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SOIL PROBLEMS

Satisfactory Progress Since War

IMPORTANT TESTS AT URRBRAE ESTATE

Written for "The News" by Prof. J. A. Prescott,
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In this article Prof. Prescott points out how complicated is the process of chemical examination of the soil. The value of different fertilisers and manure is mentioned. Developments in the production of high-class fertilisers are also reviewed.

Virtually all South Australian soils are deficient in phosphates, the form in which phosphorus is of greatest service to plants.

The most elementary analysis consists of replacing the soil moisture and analysing this; then comes the extraction of the soil with water saturated with carbon dioxide or containing 1 per cent. citric acid or other dilute acids. We have even more recent methods based on highly complicated psycho-chemical soil phenomena. The choice is in fact bewildering even to the chemist, so that to send a soil to an agricultural chemist and ask him to analyse it to see what it lacks is not really such a simple thing as it was once considered to be.

Soil fertility is made up of such a number of factors that unless certain field indications are available the chemist might easily work for several weeks and find little. With the proper guidance he may be able, however, to find out what is wrong in as many minutes. The soil chemist is still exercising much thought and time in devising methods which will give the information desired by farmers.

The soil shows a number of interesting chemical properties which are of great importance. It has an absorptive power for various substances which was made the subject of the first important investigation in soil properties ever done by any chemist. By virtue of the large surface offered by the aggregate of the finest soil particles, many important chemical fertilisers added to the soil are retained.

Certain chemical reactions take place, but the important fertiliser element is held firmly by the soil so that it is not washed out by rain. There is one important exception, namely, nitrogen in the form of nitrate, which is easily washed away, and which therefore should be applied only as a dressing to the growing crop. Phosphates, potassium salts, sulphate of ammonia, all have their essential fertiliser elements fixed by the soil and so can be used at earlier stages.

The use of fertilisers and manures is very old. Farmyard manure is the oldest of all, and exists in all countries in some form or other. It has never yet been entirely replaced by what we know as artificial fertilisers. We know that the organic matter it contains gives it a superiority, helping to maintain good physical conditions in the soil and to keep soil moisture relationships more ideal, but we are not at all certain that it does not supply in addition those rarer necessitites which are known to be occasionally useful.

Organic manures such as farmyard manure, dried blood, and refuse work slowly, supplying the needs of the plants in small amounts as such needs arise. Frequently the best needs of crops may be met most economically by a judicious combination of organic and of mineral fertilisers.

The importance of phosphates under Australian conditions needs no emphasis. The main question today is not when to use phosphates, but how much to apply. The effect of relatively small quantities such as half hundredweights is so remarkable that agriculturists the world over have been tremendously impressed, and it is not unlikely that we have still much to learn why phosphates are so effective here, and why the soil is so deficient, as is undoubtedly the case.

One of the most important effects of superphosphate was noted by Lawes as early as 1847—the underground part of the plant, especially the fibrous root development is very extensively encouraged. On this account, superphosphate was speedily recognised as an important fertiliser for root crops and for shallow-rooted, rapidly maturing crops such as barley.

In times of drought phosphates help the roots rapidly to grow into the moister layers of the subsoil. Phosphates also assist in ripening the crop, although this factor is perhaps not so important to us as to other and wetter countries.

The choice of phosphatic fertiliser is important. Many natural phosphates exist; bones have been used from classical times, and there are large deposits of rock phosphate in various parts of the world. Rock phosphates, however, seem to have little value unless very finely ground, and they have not yet shown themselves to be very efficient under Australian conditions.

Basic slag, another phosphatic fertiliser, seems to be very effective, and at the Waite Institute so far has given results both with cereals and on pasture quite comparable with those obtained with superphosphate. In super the phosphate is soluble in water.

Use of Potassium

The effect of phosphate on pasture is becoming better known in Australia. When we have a group of plants growing in competition, as in a pasture, the effect of fertiliser is frequently to change the balance of life. Such plants as clovers are encouraged so that the relative proportions of grasses, clovers, and other herbage are changed.

The deficiency of Australian soils in phosphoric acid makes its impress not only on the possibilities of wheatgrowing and on the grazing value of the land, but it may have much to do with certain nutritional diseases of stock. In South Africa it is found possible to cure certain diseases of this character by feeding bonemeal in given amounts daily.

The value of potassium salts is less well known in Australia. Most soils seem to contain sufficient quantities, and experiments so far conducted indicate that potassium is not a factor limiting the yield of cereals. Potassium is frequently of value in improving the resistance to disease, particularly when abundance of other plant food is present.

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In the classical Rothamsted experiments the plots receiving potassium salts are better able to withstand bad seasons. In recent experiments with tomatoes resistance to certain diseases has been quite appreciably increased by the use of potassic fertilisers.

It is the use of nitrogen, however, which produces the most striking results with crops. One-half the value of fallowing is that suitable nitrogen compounds are accumulated in the soil for the use of the following crop. Nitrogen is not usually employed for cereal crops in Australia on this account, but it is important for rapidly growing crops, such as sugar cane and maize.

There is reason to believe that nitrogenous manures would be of value to our cereal crops not grown after fallow. The writer has seen many such crops in South Australia obviously in need of nitrogen.

Lesson of War

It is the supply of nitrogen which will eventually determine the world's food supply, and we may now say that the industrial chemist has solved the problem in a magnificent way. The necessity for high explosives during the war gave a great stimulus to the fixed nitrogen industry, and we have no better example of swords being turned into ploughshares than in this case.

Great strides have been made since the war, and the most recent development is the production of highly concentrated fertilisers, such as urea (46 per cent. nitrogen) to reduce the cost of transport, and meet the needs of distant oversea markets.

Sulphate of ammonia is, of course, the classical British nitrogenous fertiliser derived from the gasworks industry. It is now being supplemented by muriate of ammonia, and the more concentrated nitrate of ammonia, and the various combinations of these salts.

The most recent development in ammonium salt production is the manufacture on a commercial scale of ammonium phosphate, containing 19 per cent. of nitrogen and 47 per cent. of phosphoric acid.

Another commercial nitrogenous fertiliser is cyanide of lime, which is somewhat cheaper to produce than ammonium salts, but which frequently gives disappointing results in field practice.

The first question asked after the question of the choice of fertiliser is decided is that of quantity. We have already seen in dealing with the question of limiting factors that as the quantity of the limiting factor is increased the yield is increased until a new limiting factor intervenes, or until a depressing effect is noted.

In the case of fertilisers the increase is not proportional to the amount of fertiliser used, but every additional unit produces a smaller and smaller effect. In South Australia the first hundredweight of superphosphate may produce as much as eight bushels increase, but the third hundredweight may produce none at all.

Among the chemical properties of the soil the question of soil reaction has played an increasingly important part in recent years. By reaction we mean the degree of acidity or "sourness" of the soil. The farmer's definition of sourness is vague, and most socalled sour soils of South Australia are not sour at all in the sense of the chemist.

Possibly a better term would be "stale" or even "bitter" if such a term could have any meaning. The usual type of sourness may be cured by the correct addition of lime. In dealing with soil acidity two factors are involved—a quantitative factor which determines the amount of acid present which is to be neutralised, and a qualitative or degree factor which may be illustrated by comparing chemical equivalent quantities of an acid soil, citric acid, and, say, sulphuric acid.

The degree of acidity is commanding the greatest interest today. Most field crops prefer a reaction which is about what we call neutral, but some crops such as buckwheat are tolerant of acid conditions. The incidence of certain diseases is controlled similarly by the soil reaction. Potato scab is most frequently found on soils well supplied with lime, while diseases of cabbages such as finger and toe occur only on acid soils.

The value of lime in overcoming soil sourness has, of course, been long established, but in many neutral soils the effect of lime on the yield of the crop is almost negligible. Its most important effect is to improve the physical texture of the soil and to make cultivation more economical. Lime is, in fact, a most important soil factor, and although it takes its place as a plant food its main value is as a soil amendment or ameliorant.

Lime is not only the cheapest alkali for restoring the neutral reaction of an acid soil; it is also the most efficient substance for bringing about a desirable soil texture. The form in which lime should be applied is one of some local controversy. The form to which all soil lime eventually reverts is calcium carbonate. Calcium carbonate to be efficient must be either finely divided or easily weathered into a fine state.

Value of Lime

Quick lime and slaked lime, however, have a certain degree of solubility, and so neutralise a soil very rapidly, and even when converted back to carbonate remain in a finely divided condition. Slaked lime, moreover, may act occasionally as a soil steriliser.

The use of gypsum, sulphate of lime, is often mentioned in this connection. Although gypsum is a corrective for certain undesirable soil reactions, it is not a cure for soil acidity, and the uses of lime and gypsum in this respect are not interchangeable, although the ultimate effect on the properties of the soil is the same.

A soil, to be ideal, should have its ultimate clay compounds saturated with lime; if the soil be acid, the soil is said to be unsaturated, and the remedy is to correct that acidity by using lime in one of its alkaline forms. If the ultimate clay compounds are saturated with sodium as a result of interaction with salt ("magnesia") then the reaction becomes very alkaline, and sodium carbonate is produced in the soil water, the most dreaded of the ordinary harmful salts.

The physical conditions of such a soil are deplorable, and it is then that gypsum finds its true value. The gypsum reacts with the sodium carbonate, the lime displaces the sodium, and we have again our ideal—the lime-saturated soil.

It is a matter of some interest to see how South Australian soils stand with respect to soil reaction. At the Waite Institute we have already examined some two hundred soils, and an interesting generalisation is beginning to show itself. The most acid soils occur in the regions of highest rainfall.

Soils that are subject to continual leaching lose lime the most rapidly, and we have at one end of the scale the Lower Murray swamps, which are our most acid soils. The South-Eastern swamps are distinct, and we find them at the other end of the scale owing to the abundance of lime. In English parlance the Murray swamps are "marsh peat" soils, and the South-Eastern swamps are "fen" soils.

With present costs of labor over the world cultivators are avoiding the use of lime wherever possible, unless the value of the crop is sufficiently high to justify the expenditure.

In testing soil for sourness it is possible to make determinations by means of dyestuffs, indicators which change color according to the degree of acidity.

The old-fashioned method of pressing a piece of litmus paper is really this method, but modern indicators are much more sensitive. Another old-fashioned method frequently recommended was to pour hydrochloric acid (spirits of salts) on the soil. If there was effervescence the soil was abundantly supplied with carbonate of lime. A soil may however, contain quite a sufficiency of lime without giving effervescence in this test.

A recent test devised by Prof. Comber, of Leeds University, is coming into universal practice in Europe. The reagent required is a 5 per cent. solution of potassium salicylate. A small quantity of soil is shaken up with a small volume of the reagent. Acid soils give a red color the depth of which is roughly proportional to the degree of acidity.

We have made a large number of tests at the Waite Institute, and find that with South Australian soils the test is quite a good one. The test is of value for the practical man, for he can determine in a short time whether his soil is in need of lime or not. If he needs further information regarding how much lime would be required he would have to send soil samples to the laboratory for further examination.

ADV. 12.10.26

CHAMBER MUSIC

The chamber music recitals at the Elder Conservatorium recently, have served to give Adelaide audiences an idea of the inherent beauties of that branch of the art. The twelfth concert of the 1926 session was held on Monday evening in the Elder Hall, and although there was a fair audience, the brilliant presentation merited a far wider recognition. A string quartet in D minor by Schubert, and a quintet in A major for piano, two violins, viola, and 'cello, by Dvorak, comprised the programme. The members taking part were Mr. Charles Schilsky (first violin), Miss Kathleen Meegan (second violin), Miss Sylvia Whitington (viola), Mr. Harold Parsons (violoncello), and Miss Maude Puddy (pianoforte).

Schubert's symphonies and chamber music have placed him in the front rank among the classics, and the string quartet in D minor is a work of exceptional beauty and inspiration which is considered to be one of the greatest masterpieces of its kind. It consists of four movements, allegro, andante, con moto, allegro molto, and presto, each in itself demanding the highest skill and technique. The interpretation given by the four artists was magnificent. Perhaps the gem of the evening was the beautiful andante con moto, a series of variations on a theme taken from Schubert's song "Death and the maiden." The interpretation of the whole of the programme, however, left nothing to be desired, and revealed the close understanding which existed between the musicians. In the allegro the vigor and fervor of the first subject was well portrayed. The sweet pathos of the andante con moto was finely given, and made a deep impression on account of its spiritual appeal. The stirring opening of the allegro molto gave an opportunity for a change into more forceful playing, and the number was given with strength and sincerity. In the presto a pleasing effect was obtained, and careful attention was given to detail, the inspiring composition being faithfully and brilliantly interpreted. The rendering of the movement was enthusiastically applauded.

In a different vein was the work by Dvorak, which included allegro ma non tanto, andante con moto, scherzo molto vivace, and finale allegro. Each of the movements was of exceptional interest, and the plaintive note of the composer's native Bohemian melodies running through them made them additionally attractive. Again the excellence of the interpretation seemed to bring out the spirit of this important work, and it merited to the full the warmth with which it was received.

to the Registrar of the University,