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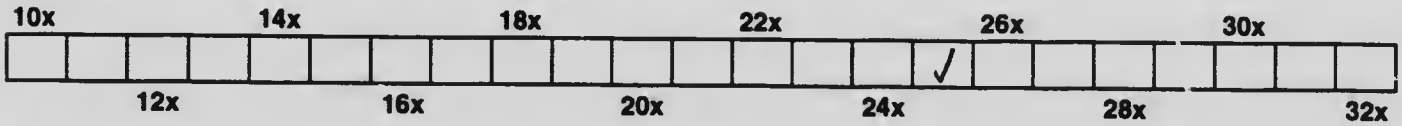

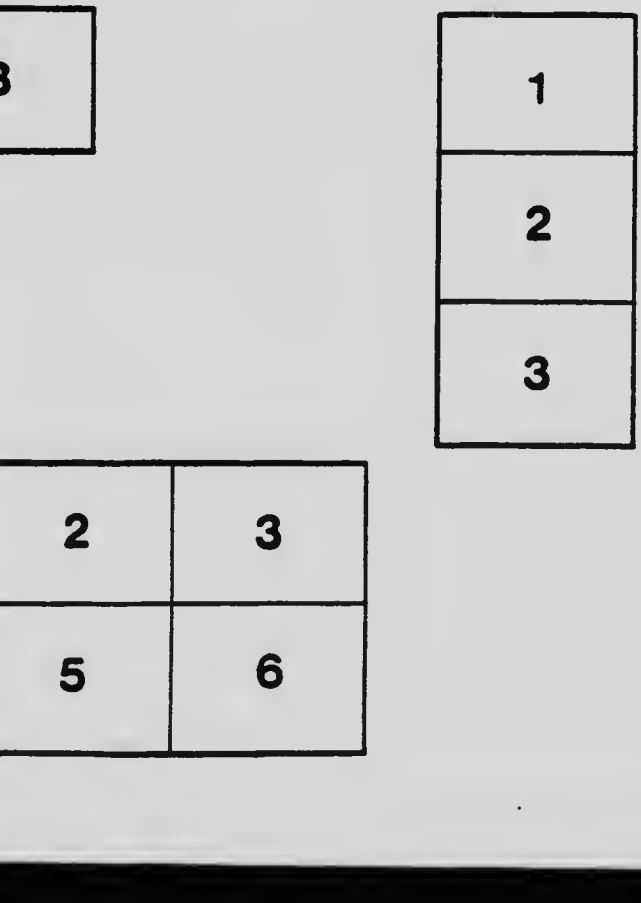

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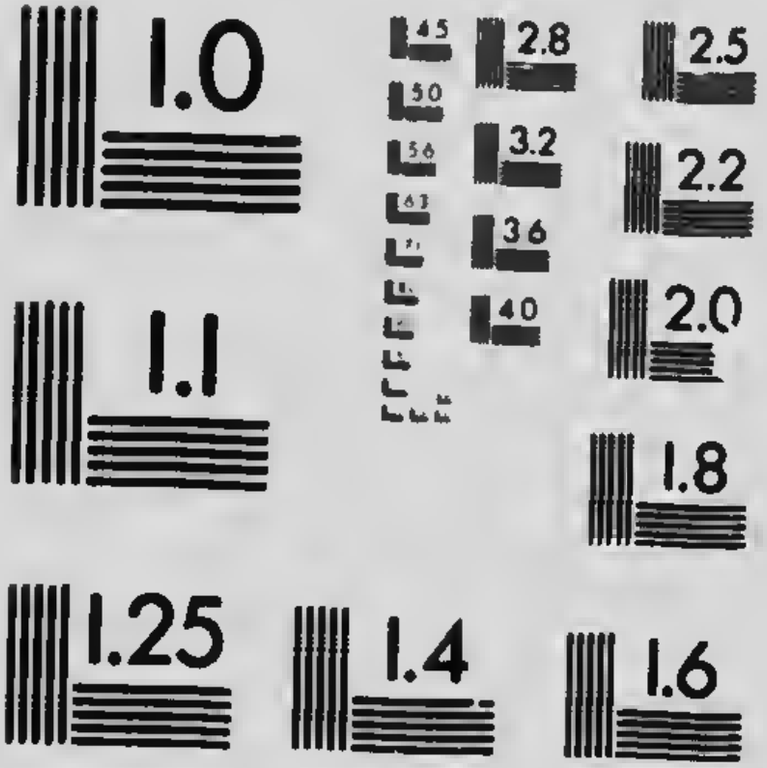

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LIME IN AGRICULTURE

BY

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THE NATURE OF LIME AND LIME COMPOUNDS USED IN AGRICULTURE.

Lime.

Lime, known also as quicklime, burnt lime, caustic lime, stone lime, etc., is produced from the burning of limestone (carbonate of lime) with wood or coal. The burning may be performed either in a specially constructed kiln or by the simpler method of heap-burning. The intense heat decomposes the carbonate, carbonic acid gas being driven off and caustic or quicklime remaining.

Slaked Lime.

Slaked lime, known also as hydrated lime, results from the union of water with quicklime. The process of slaking, or adding water to the lime, is commonly practised by builders in the making of mortars, and is accompanied by the generation of a considerable amount of heat. The result is a whitish-grey or greyish-white (according to the quality of the lime) powder having properties that are distinctly caustic and alkaline. The bean of lime in slaking swells to nearly double its original bulk and a bushel of freshly-slaked lime will weigh approximately 40 pounds, as compared with 70 pounds per bushel, which may be taken as the average weight of lime. The weight of lime, however, may vary between 60 and 100 pounds per bushel, according to its degree of purity and the thoroughness of burning. This fact furnishes an argument in favour of purchasing lime and lime compounds by weight rather than by measure.

Air-slaked lime results from the long exposure of quicklime to the air. The lime first absorbs moisture, being converted into the hydrate (slaked lime), which then takes up and combines with the carbonic acid gas of the atmosphere to form the carbonate. Slaked lime, therefore, is variable in composition; it may be essentially slaked lime with a small percentage of carbonate, or largely carbonate of lime with traces only of slaked lime, depending chiefly upon the duration of the exposure.

Limestone, Marl.

These are essentially carbonate of lime. Limestones are not all identical in composition; some contain notable amounts of carbonate of magnesium and are known as magnesian limestone or dolomite; others contain varying proportions of inert rock material. Hence the higher grades of limestone used in agriculture may be almost pure carbonate of lime, while the lower grades may contain less than three-fourths of their weight of carbonate.

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Marls containing over 90 per cent of carbonate of lime are frequently found in Canada; others containing varying proportions of clay, sand or organic matter may show as low as 30 per cent of carbonate of lime. Chiefly by reason of the facility with which they may be reduced to a fine powder, marls constitute a very suitable form of carbonate of lime for use in agriculture.

The Agricultural Functions of Lime and its Compounds.

The chief objects of applying lime or carbonate of lime are two: the neutralization of acidity and the improvement of tilth or mechanical condition of soils.

Acidity or Sourness.

Lime and carbonate of lime combine with and neutralize the soil's acids and the excess used renders the soil slightly alkaline, a condition favourable to crop growth.

Wet, low-lying and ill-drained soils are especially apt to become sour. Soils consisting essentially of vegetable organic matter, as mucks and peat loams, are usually, though not invariably, sour. Many light upland soils are slightly acid, presumably by the washing out and leaching away of their original store of carbonate of lime or its withdrawal by many years of cropping.

In all soils, but more especially in sandy and gravelly loams, there is a tendency for the lime compounds to disappear, partly through removal by crops but more particularly by their solution (in water containing carbonic acid) and passage into the strata below the root area.

Method of Testing for Acidity with Litmus Paper.

The usual test for soil acidity is blue litmus paper, which may be purchased at any drug store. It should be kept in a clean, dry, preferably wide-mouthed, well-corked bottle. When tearing or cutting off a strip of litmus paper for use, a pair of forceps or scissors should be used, as the paper is sensitive and the fingers may cause its reddening. The following test, if carefully carried out, is reliable:—

1. Take up, by means of a spade or trowel, a little of the surface soil from, say, half a dozen places on the area to be examined and mix well; do not handle the soil. Take a small quantity (a few ounces) of the sample, put it in a clean cup or tumbler, pour on a little boiled water and stir with a clean piece of stick or spoon until a pasty mass is obtained. Into this "mud" press, by means of a small stick or the back of a knife, a strip of blue litmus paper for about one-half to two-thirds of its length. If on drawing out the paper, at the end of fifteen minutes, the part in contact with the soil has turned red, then the soil is acid.

Influence of Lime on Tilth.

The influence of lime and its compounds upon the tilth or texture of the soil is most marked in the case of clays, which it renders less sticky and cohesive when wet, and more friable and mellow when dry. On light soils—sandy and gravelly loams—lime and carbonate of lime exert a beneficial influence, their action being to cement slightly the soil particles, rendering the soils somewhat heavier and more compact in texture and, thus, less liable to dry out in seasons of drought.

Chemical Effects of Lime Compounds.

In addition to their beneficial effects already described, lime, as also the carbonate and sulphate of lime, possesses in a considerable degree the power to decompose the insoluble potash compounds in the soil, the lime taking the place of the potash, which is liberated in a form assimilable by plants. **Thus the lime compounds may act as indirect potash fertilizers.** The effect is naturally most noticeable on clays and will most materially benefit clover and other leguminous crops which more particularly respond to potassic fertilizers.

Influence of Lime on the Bacterial Life of the Soil.

The humus or semi-decayed organic matter in the soil is the main source and storehouse of nitrogen, the dominant and most costly element of plant food. Before this humus-nitrogen can be utilized by growing crops it must be oxidized and converted into nitrates. This process, known as nitrification, is the life work of certain vegetable micro-organisms or bacteria within the soil. In soils deficient in carbonate of lime, and especially in ill-drained, water-logged soils, the decay of the organic matter is accompanied by the development of certain organic acids, and thus the soil becomes sour. This acid condition of the soil is distinctly unfavourable to the life and development of the useful nitrifying organisms, for these can flourish only in a neutral, or rather slightly alkaline soil. Lime and carbonate of lime neutralize these acids, making the soil a suitable medium for the growth of these bacteria and, further, furnish a base or alkali to combine with the nitric acid produced by them. The nitrate of lime so formed is, no doubt, the immediate source of the nitrogen supply of our field crops.

Comparative Values of Lime Compounds.

All forms of lime used in agriculture are not of equal value, especially for the correction of acidity. In acid-correcting power and in furnishing available lime, and considering the various forms on a basis of equal purity, 56 pounds of quicklime is the equivalent of 74 pounds of freshly-slaked lime and of 100 pounds of carbonate of lime whether it be as marl or ground limestone. Air-slaked lime, for reasons already noted, may be partly hydrate and partly carbonate; its value will, therefore, be intermediate between that of freshly-slaked lime and the carbonate: that is, 56 pounds of quicklime will be equal to a weight of air-slaked lime between 74 and 100 pounds. Presenting these facts in tabular form we have:—

2,000 lbs. quicklime = 3,571 lbs. ground limestone and marl.
2,000 lbs. quicklime = 2,643 lbs. freshly-slaked lime.

If quicklime were worth $5 per ton, ground limestone, equally free from impurities, would be worth $2.80 per ton, and freshly-slaked lime, $3.80 per ton. While the above comparison, as to equivalent weights and values, may serve in a general way, an analysis is necessary when the exact lime value of any particular sample or samples is desired.

Is Lime or Carbonate of Lime Preferable?

In settling this question the character of the soil and the desired rapidity of action should be considered.

On account of their influence in hastening the decomposition of the humus, quicklime and slaked lime are not so desirable or safe to use on light sandy and gravelly loams as are ground limestone and marl. If lime be applied to these soils it should be in small dressings (not more than 1,000 pounds per acre) and at long intervals. Carbonate of lime (limestone and marl) is much milder in its action and an excess can do little or no harm.

For heavy clays or soils rich in organic matter, mucks and peaty loams, lime or slaked lime is to be preferred and may be applied in fairly large amounts—say 1½ to 3 tons per acre. These compounds are gradually converted into carbonate of lime within the soil, but being more vigorous and active from the outset and being in finer powder than ground limestone they pass more readily into solution, thus allowing a more uniform distribution throughout the soil. As a result their influence in flocculating the clay particles and improving tilth will be more rapid. For the same reason the chemical action also of these forms is more vigorous than that of ground limestone and marl.

Gypsum or Land Plaster.

Gypsum may be valuable agriculturally in furnishing lime for plant growth, as it is fairly soluble in water, but since in this form lime is combined with sulphuric acid and is present in a neutral condition it follows that *gypsum has no value for the treatment of sour or acid soils.* For this purpose it cannot take the place of quicklime, slaked lime, or marl or ground limestone, which are essentially alkaline in character.

The two chief agricultural functions of land plaster are its property of flocculating clay and its effect or influence on the insoluble potash compounds, setting free this element in forms available for plant use. The first of these functions makes it valuable for the dressing of heavy clay loams, which it improves in tilth by rendering them less plastic, more open and friable; in a word, mellower and more easily worked.

The Application of Lime Compounds.

Quicklime.—In order to facilitate its uniform distribution over the soil, quicklime should be slaked. Place the lime in small heaps of about a bushel each at regular distances on the field to be treated. Pour a little water, about one-third the weight of the lime, so that the slaking may be gradual and a fine powder result, on each; cover the heap with an inch or two of moist soil and allow to remain for two or three weeks, when the lime will be thoroughly slaked and fall into a fine powder. Mix the slaked lime with a little soil and spread with a shovel, choosing preferably a damp day for the work.

Forty heaps of about 50 pounds or twenty-five heaps of 80 pounds each is an application of approximately one ton per acre.

Slaked Lime.—This is in the form of a powder and may be most conveniently, pleasantly and uniformly spread by employing a lime spreader or fertilizer drill. It can, of course, be spread from a wagon box, but the operation is more or less disagreeable. If this method is adopted, the mixing of the slaked lime with a little fine soil is said to make the handling less unpleasant.

For these more caustic forms—quicklime and slaked lime—autumn is probably the best season for application, spreading on the ploughed land and immediately harrowing it in. The aim should be to incorporate the lime with the first three or four inches of soil. The tendency for all lime compounds is to sink to be washed down by the rain, and, therefore, they should never be ploughed under. It is better to make light applications frequently, say once in a rotation if necessary, than large applications at longer intervals. It is well to err on the side of too little than too much, especially if the organic content of the soil cannot be constantly enriched.

Ground limestone.—The essential points to be remembered in the purchase of this form are composition and degree of fineness. If a quick prompt action is desired, a material 75 per cent of which passes through a sieve with 100 meshes to the linear inch, will be found satisfactory. Coarser ground lime may, however, be successfully used—say 50 to 75 per cent passing through a 50 sieve—and all through a 10-mesh sieve—if immediate and, in a sense, quick, de is not important.

The application may be from two to ten tons per a to the character and the acidity of the soil and the degree of fineness al. Unlike quick and slaked lime, excess of ground limestone can do lit arm and the same holds true of marl.

The application of ground limestone and marl offers special difficulty or unpleasantness; a spreader may be used or the material distributed by a shovel from a wagon. They may be applied at any season of the year and specially suited, as has been stated, for light loams and soils generally that are in organic matter. As with lime they should be harrowed in, not ploughed under in the case of meadows or pastures, merely spread on the surface.

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