rounded particles may move along the vane more smoothly and predictably and will probably travel through the air more predictably than very irregular shaped particles. For most variations in shape though, this would not be a large factor. Differences in density and size would tend to have a greater effect. However with some machines very irregular shapes would not spread as well as rounded particles. Many spreader manufacturers use characteristic photographs to classify fertiliser particle shape.

**Particle strength is important** to avoid been broken by the impact of high speed vanes on modern fertiliser spreaders. If the granule breaks, then the spreader is trying to spread a range of smaller granule sizes down to dust. Particle strength is much more important today than it was in the past. A simple individual particle strength tester is now available from many fertiliser spreader manufacturers.

**Prills or Granules**

Fertilisers are manufactured by different processes. Some are simply broken stone while others, produced by different manufacturing processes, can vary from being almost rounded and regular shaped to being quite irregular. Prills are generally rounded and regular shaped. There is occasionally debate as to whether prills or regularly shaped granules spread better. **In this case the wrong question is being asked.** What’s important is the density and size distribution of the particles, as these will be the main determinants of the spreadability of the products. Both prills and granules can vary in density and size.

If the density and size distribution of a prilled product are the same as a granular product, then it will spread at least as well as the granular product. If the granular product is very irregularly shaped, then on some machines the prilled product is likely to produce a better spread pattern if its density and size distribution are the same.

It is not whether a product is prilled or granular! The questions to ask when considering spreadability are:

1. Density of the product: the higher the better.
2. Size distribution: generally bigger better and as little as possible below 2mm diameter.
3. Strength: stronger better
4. Shape: regular and/or rounded better
Give a dog a bad name!

Some of the doubts that people have about prilled fertiliser is their association with specific products. For instance urea is commonly sold as very small prills. With just 80% of the density of other fertilisers and a very small size distribution, these are very difficult to spread evenly at anything other than very modest bout widths, but not because they are prills! It's due to their size distribution and density. Similarly some specific imported prilled CAN products had a very small size distribution and consequently were challenging to spread at wide bout widths. Again, this was due to their size distribution; and not because they were prills.

Best approach

Know your spreaders limitations in terms of bout width and how well it copes with fertiliser of different physical quality. Ensure you purchase fertiliser of suitable physical quality and ensure you set the spreader correctly for the fertiliser and bout width. Fertiliser suppliers should be asked for specification sheets which indicate the size distribution and density of the product. Consider this when making a purchase decision i.e. don’t necessarily choose the cheapest product. Most spreader manufacturers have detailed setting charts available on-line or in setting manuals which increasingly are based on size distribution, density, particle strength and shape. Sieve boxes, strength and density testers and shape guides are all available from manufacturers. While these will help get the best pattern from different quality fertilisers, it’s important to note that fertiliser quality will still impact on evenness particularly at wider bout widths.

Finally

Spreading fertiliser evenly at very wide bout widths (18m+) is challenging. Fertiliser physical quality has a huge role to play in achieving even spreading in combination with appropriate machine selection and correct spreader setting. The key fertiliser quality factors are: density; size distribution; particle strength and particle shape. Separate from these, whether a fertiliser is prilled or simply granular has little impact on spreadability. Buy fertiliser carefully and set your spreader properly.

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Fig 1: The granular and prilled products on the left and centre have similar size distribution and would spread similarly. The prilled product on the right has a much smaller size distribution and would be more difficult to spread at wider bout widths.