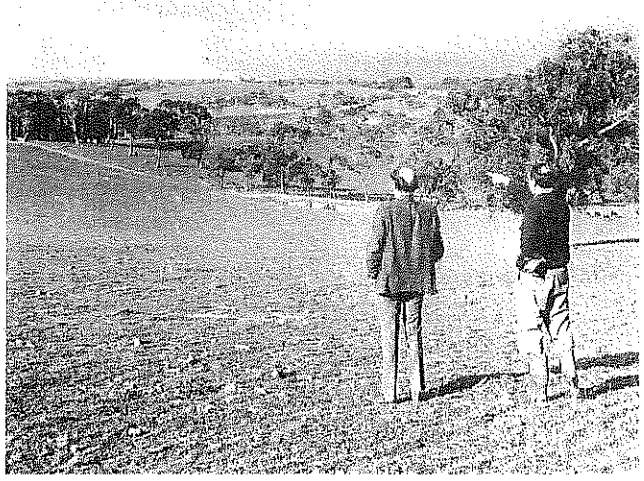
Department of Agriculture, South Australia

Leaflet No. 3974

SOIL TESTING

IN SOUTH AUSTRALIA-

Tentative standards for interpreting the bicarbonate soil phosphorus test



Farmers are asking how much fertiliser they really need to apply.

By J.S. Potter, Senior Soil Conservation Officer, and R.J. French, Principal Research Officer.

... their natural state, South Australian soils are grossly deficient in phosphorus, and phosphorus fertiliser, particularly superphosphate, has been widely used by farmers for many years. In just the last five years, South Australian farmers have invested about $60 million in superphosphate and the Federal Government has contributed a further $24 million in the form of subsidies.

Until the early 1960's most farmers were obtaining consistently large yield responses to superphosphate, and the rate applied was determined largely by finance available. Since then it has become obvious that responses have become much less consistent, particularly where phosphate has been applied for a number of years. Farmers have been asking how much phosphate they really need to apply. Maybe they can cut back their rate of application, at least for a time.

One approach to this problem is to try to find a simple chemical test which will indicate how much of the phosphorus in a soil is available to plants. Such tests have been used in the old agricultural areas of the Northern Hemisphere for upwards of 35 years. They have been, in general, only reasonably successful, performing best in high rainfall areas of uniform soils where only a few types of plants are grown. It has proved much more difficult to develop meaningful tests for South Aus-

The bicarbonate test

In the laboratory a precise weight of soil is taken from the field sample.* This is shaken for 16 hours with an exact volume of sodium bicarbonate solution. The amount of phosphorus extracted from the soil by this solution is then measured. This, in turn, is related back to the original weight of soil and the results are expressed as parts of phosphorus per million parts of soil (p.p.m.).

It is believed that the sodium bicarbonate solution mainly extracts the phosphorus in the soil solution and that adsorbed on the clay particles. It is therefore referred to as the phosphorus available to plants (available phosphorus).

P-test standards

The laboratory analysis simply tells us that the soil contains a certain amount of available phosphorus – say 15 p.p.m. Clearly this tells us nothing unless we are able to interpret it. To do this we need information from field trials. In fact, a soil test service is quite useless unless it is backed by a local field research programme.

Over the past 10 years the Department of Agriculture has conducted a large field fertiliser research programme. Trials have been carried out over a wide range of soil and climatic conditions, from the Far West Coast through to the Lower South-East. Since 1967 the C.S.I.R.O. Division of Soils and the South Australian superphosphate manufacturers have also thrown their resources into the programme.

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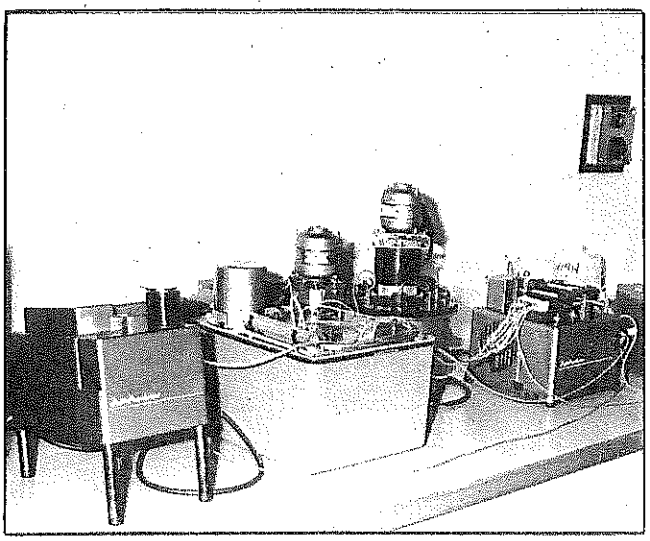
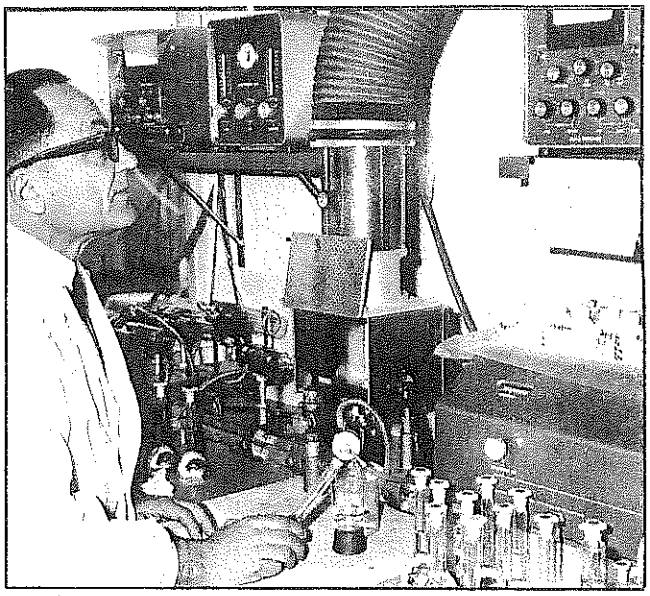
*"Soil Testing in South Australia – a progress report" by J.S. Potter. Journal of Agriculture, South Australia, November 1970.





There are two steps in analysing soils – extraction and measurement. The photos show two methods used to measure the concentration of nutrients extracted from soils at the Department of Agriculture Northfield Laboratories. Above: Auto-analyser Below: Atomic absorption spectrophotometer

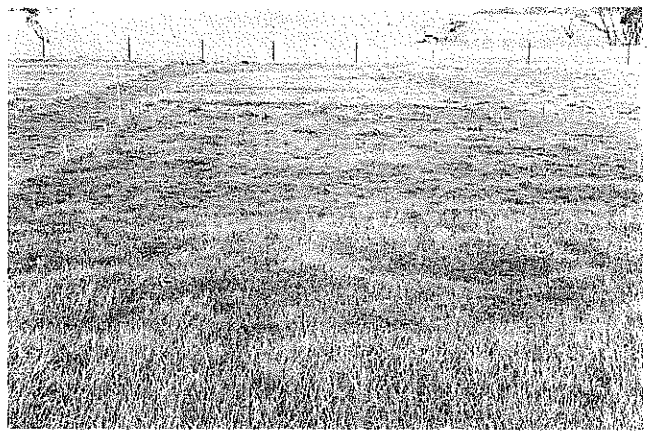
from the start that it will not tell us exactly how much fertiliser **should** be applied in any one year. Yield response is dependent on many physical factors such as rainfall, time of seeding, effectiveness of weed and disease control as well as the amount of available phosphorus in the soil. Economic factors such as market price, and available capital will also be important in fertiliser decisions. However, used sensibly, a soil test can **help** in deciding the amount of fertiliser to apply.

Table 1 shows how to interpret a soil test value. To use the table, locate in turn the appropriate land use zone, the annual rainfall class, and the particular soil within this class – and read the desirable standard. It is important to remember that these standards are based on samples taken in moist soil in the April–May period. Even for this period they can only be regarded as tentative, but they are the best that research has so far been able to produce.

The next step is to compare the result from your paddock with the desirable standard. Three different situations might arise (see also Figure 1).

- **The result may be low** – (more than 10 p.p.m. below the desired level).

In this case the aim should be to build up the soil level by applying as much fertiliser as practical. This applies to both cereal areas and high rainfall country. The amount will depend on the money available for buying fertiliser, but rates of at least 16 lb. of phosphorus, that is one 187 lb. bag of superphosphate, should be applied per acre if at all possible. Where values are very low, say on new ground, doubling this amount to two bags has been shown to be an advantage. For best results it is also important that the fertiliser be applied every year and applied at seeding of crops or close to the break of the season on pastures.



A soil testing service is quite useless unless backed by a field research programme. The Department of Agriculture has carried out hundreds of field trials over the last 10 years.

Above: A phosphorus on wheat experiment on Yorke Peninsula.

Below: Different forms of phosphorus fertiliser being tested at Hope Forest.

different. Here the rate should be adjusted to suit the stocking rate. Research work has clearly shown that the more sheep that are carried, the more phosphorus is needed. If the stocking rate is low, say less than two dry sheep, then a maintenance level of phosphorus will be sufficient. With higher stocking rates, more phosphorus will be essential.

It is not possible to give precise advice to cover all pasture-stocking rate situations here. It is suggested that landholders discuss their particular situation with an adviser.

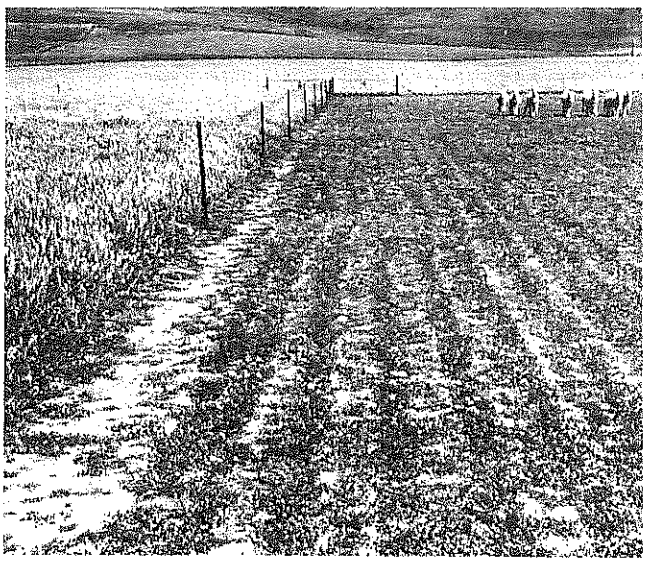
- **The result may be at, or above, the standard.**

The aim here should be to apply sufficient phosphorus to maintain the soil at the desirable standard, that is enough to compensate for that which will be removed by the current crop or pasture, or lost through fixation and leaching.

Maintenance levels have been worked out for the different land use and soil zones – see the second part of Table 1. The figures given are in pounds of elemental phosphorus. To convert these figures to pounds of superphosphate use the following formula:

$$\frac{\text{Maintenance level (lb.P)} \times 100}{\%\text{ available P in fertiliser*}} = \text{lb. fertiliser needed /acre}$$

*This is normally water soluble and citrate soluble phosphorus. However, current research suggests that in some areas of deep acid sands receiving above 25 in. of annual rainfall, acid soluble P in finely ground rock phosphate may be included in the calculation.



Research work has clearly shown that the more sheep that are carried the more phosphorus is needed.

The photo shows a grazing experiment being carried out by the farmers in the Mount Bryan district. The left hand paddock easily carries three sheep per acre, with only one hundredweight of superphosphate, the right hand paddock is carrying six sheep per acre, but needs four hundredweights of superphosphate per acre annually.

e.g. If the maintenance level is 6 lb./year you will need:

$$\frac{6 \times 100}{8.6} = 70 \text{ lb. superphosphate}$$

or

$$\frac{6 \times 100}{19} = 32 \text{ lb. Double super}$$

In cereal areas the maintenance rates suggested are adequate for a crop and the following year's pasture. It will usually be best to apply the whole