MEASURING THE SPREADING EFFICIENCY OF NITROGEN FERTILISERS

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The application of nitrogen fertiliser is probably the largest cost input of arable farms, and current statistics show that around £56 million is wasted each year on British farms alone through poor fertiliser application. A large proportion of this wastage is due to the move towards wider spreading widths of 24 m (80 ft) and the increasing use of cheaper, poor quality fertilisers.

At these greater spreading widths, poorer quality fertiliser granules tend to shatter, resulting in increased application behind the spreader, which can be seen later in the season as striping.

The £56 million can be broken down into a direct cereal yield penalty of more than £32/tonne, according to the first-ever fertiliser quality rating system developed from joint ICI Fertiliser/Silsoe Research Institute studies of nitrogen application accuracy.

The Spread Pattern (SP) rating system is a two-dimensional spread pattern evaluation system combining the results of both longitudinal and transverse tests.

Spreader Functions

Before we look at the SP system it is important to understand the reasons for its development.

Regardless of type, fertiliser spreaders essentially perform two functions, both of which have a direct effect on application accuracy. The first is that they meter as even a flow of fertiliser as possible on to the spreading metering mechanism to give the required application rate across the entire area.

Secondly, they distribute it across the spreading width to produce a uniform transverse application with overlapping distributions from adjacent bouts.

Transverse tests have for some years been standard practice in determining spreading accuracy, with some form of collecting device placed at right angles to the direction of forward travel. Although accurate, this is just a "snap-shot" of spreading performance and provides no real indication of the accuracy with which fertiliser is being applied in a forward direction.

Dr. Paul Millar of the Silsoe Research Institute, north of London, believes we often forget there are two aspects to fertiliser application accuracy.

"The first is the applied rate," he says, "and the second is the uniformity of application. Environmental aspects are also becoming increasingly important and we are having to take these into consideration."

Repeatable Simulation

To simulate field conditions and determine the amount of irregular flow, a bump track was developed at Silsoe.

In tests, three commercial twin-disc fertiliser spreaders had their discs removed, which enabled repeatable simulation of spreading on a typical field surface at a realistic operating speed over the 100-m (330-ft) stretch. Spinning disc, oscillating spout and pneumatic spreaders were also adapted to allow the output from the metering mechanism to be ducted downwards and collected in a series of trays mounted in the centre of the track.

Dr. Millar says the results of the transverse tests reveal that poor quality fertilisers may lead to significant losses on arable farms. "There is an element of doubt, however," he adds, "and only by performing longitudinal tests can the full picture and any real problems become apparent."

Richard Martin of ICI Fertilisers says the results of the two tests provide enough data to produce a two-dimensional spread pattern where variations above 10% of the average mean can be highlighted.

"Major financial penalties from poorer quality fertilisers became immediately obvious when Silsoe compared the predicted crop returns from specific spread patterns with one another on this basis. For example, at an average of 160 kg/ha (143 lb/acre), returns from one poor quality ammonium nitrate sample were nearly £6/ha (£2.40/acre) lower than those from Nitram.

"These figures represent a direct penalty of £12-£50/tonne for the 34.5% N ammonium nitrate, and £32/tonne for the 46% urea, against which their lower unit prices must be assessed."

Inconsistent Particle Size

Silsoe compared seven different fertiliser samples - each with an average of 30 combinations of spreader type and rate setting - and revealed even greater spreading inaccuracies from poor quality fertilisers than previously recognised.

Results have shown that inconsistent particle size, with or without lumps in the hopper, will flow unevenly into the distribution mechanism. Fertiliser may also be spread inconsistently across the bout width. Under these circumstances there is little or nothing that spreader sophistication or operator skill can do to prevent variations in the rate at which the fertiliser is applied to each part of the crop.

These variations it was found, may not be sufficiently large (or irregular) to cause visibly uneven growth. Nevertheless, they can result in significant financial losses through lower yields, reduced crop quality and wasted fertiliser. These findings seem to point to the fact that it may be in the farmer's interest to invest less money in complicated spreading machinery and instead purchase the best quality nitrogen fertiliser on the market. It may also prompt fertiliser manufacturers to look at and perhaps even reformulate some of their products.

Fertilisers with a low bulk density, for example, cause particular transverse spreading problems through oscillating spout or spinning disc spreaders, because their lighter "hollow" particles cannot be thrown far enough. They may, however, be very suited to pneumatic-type fertiliser spreaders, so farmers are going to have to look at matching fertiliser to their spreaders, rather than buying the cheapest product available, which could be more costly in the long term.

Variation Coefficiencies

The majority of fertiliser spreader manufacturers are already in the process of developing their own automatic calibration systems with automatic weighing facilities.

For accurate application, spreaders should be calibrated for both rate of flow and transverse spread for the specific product used. Assuming that one product is like another for calibration purposes is a recipe for disaster.

Two-dimensional evaluation has allowed Silsoe researchers to calculate the amount of fertiliser accurately applied to the spreading area for each combination of spreader and product. The inherent differences in application accuracy between the fertilisers, irrespective of spreader type, were evident in substantial differences in recorded Overall Variation Coefficiencies (OVC).

The new system allows for the inevitable variations between different fertiliser samples and spreaders by rating fertilisers on a scale of 1 to 5 on the basis of their recorded OVC in the standard two-dimensional protocol.

"For the first time this system puts the substantial variations in physical quality, which were always known to exist between fertilisers from different sources, on to a firm financial footing," says Mr. Martin.

Dr. Millar observes that he would ideally like to see the SP rating put on the fertiliser bag: "At some point there will be harmonisation in Europe and we hope the SP system will become a national standard rating for assessing fertiliser quality."

Mr. Martin also expects the SP system to become an industry standard. "It makes economic and environmental sense," he says, "and I believe it will be easily understood when it is brought into use."