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A COMPARISON OF NITROGENOUS FERTILISERS FOR CEREALS

By M. G. MASON, B.Sc. (Agric.), Plant Research Division

THE use of nitrogenous fertilisers has become an important aspect of cereal growing in many districts and farmers now have a number of sources of nitrogen from which to choose.

The main nitrogenous fertilisers available for cereal growing are urea (46 per cent nitrogen), sulphate of ammonia (21 per cent.), anhydrous ammonia (82 per cent.), calcium ammonium nitrate (20.5 per cent.), nitrate of soda (16 per cent.) and the nitrogen-phosphorus compound fertilisers containing either 28 or 24 per cent. nitrogen.

The fertiliser selected should be that which will give the best return for money invested in the fertiliser. In making the choice, the cost, relative effectiveness and certain physical differences which influence convenience, manner and time of application of the fertiliser are the main considerations.

Relative effectiveness

Trials carried out by the Department of Agriculture over a number of years have shown no real differences in relative effectiveness of urea, sulphate of ammonia, calcium ammonium nitrate and nitrate of soda. If equivalent amounts of nitrogen are applied these fertilisers give about the same increase in yield.

As these sources of nitrogen appear to be equally effective the cost of the actual nitrogen it contains should usually determine which is chosen. The important figure is the cost per unit weight of nitrogen applied, not the cost of the fertiliser.

For example, the price of urea at Perth works (March, 1967), is $67.20 per ton, compared with $53.76 for sulphate of ammonia. However, urea contains 46 per cent. nitrogen while sulphate of ammonia contains only 21 per cent. When the two prices are compared on an equal nitrogen basis the cost per unit of nitrogen (22.4 lb.) in urea is $1.46, compared with $2.56 per unit for sulphate of ammonia.

To determine the cost per unit of nitrogen in a fertiliser the cost per ton is divided by the percentage nitrogen in the fertiliser, giving the cost for 22.4 lb. of nitrogen. When all the sources are compared on this basis it is obvious that urea is at present by far the cheapest source of artificial nitrogen available in Western Australia.

The compound nitrogen/phosphorus fertilisers can not be compared on this basis as they are sources of both nitrogen and phosphorus. As yet, the Department of Agriculture has no information on the relative merits of the compound fertilisers as sources of these two elements, compared with urea and superphosphate. Trials are planned for the 1967 season to provide this information.

One limitation of the compound fertilisers may be their inflexibility, because of the fixed ratios of nitrogen and phosphorus they contain. The rate of application of one component cannot be varied without varying the rate of the other in the same proportion, so that sometimes to obtain enough phosphorus, an excessive amount of nitrogen would be applied.
Ease of application

Ease of application may influence the choice of a nitrogenous fertiliser—and one aspect of this will be rate used.

The more concentrated the fertiliser, the lower the rate needed to supply the required amount of nitrogen. This in turn means less freight, less handling, and the fertiliser box is filled less often.

This tends to give the high analysis fertilisers, such as anhydrous ammonia and urea, an advantage.

Other factors also influence ease of application. For instance, urea cannot be mixed with super as this results in a sticky mess in the fertiliser box. The urea must be applied separately by fitting an extra fertiliser box, by towing an extra drill or combine (either in front of or behind the seeding machine) or by carrying out a separate operation. Sulphate of ammonia is more easily applied as it can be mixed with the super and drilled in the seeding operation.

Anhydrous ammonia is applied before seeding, and this requires specialised equipment. However, the farmer need not be involved in this operation if he is prepared to meet the cost of having the fertiliser “custom” applied.

On light soils it is very important to inject the ammonia deep enough to avoid losses of the gas into the atmosphere. On a yellow loamy sand at Wongan Hills in 1965, the applications 6 in. deep gave on the average, 3 bushels per acre more than applications 4 in. deep. On a sandy soil, application 8 in. deep gave an average of 3.8 bushels per acre more than the 6 in. application.

The compound fertilisers involve the handling of only one fertiliser as they supply both nitrogen and phosphorus.

Time of application

If time of application is important this may also influence the choice of fertiliser. Generally, the most convenient time is at seeding as this avoids an extra operation. All the above sources except anhydrous ammonia can be applied with the seeding operation, although application of urea at seeding requires an extra fertiliser box or combine.

Nitrogenous fertilisers may also be applied at other times, depending on the district. In drier areas, results of trials with urea and sulphate of ammonia have shown that yield is likely to be higher if the nitrogen is applied as close to seeding time as possible.

In areas with a longer growing season the results have varied with season. However, on these areas the application should still be made within six weeks after sowing.

At Wongan Hills, on yellow loamy sand in 1965, when urea was applied to wheat four weeks before sowing the yield was 7.5 bushels an acre less than that obtained with application at seeding even though, in this case, there was still a profitable response to nitrogen. Generally it would be very risky to apply urea very long before seeding.

Another advantage of the solid fertiliser sources is that they can be topdressed from the air if necessary.

Anhydrous ammonia must be applied some time before seeding; this saves handling of nitrogen fertiliser at seeding time. Results of trials at Wongan Hills showed that application as close as possible to seeding time is desirable. On loamy sand the applications at seeding gave on the average, 2.5 bushels per acre more yield than applications four weeks before seeding. On sandy soil, the yield with application at seeding averaged 1.5 bushels per acre more than with application four weeks before seeding.

It is technically possible to make applications of anhydrous ammonia after seeding and this was tested with special applicator equipment in 1965. Where applications were made two or four weeks after seeding, the yield was about 4 bushels per acre less than where the fertiliser was applied at seeding.

Other differences

There are other differences between sources, which under some circumstances result in different effects due to source.

Some sources add nutrients other than nitrogen to the soil. Sulphate of ammonia contains some sulphur—but it is doubtful whether this is an advantage because the superphosphate normally applied would supply enough sulphur to satisfy any requirements.

Nitrate of soda contains sodium, and calcium ammonium nitrate contains calcium as well as nitrogen. These nutrients would have no added benefit under our
COSTS OF NITROGENOUS FERTILISERS

<table>
<thead>
<tr>
<th>Fertiliser</th>
<th>Cost per ton (Perth)</th>
<th>Percentage nitrogen</th>
<th>Cost per unit of nitrogen (22.4 lb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>$67.20</td>
<td>46%</td>
<td>$1.46</td>
</tr>
<tr>
<td>Sulphate of ammonia</td>
<td>$53.70</td>
<td>21%</td>
<td>$2.56</td>
</tr>
<tr>
<td>Nitrate of soda</td>
<td>$72.20</td>
<td>16%</td>
<td>$4.51</td>
</tr>
<tr>
<td>Calcium ammonium nitrate</td>
<td>$66.60</td>
<td>20.5%</td>
<td>$3.25</td>
</tr>
<tr>
<td>Anhydrous ammonia (costs include transport to farm)—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custom applied*</td>
<td>$234.00</td>
<td>82%</td>
<td>$2.56</td>
</tr>
<tr>
<td>Farmer applied*</td>
<td>$202.00</td>
<td>82%</td>
<td>$2.46</td>
</tr>
</tbody>
</table>

* Add $11 per ton if more than 125 miles from Perth.

Conditions. Calcium is also supplied by the superphosphate. As mentioned previously, the compound fertilisers contain phosphate as well as nitrogen.

Under some conditions, the use of one source or another may cause some after-effects in the soil. A number of the nitrogen sources tend to promote more acid conditions in the soil. Anhydrous ammonia, sulphate of ammonia and urea have an acid reaction in the soil, sulphate of ammonia having the most acid effect of these three. Unless the soil is already markedly acid before application, this should not do any harm. However, continued use of an acid-forming fertiliser may increase soil acidity, which could affect crop growth. In a continuous cropping trial at Merredin Research Station, yields from plots receiving sulphate of ammonia every year have fallen below those from plots where urea or calcium ammonium nitrate is applied each year. This is associated with an increase in acidity. It is also associated with a greater build-up of Wimmera rye grass in the crop.

Some fertilisers, such as nitrate of soda, on the other hand, are alkaline in reaction.

Residual effects

The solid fertilisers, at rates used under our conditions, have not been shown to have any marked residual effect on most of our soil. However, anhydrous ammonia is theoretically more resistant to leaching than are other forms of fertiliser. This has not yet been proved in practice, but will be tested in the coming season. In soil investigations carried out in 1966, the anhydrous ammonia did not move from the point of application very quickly, while the urea was rapidly converted into other forms of nitrogen available to the plants, but which are more easily leached.

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