CANTERBURY CHAMBER OF COMMERCE

AGRICULTURAL BULLETIN

No. 450 MAY, 1967.

PHOSPHATIC FERTILIZERS

By A. F. R. ADAMS, Senior Lecturer in Soil Science, Lincoln College.

There are a number of different fertilizers available at present which may be used to supply phosphate for plants and there is sometimes a lack of understanding by farmers as to just what these fertilizers contain, and whether any one sort is better than any other. Before long it is quite possible that this situation will be further complicated by the appearance on the New Zealand market of new forms of phosphate fertilizers. The purpose of this bulletin is to say something about all these materials in order to try to prevent confusion. A table setting out the pounds of phosphorus in one cwt. and also the pounds of phosphorus considered available to plants in each cwt. together with certain other information is appended. In keeping with the 1960 Fertilizer Act the figures are quoted as phosphorus (P). For example superphosphate is now said to contain 9% P, formerly it was quoted as 20% P_2O_5, which was simply another way of saying the same thing.

KINDS OF PHOSPHATE FERTILIZER

Superphosphate:

Everyone is familiar with super. In New Zealand alone over 1½ million tons are now made annually and almost one half of all the phosphate fertilizer produced in the world is super. This fertilizer and the fertilizers made from it, which are described later, have been a [illegible] to compare all other phosphate fertilizers against. Very large numbers of trials have been and are still being conducted for this purpose.

The amount of 'straight super' used to-day, that is super with nothing added to it, is only about 20% of the total but a considerable proportion of the remainder is simply in the form of mixtures with trace elements, weedicides and insecticides and sulphur. In these cases the phosphate part is still identical with super and except in the case of the sulphur-fortified supers the amounts of added materials such as trace elements is very small. For each cwt of these materials that you buy therefore you are virtually getting 1 cwt, of super plus a little trace element or insecticide. The extra cost for these mixtures is for the added material plus mixing and handling costs. When 200 lb. or 400 lb. sulphur is included per ton of fertilizer, however, you are getting respectively 9% and 18% less super in each cwt. This is part of the price you pay for the extra sulphur you need.

Lime-reverted super (Basic super) and Serpentine Super:

Both of these products differ from ordinary super in several respects. Firstly, the phosphate they contain is in a different form. Secondly, there is only three-quarters as much of it, because they are made by mixing three parts of super with one part of limestone or ground serpentine rock respectively. (Serpentine is a rock the main ingredient of which is magnesium silicate.) During this mixing a chemical process occurs that causes the 'reversion' of the phosphate so that it will no

ERRATA

Bulletin No. 450: "Phosphatic Fertilizers".

Please note: Page Three under "Basic Slag", Line Three—"Sulphate" should read "Phosphate".

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longer dissolve in water. The significance of this will be dealt with later.

Aerial Super

This product was first introduced in 1955 and since that time its use has grown to the extent that more of it is used than any other product. It too is made by mixing super and serpentine rock, but in the proportion of 9 to 1. This is not enough serpentine to change all the phosphorus into the reverted form so that we can regard aerial super as a partly-reverted super.

In these three products you are actually getting less phosphate than in super; 25% less in reverted and serpentine and 10% less in aerial. The same reduction applies to the sulphate content. Instead of the 11% of sulphur in super you get about 8% and 10% respectively.

It should be remembered then that when you pay an approximately equal price per ton for all materials so far mentioned, you are in fact paying considerably more for each unit of phosphate in some cases than in others. For example, it would cost $800 using serpentine super, or $660 using aerial super to supply as much phosphate (and sulphate) as $600 worth of ordinary super. These facts then prompt the question—is there some other hidden magical property in these products to justify the extra cost? And this could be answered by saying that additional differences to those already mentioned are the fact that serpentine and aerial supers contain magnesium, which super does not, that seedling and legume inoculum damage is less likely to occur with these materials than with super, that their flow properties from drills, seed boxes and aeroplane hoppers show a marked improvement over super, and that their storage properties are much better. Lime-reverted super is similar in these respects except that it has no magnesium. It does, however, contain more calcium than the others but it is doubtful if this has any real value.

'Reverted' Phosphate:

It was mentioned earlier that in serpentine and lime-reverted super and to a lesser extent in aerial super, the phosphate was called 'reverted.' The effect of this is to change the phosphate so that it will no longer dissolve in water. The bulk of it, however, is still able to be used by plants, and indeed it has often been claimed for these and other insoluble phosphates that they will therefore last longer than super and be less subject to that 'fate worse than death' for a phosphate which we call 'fixation.'

Such claims are hard to prove or disprove but the best evidence available suggests that 3 cwt. super per annum has much the same effect as 4 cwt. serpentine super and furthermore that their effect lasts equally well for a period of four years after applications ceased by which time production from both had dropped to about 75% of the previous figures.

Even if magnesium were known to be needed to help overcome grass tetany or hypomagnesaemia, the amounts in serpentine are too small to make an appreciable difference to the magnesium content of the crop, although the use of this fertilizer is sometimes regarded as an insurance against the onset of this disease. There is little doubt that there are other much more effective ways of supplying additional magnesium to animals and opinions differ on the question of 'insurance' treatments, but do you take aspirins every day to guard against the possibility of a headache? On the evidence available then one would hesitate to use serpentine super in preference to super and the same arguments apply to some mixtures such as sulphur serpentine super by comparison with sulphur super. Mixtures with muriate of potash are, however, better made with serpentine super for reasons of better storage properties, but again a satisfactory potassic super can be made by incorporating about 5% of lime into the mixture.

For aerial sowing, aerial super is probably worth the extra cost per unit of phosphate because of its good flow properties and any of the reverted forms may find a useful place when we consider their other advantages in relation to certain conditions of use. Thus seedling damage may occur with straight super, especially if fresh or if drilled into dry soil with small seeds like rape, turnips, swedes, clovers, and

lucerne, but there is much less chance of damage if broadcast, while larger seeded crops such as cereals and grasses rarely come to any harm. With inoculated legumes it is not advisable to use straight super either. The reverted forms are safer and a lime super mix in equal proportions is best of all. Whatever fertilizer is used, seed should remain in contact with it for the least possible time; the best solution for aerial work is to fly seed and fertiliser on separately—a practice not unusual nowadays.

Sulphur Supers

These are simply mixtures of superphosphate and sulphur. They therefore contain two types of sulphur, calcium sulphate from the original super and ordinary sulphur, and are intended for use in those areas where relatively more sulphur is needed than phosphorus. Thus whereas ordinary super supplies sulphur and phosphorus in roughly equal proportions, the 400 lbs. sulphur super supplies them in the proportion of 3½ to 1. The phosphate content (per cwt.) of this material is of course lowered as a result of the inclusion of the sulphur.

OTHER FORMS OF PHOSPHATES

Basic Slag:

The slag used in New Zealand contains something like 15-20% less total sulphate than super so that on this count and also on availability of the phosphate it falls between super and serpentine super. It contains virtually no sulphur and for much of the South Island especially, but also for appreciable areas of the North, this element would need to be added. However, it does have considerable liming value, sufficient to benefit those soils which respond to amounts of lime of the order of 5 cwt. or so, and on such soils, if not deficient in sulphur, gives slightly better results than super when applied at rates supplying the same amount of phosphate. It is not satisfactory for aerial distribution, and there are few situations where molybdic super does not perform as well.

Rock Phosphates:

Rock phosphates are the raw materials from which super is made but may themselves be used as fertilizers if very finely ground. They contain no sulphur. In the past many trials have tested their usefulness against other phosphatic fertilizers, and briefly Nauru phosphate seems to be a poor source of phosphate to plants, while the North African Gafsa phosphate has performed about as well as super on acid soils not deficient in sulphur when applied at equal weights. It has not performed as well on soils of pH greater than 6.0, although its lasting effect after applications cease is often better than super on both limed and unlimed soils. With our greater knowledge of sulphur needs new trials are under way with these rock phosphates and it could well be that a combination of sulphur and rock phosphate will be found that is economic and successful, especially for follow-up topdressing on moderately and strongly acid soils, after an initial application of say, molybdic super. Some success has been achieved in American trials with a product made by mixing powdered rock phosphate with molten sulphur and then grinding to a fine powder.

New Possibilities for Rock Phosphates:

In future New Zealand will be importing considerable quantities of rock phosphate from Christmas Island, the better grade going to make super. It has been found that the poor quality material from this source, which is unsuitable for super manufacture, can be converted into a useful fertilizer simply by heating it strongly for a short time. This product has performed as well as super in some pasture trials and it is quite possible that a mixture of super and this Calciphos as it has been called, will be marketed before long. It should be reasonably priced, be able to replace super satisfactorily in most conditions and be better suited for aerial work. Such a mixture would have slightly more phosphate than super, but availability of this phosphate would be a little lower. Sulphur content would also be lower.

Other Phosphates:

Small amounts of double (triple) super are used. It contains 2½ times as much phosphate as super but virtually no sulphur. For soils not

deficient in sulphur it is a good source of phosphate and is an example of the modern trend in fertilizer manufacture towards materials with high percentages of fertiliser elements. Obviously if you can get twice as much nitrogen or phosphate into a ton of fertilizer as there was before, the transport cost per lb. of nitrogen or phosphate will be halved and in countries where the transport cost is a high proportion of the total cost at the gate, this represents a major saving. The reduction is often, however, offset to some extent by higher manufacturing costs of the more concentrated product.

The Ammonium phosphate products, of which a large number are available under different formulations and trade names, are another example of this tendency, and in addition to high percentages of nitrogen and phosphate—both in readily available forms—these materials handle particularly well. On a unit cost basis they are dearer than equal amounts supplied in simple materials, but the extent of the saving has to be balanced against cost of mixing and application of larger quantities as well as convenience

Finally, another possibility for New Zealand which in a few cases has proved better than super phosphate at equal rates of application is a material made by melting together rock phosphate and serpentine rock or other similar magnesium compounds. This contains no sulphur, but this could be added, and the material would probably be best used in districts of moderate to high rainfall. Small amounts of this sort of product have been imported for trial use as Thermophos or Calmag but it could be made locally. It deserves to be tested more widely.

Trace Element Content of Fertilizers:

In addition to their phosphate content, all these materials contain small and different amounts of trace elements, but apart from any that is added at normal application rates the amounts supplied will rarely obviate the need for additional amounts in cases of deficiency. An exception to this statement is basic slag, where the combination of liming effect and molybdenum content may provide significant quantities of molybdenum.

From what has been said it is obvious that many products are available to farmers as phosphatic fertilizers and that it is often difficult to choose between them. If this bulletin has taught you that no one fertiliser is the best for all crops or for all soils and that consequently each situation needs to be treated on its merits it will have served its purpose.

POUNDS IN ONE CWT.

	Total P	Available P	Sulphur	Mag.
Superphosphate	10	9.3	12.5	0
Serpentine super	7.8	5.8	9.4	5.5
Reverted super	7.8	5.8	9.4	0
Aerial super	9	6.6	11	2.2
400 lb. Sulphur super	8.2	7.7	30.2	0
Double super	22	20.5	1	0
Basic Slag	8.1	7.3	0	1.5
Nauru rock	18.2	3.5	0	0
North African (Gafsa) rock	12.6	5.5	0	0
Thermophos (Calmag)	9.8	9.6	0	11.6
Ammonium Phosphates (a range of values)	6.6 up to 23		Almost all Variable	0

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