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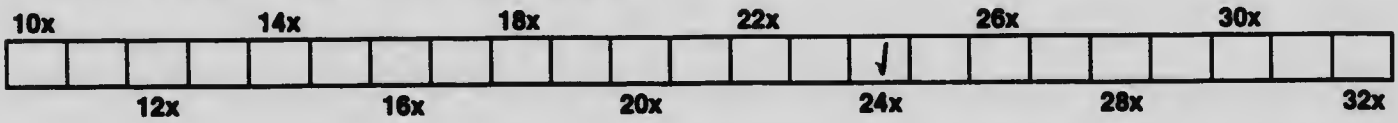

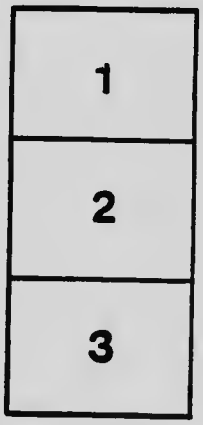

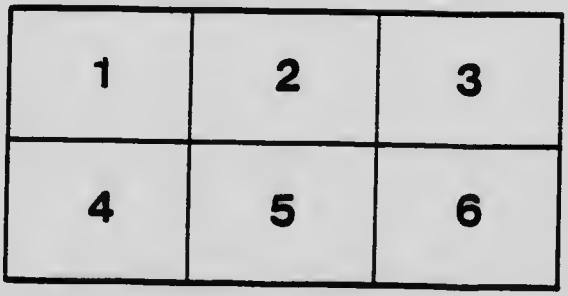

Ontario Department of Agriculture

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Lime and its Uses in Agriculture

By

R. HARCOURT

Professor of Chemistry

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Lime and its Uses in Agriculture

By R. HARCOURT

LIME IN AGRICULTURE.

During the last two or three years there has been a great deal of interest taken in the question of applying lime to farm lands. Yet correspondents appear to have no common understanding of soil acidity, its causes, its effects, tests which may be made in the field, what materials may be used to counteract it, and many other points in connection with this question.

It must not be thought that all soils are acid, for some, by reason of their origin, are well supplied with lime. These are almost invariably strong, productive soils, and stock fed on their crops are thrifty, with plenty of bone. On the other hand, large areas of land are just as naturally poor in this constituent from the outset, and under cultivation, the supply is soon so reduced that there is not enough of it to do the work which has apparently been assigned to it in crop prodnction. Stiff clays and wet, low-lying and ill-drained soils are apt to become sour, probably due to the fact that there is little chance for the acid materials found in the soil to drain away. Such soils should be drained first and then limed.

Combined with the fact that some of the soils of this Province are sour and that the natural changes taking place in any soil tend in that direction, we have the other fact that few, if any, of our farm crops can make their best growth in a soil carrying a poor or insufficient supply of lime. In the case of legumes an abundance of lime is essential. In fact it is probable that the frequent failure of clover to come through the first winter is due to lack of lime in the soil.

Lime has three main actions in the soil, it neutralizes the acids formed, it improves the physical condition, and it is apparently essential for the proper development of certain plants and organisms in the soil.

How Soils Become Acid.

The acidity of a soil is due to the presence of acids or acid salts, and they may be either organic or inorganic. We are familiar with the fact that sweet immatnre corn makes sonr silage, sweet cider ferments to vinegar, and that sweet milk will sour. In a similar manner organic matter such as green manures crop residnes, and farm manures undergo fermentation or decomposition in the soil and prodnce acids. If this acid is to be counteracted or neutralized, there must be some material of an alkali or basic nature present to combine with the acid and form a neutral salt and thus destroy the acids formed. This is one of the functions of lime in a

soil. If the soil is naturally poor in lime, or has been depleted of its natural store of lime, the soil will probably be sour.

The natural chemical changes that take place in a cultivated soil tend to bring its soluble plant food constituents into a soluble form. These changes are essential to render the food available to the plant. But, among these food constituents, lime, at least, is rendered soluble faster than is necessary for food purposes. Naturally, unless it is again taken up in an insoluble form, it must gradually be carried downward with the water that sinks into the soil. For this reason the water of wells, of many springs, and of our rivers is hard or limey. For the same reason a subsoil contains more lime than a surface soil, and the latter may become so leached that it does not contain sufficient lime to neutralize the acids formed in the decay of the organic matter when the soil becomes acid or "sour." It is well to remember that the richer the soil is in decaying vegetable matter and the more thorough the cultivation, the faster the lime will be rendered soluble and leached away. For the same reason, the longer the land has been under cultivation, the more likely it is to need lime. Thus it is many years since some of the lands of England and Scotland needed lime. The same is true of much of the land in the States to the south of us, and now our, comparatively speaking, newer lands are reaching the same condition.

During the past season's work on the soil survey, we have had abundance of evidence that these changes have progressed far enough to render the application of lime a necessity in many districts. In the course of the summer's work thousands of borings were made in the soils of the counties studied. In most cases the surface soils were acid to litmus paper, and there was not enough carbonate of lime present to cause any apparent effervescence until a depth of 20 to 24 inches was reached. In some cases there was none even at 40 inches. The only surface soil rich enough in carbonates to give an effervescence with acid was found in Lambton County, and that was of comparatively small area. On such a soil it would naturally be useless to apply lime. In some other places, as in the neighborhood of Guelph, the soil is not yet in need of lime, but the supply is working downward, while in other districts, there is great immediate need. All these data we hope to have clearly mapped, when we get farther on with the work of our soil survey.

Many inorganic fertilizer materials tend to increase soil acidity. Thus sulphate of potash, muriate of potash, and sulphate of calcium, or land plaster, are neutral salts; but the basic part of the salt (potassium and calcium) is taken up by the plants more rapidly than the acid radicle, and the soil becomes sour. Ammonium sulphate has this effect in a double sense, because the nitrogen in the basic part of the compound, ammonium (NH_4), is nitrified in the soil to nitric acid and both parts of the original substance furnish acids.

Lime Improves the Physical Condition of Soils.

But the addition of lime does a great deal more than simply neutralize the acid of a soil. It influences the tilth or texture of a soil. This is most marked and most beneficial in the case of clays and clay loams, rendering them less tenacious when wet, and more friable and mellow when dry. This it does by causing the fine particles of the clay to gather into larger units and makes the soil act more like one made up of larger particles. This flocculation can be readily shown by carrying out the following experiment: Take two glass cylinders or jars, and place in each about a tablespoonful of clay soil, and nearly fill with soft water. To

one cylinder, or jar, add about a teaspoonful of slaked lime, then mix thoroughly the contents of each jar by shaking and turning upside down and shaking. Allow to stand and settle. Note the difference in the size of the particles and the rate of settling. The flocculation does away with the stiff, waxy, impervious nature common in clays deficient in lime, and renders them drier, warmer, better aerated, with a larger content of moisture available for plant growth. It also brings about a more favorable condition for root development; improves drainage and permits the farmer to cultivate his clay soil earlier in the spring with all the advantages that naturally follow.

The action of lime on sandy soils is somewhat similar to that on clay, that is, it binds, or cements, the sand particles together; but the effect on the soil is different. It renders the soil closer in texture, and thus, being less open and porous, it does not dry out so readily in seasons of drought.

Lime Liberates Mineral Plant Food.

In addition to neutralizing the acid of soils, and improving their physical condition, lime is also credited with causing certain chemical reactions in the soil whereby the inert potash and phosphoric acid are brought into an available form. In fact, the carbonate of lime appears to be the main-spring of many beneficial reactions occurring in the soil. Most of our soils contain immense quantities of potash in an insoluble form. Through the action of lime compounds these insoluble potash compounds are broken up, the lime taking the place of the potash which is liberated in a form that plants can assimilate. In this way lime compounds may act as an indirect potassic fertilizer, which gives lime a double value at the present time when potash materials are so scarce and expensive. This effect is naturally most noticeable on clays, and more particularly with clover and other leguminous crops which have the greatest difficulty in securing their supply of potash from the soil.

Phosphoric acid is largely held in the soil in combination with iron and aluminum in compounds that are very slowly rendered soluble. The lime reacts with these with the formation of phosphate of lime which is more readily rendered available to the plants. Thus while lime does not directly supply either potash or phosphoric acid, it does help to bring that which is in the soil into an available form. Furthermore, it is generally considered that soils destitute of lime have little power of retaining plant food constituents when applied to the soil as fertilizers in the form of salts of strong acid.

Micro-organisms in Soils Cannot Develop in an Acid Soil.

Thus far we have credited lime with neutralizing the acid of soils, improving the physical condition, and liberating mineral plant food from insoluble forms of combination. But it has still other uses in the soil. A soil worthy of the name must contain a supply of decaying organic matter, humus, or humus-forming material, which is the source and the storehouse of nitrogen, the most important and the most costly element of plant food. In this form, however, the nitrogen is not available as a plant nutrient, the material must undergo further changes with the formation of nitrates. The process by which this is brought about is known as nitrification, and is the work of certain vegetable micro-organisms or bacteria within the soil. As these nitrifying organisms flourish only in a neutral, or rather slightly alkaline soil, it is necessary that some such substance as lime be present to

neutralize the acids that are formed in the decay of the organic matter. The nitrate of lime thus formed is the principal direct source of nitrogen to the plant.

Then, there is another class of bacteria whose function is to fix atmosphere nitrogen within the soil. This is one of the micro-organisms which Professor Bottomley claims performs such an important function in his "Humogen," which has recently come into prominence. These organisms known as *Azotobacter*, are, so far as we know, present in all fertile soils. They have, apparently, a very important function to perform in adding to the soil's store of nitrogen, a function they cannot perform in an acid medium. Hence, again we have a reason for the use of lime.

A third class of bacteria important in agriculture is the nitrogen gathering bacteria associated with the legumes. The value of this agent in increasing the productiveness of soils is now well recognized; but it, like the other classes of bacteria mentioned, cannot perform its important function in an acid soil. This is doubtless one of the reasons why an application of lime so beneficially influences the growth of legumes.

Taking into consideration then, all the important functions which lime has to perform in the soil, and the fact that our soils are steadily losing their lime, it is evident why the application of this material is so important. Fortunately, we have abundance of the lime in our own country, and it is not a costly material.

How to Test for Acid in Soils.

Many methods have been devised for determining the amount of acid in a soil, but none of these are suitable for field use. In most cases, it is sufficient to ascertain the fact that the soil is acid. For this purpose a fairly satisfactory test can be made with blue litmus paper, which can be purchased at almost any drug store. It is sold in sheets or in little "books" which contain about twenty-five or fifty strips of the paper about one-half inch wide and two or three inches long. This is the most convenient form in which to have the test paper. If the sheets are purchased, they may be cut into strips the size of those in the books and preserved in a clean, dry, wide-mouthed, well-corked bottle to keep them from acid fumes. When this paper comes in contact with an acid it turns red.

A very simple method and a very satisfactory one in our experience of applying the test is to make a ball of damp soil, break it open and lay the paper on the broken surface, squeeze the parts together again and allow to stand for from five to ten minutes. If on opening the ball, it is found that the blue paper has turned red, the soil is acid and in need of lime. It is apparent that the hands must be free from acid and the soil damp enough to press into shape. Unless the soil is very dry, we have usually found that by getting a sample three or four inches below the surface there was enough moisture to answer the purpose. If the soil is moderately dry the change in color may appear only in spots and greater pressure or longer time may be needed to make a satisfactory test. The rapidity of change and intensity of color developed indicate to some extent the relative degree of acidity. To overcome accidental difference in the soil, the test should be repeated several times with samples taken from different parts of the field. In Bulletin No. 80, Dominion Experimental Farms, Ottawa, Dr. Shutt describes two methods which are not difficult to carry out, and may give more reliable results, especially where the soil is dry. These results are as follows:—

1. "Take up, by means of a spade or t[illegible], a little of the surface soil from, say, half a dozen places on the area to be exa[illegible]ed, and mix well, using the trowel or a clean piece of board. Do not handle the soil. Take a small quantity (a few ounces) of the mixed soil and, putting it in a clean cup or tumbler, pour on a little boiled water, and stir with a clean piece of stick or spoon until the mass is of a consistency of a very thick paste. Into this "mud" pre[illegible] a piece of blue litmus paper by means of a small stick or the back of the kn[illegible] inserting the paper [illegible] one-hal[illegible] two-thirds of its length is within the pasty mass. At the end of fifteen minutes, carefully draw out the paper and note if the part that has been in contact with the soil has turned red. If so, the soil is acid."

2. "Place a strip of blue litmus paper in the bottom of a clean, dry glass tumbler (preferably flat-bottomed) and over it place a round "filter paper" (purchaseable at a druggist's), or, if such is not readily obtainable, a piece of clean, white blotting paper cut to fit the bottom of the tumbler. On this put a few ounces of the soil to be tested, collected and mixed, as already described, and pour on sufficient boiled water to moisten or wet the soil thoroughly throughout its mass, but no more, and set aside for half an hour or longer. To examine the litmus paper, the tumbler is inverted: viewed through the bottom of the glass, its color will be well brought out against the white filter paper. As a check and to ensure that any change in color may not be due to acidity of the water or filter paper used, a blank test should be made in the same manner, but using no soil."

Forms of Lime.

In the above discussion we have used the term *"lime"* without designating any particular form. It now remains for us to deal with the various forms of this material on the market.

There are several forms of lime that may be used for agricultural purposes. These are quicklime, air-slaked lime, hydrated lime and ground limestone.

Quicklime must be slaked before it can be evenly distributed over the ground. The best plan is to distribute it over the field in small heaps much as is done with stable manure. Fifty pounds to four square rods will give an application of one ton per acre. If water amounting to one-third the weight of the lime be added and the heap covered with about an inch of soil, the lime will soon slake, when it may be spread with a shovel. This latter operation is not a pleasant one, but if the slaked lime is mixed with earth and a damp day chosen for the work, it may be accomplished without any great inconvenience.

Hydrated lime is simply the quicklime slaked, screened and bagged. It is, consequently, more expensive, but its action in the soil will be the same as the quicklime slaked in the field. Generally speaking it is too expensive a form to use for agricultural purposes. Where a small amount is needed for a garden, it would be a very convenient form to use.

Air slaked lime is quicklime that has been allowed to slake without the direct addition of water. It differs from the freshly slaked lime in that it has taken up some carbon dioxide from the air, and part of the lime has passed back into the carbonate condition. The amount that has been thus changed will depend upon the length of time the lime has been exposed to the air.

Ground limestone is simply the limestone rock, similar to that which is burned in the preparation of quicklime, finely pulverized. Naturally the more finely it is ground the quicker it will react in the soil. The coarser-ground material will

remain an active agent for a longer time in the soil. Consequently, it is not essential that the whole of the material be very fine. Generally speaking, if the rock is so pulverized that the larger particles are no bigger than flax seed and all the fine material that would naturally be formed in the process of grinding it remain in it, it will be fine enough. The very finely pulverized material costs more to prepare and is more difficult to handle, and does not serve the purpose any better; for applications of ground limestone only need be made at intervals of four or five years. The finest materials will come into use first and the coarsest later. At the same time, it may prevent a too rapid leaching away of the material.

Gypsum, or sulphate of lime, is found in beds or deposits in various parts of the Dominion. When pulverized, it is very commonly called "land plaster." It is a valuable source of lime, as the compound is more soluble in water than the carbonate of lime, but it does not neutralize the acid of sour soils, and cannot, therefore, take the place of the above mentioned forms of lime for this purpose. In other respects, gypsum, or land plaster, may substitute lime, and being more soluble, may be applied at a much less rate per acre. It also contains some sulphur, which some authorities now think may have a special value in the soil.

Marl is found in beds or as deposits, varying from a few inches to several feet in depth, and it is usually covered with a layer of partially decayed organic matter, commonly called muck. In some cases the deposit is practically pure calcium carbonate; in other cases it will be found mixed with clay, sand or organic matter. Its value for agricultural purposes depends upon the calcium carbonate it contains. It may be drawn directly from beds and applied to the land, or it may be taken out and dried and pulverized, when it may be used in the same way as ground limestone. It is easily reduced to a fine powder, and is a valuable source of carbonate of lime for agricultural purposes.

Lime kiln refuse is a product from the lime kiln and consists of unburnt limestone, quicklime, air-slaked lime and sometimes may contain wood ashes, clay or sand. The ashes are derived from the wood which was used as fuel in burning the lime. This material is somewhat variable in composition, but it is frequently a cheap source of lime, and when wood ashes are mixed with it, there may be considerable potash present.

Gas lime is a by-product in the purification of illuminating gas. It contains certain sulphides of lime which will destroy vegetation, and hence the immediate application to the soil is not advised. But if it is put out in small heaps or spread out in such a way that the air can get through it, these harmful sulphides will in two or three months' time be converted into sulphate of lime. It is then essentially a mixture of carbonate of lime and sulphate of lime or gypsum, both of which have agricultural value and may be used for all the purposes for which ground limestone and gypsum are employed.

Acetylene tank residues are essentially calcium hydroxide or slaked lime. It will probably be partially carbonated, depending on the length of time it has been exposed and may be used for the same purposes and at the same rate per acre as described above for corresponding products.

Equivalent Weights.

In dealing with these various forms of lime, it is well to remember that 56 pounds of quicklime will have the same action, especially in correcting acidity, as 74 pounds of slaked lime and 100 pounds of carbonate of lime, or ground limestone;

or one ton of quicklime will be the equivalent of 2,643 pounds of hydrated lime or 3,571 of carbonate of lime. In general practice, two tons of ground limestone is considered equal to one ton of quicklime. As has been pointed out, air-slaked lime is partly slaked lime and partly carbonate of lime, and is, consequently, a mixture of the hydrate and carbonate of lime. 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. From the above data it will be seen that if quicklime is worth $5.00 per ton, ground limestone, equally free from impurities, would be worth $2.80 per ton and slaked lime $3.80 per ton. Furthermore, the cost of transportation of the ground limestone will be approximately double that of the quicklime.

Which Form Should be Used.

The cost of the material, however, is not the only factor to consider in deciding which form of lime shall be applied. The character of the soil and the rapidity of action required must be considered.

Carbonate of lime, that is, ground limestone or marl, is much milder in its action than the freshly slaked lime, and is therefore the better material to apply where rapid action is not an important point, and especially on light sandy and gravelly soils. These soils are usually poor in organic matter, due to the free oxidation induced by their open porous nature. Freshly slaked lime is generally credited with hastening this oxidation, and, on light soils, would thus cause too rapid a dissipation of this valuable material. On heavy clays, freshly slaked lime may be used to advantage. There is not the same fear of unduly hastening the decay of the organic matter and its action in causing flocculation of the clay particles will be more rapid and the improvement in the physical condition of the soil more quickly obtained. On soils between the sands and clays, experiments in other countries indicate that the carbonate of lime will probably give the best results through a term of years, although the returns for the first year or two may be in favor of fresh burned lime.

For mucks and peaty soils that may be decidedly acid, the fresh slaked lime is to be preferred. Quite frequently, it is found that the organic matter in these soils is not sufficiently decayed to give the best results in crop production, consequently, if the lime hastens the decay, an improvement in texture will be effected as well as the acid neutralized.

Amount of Lime to Apply.

The amount of lime that should be applied naturally varies with the nature of the soil, and the degree of acidity. We have generally recommended one ton of fresh lime, or two of ground limestone, per acre. This is probably enough for light soils that are not very acid, but experience is showing us that much heavier applications may be made on clays that show acid with litmus paper. Too heavy dressings with fresh lime tend to sterilize the soil for a time, that is, the lime checks the life process of the organisms within the soil. There is, however, no fear of this with the carbonate of lime. On light soils it is safe to apply from one to two tons of the ground limestone, and on clay the same amount of the fresh lime, or double that amount of limestone dust. But in some cases the clays may be so sour that much heavier applications are required to neutralize the acid present and give the maximum results.

The Time to Apply Lime.

Regarding the time of application, due consideration should be given to other necessary farm work. Lime is not for the sole benefit of any particular crop, but for all the crops in the rotation, although its greatest influence is upon the leguminous crops. A good plan is to apply the limestone dust after plowing and before preparing the seed bed for the legumes. The main essential is to get the limestone on the soil, and convenience or economy in getting the work done is usually the factor which should govern the time of application. There is no reason why limestone dust, and especially limestone screenings, should not be applied in the winter, provided the snow is not too deep, that the material can be evenly distributed, and that the land will not be plowed in the spring.

How to Spread the Limestone.

The main point is to get the material evenly distributed over the ground. It may be spread with a shovel either directly from the wagon or from heaps placed at regular intervals over the ground. Possibly it may be applied by means of a grain drill, or the manure spreader; but undoubtedly the most convenient method is to use the spreaders made for the purpose. *In a recent bulletin Dr. Hopkins of Illinois describes how to make a "home-made" spreader which he considers better than those on the market, especially where heavy applications of the ground limestone have to be made. The instructions are as follows:—

"Make a hopper similar to that of an ordinary grain drill, but measuring 8¼ feet long, with sides at least 20 inches wide and 20 inches apart at the top. The sides may be trussed with ⅜-inch iron rods running from the bottom at the middle to the top at the ends of the hopper. Let the bottom be 5 inches wide in the clear with 2-inch holes 5 inches between centres. Make a second bottom to slide under the first on straps of iron 10 inches apart, which should be carried from one side to the other under the hopper to strengthen it, also with holes to register. Both bottoms may be of sheet steel or the lower one may be of hardwood, reinforced with straps of iron if necessary.

"To the lower and movable bottom attach a V-shaped arm projecting an inch from under the hopper, with a half-inch hole in the point of the V, in which drop the end of a strong lever, bolting the lever loosely but securely to the hopper with a single bolt, and fasten to the top of the hopper a guide of strap iron in which the lever may move to regulate the size of the opening by sliding the lower bottom. Make a strong frame for the hopper, with a strong, well-braced tongue.

"Take a pair of old mowing machine wheels of good size and with strong ratchets in the hubs, and fit these to an axle of suitable length (about 10 feet), and 1⅜ or 1½ inches in diameter. The axle should be fitted with journals bolted to the under side of the frame. Make a reel to work inside the hopper by securing to the axle, 10 inches apart, short arms of ⅜-inch by 1-inch iron and fastening to these arms four slats or beaters of ⅝ by ¾-inch iron about an inch shorter than the inside of the hopper, the reel being so adjusted that the beaters will almost scrape the bottom but will revolve freely between the sides. The diameter of the completed wheel is about 5 inches and it serves as a force feed.

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*Farm Truth, No. 1. Ground Limestone for Southern Soils, Southern Settlement and Development Organization, Baltimore, Md.

"Hundreds of these 'home-made' machines are in use, and they are usually more satisfactory and more durable than anything on the market. The cash expense for such a machine has varied from less than $10 to more than $30, depending on how much of the materials and labor must be paid for. Farmers with some mechanical skill may hire only the necessary blacksmithing."

Experiments with Lime.

We have placed very few experiments with lime with the idea of gathering actual weights of increase produce. This was partly because the soil on this farm does not need lime and gives no response to its application, and partly because of the difficulty of carrying out co-operative experiments that extend over a number of years. In 1913 we did get some actual figures from an experiment in which quicklime was applied at the rate of one ton per acre, to a sour loamy soil that was to be planted with corn. The unlimed check plot gave a yield of 690 pounds of crop, the limed plot gave 1,865 pounds.

Last year's experiments on the light sand plots in Norfolk County showed that the limed and manured plots give an average of two tons more potatoes per acre than where manure alone was used. These are very large increased yields, but we must remember that when a soil is sour, it is a waste of time and money to cultivate until this is corrected, for the economic use of every other fertilizing material, including manure, depends upon the lime supply.

There should, however, be little need of demonstrating the fact that lime will improve soils deficient in this constituent. We have, consequently, spent more time in trying out some of the cheaper forms of lime that can now be procured. Two years ago, and again last spring, we had a few carloads of limestone screenings from stone-crushing plants, applied. This is the dust and finely broken stone which is sifted out of the crushed stone before shipping. A part of this is fine enough for agricultural purposes, but a large part is too coarse to effect any immediate results. At one quarry we were able to procure screenings from which two grades of coarser particles had been removed. The remaining material is so fine that 75 per cent. of it will pass a 10-mesh sieve, and 20 to 25 per cent. a 100-mesh sieve, or a sieve with 10,000 openings to the square inch. As this limestone dust can be procured for very little more than cost of loading, we had a few car loads applied experimentally last spring. It was expected that this material would be slower in its action than fresh burned lime or the specially prepared and more finely ground limestone. Many of the experimenters reported that the season was so wet that they had little chance of judging results, and generally speaking it appeared as though where the dust was applied at less than three tons per acre, there was no appreciable result. However, where for any reason it was applied in heavy dressings, good results were plainly visible even the first year, both in the physical state of the soil and in the yield of crop. The effect of this application will probably be more plainly seen next season.

When we commenced experimenting with limestone screenings, there was, so far as we were aware, no home-prepared ground limestone for agricultural purposes on the market. Now there are several firms producing this material in this Province alone. Our experience with the screenings leads us to think that, while they are a cheap material, it will not pay to purchase these, even at the low price, and pay the long freight haul. The finely ground limestone is much quicker in its action, and may be purchased either in bulk or in paper or cotton sacks. When

bagged it comes under a higher freight rate than the screenings, which are shipped in bulk in open cars. It is, however, more conveniently handled and it is possible to purchase a few tons, whereas the other must be shipped in carload lots. The bagging must, of course, increase the cost of the material.

As stated earlier in this article, our experience leads us to believe that in some parts of the country the soil is so sour that heavy applications of lime are needed to correct it. This state exists chiefly in clays and muck soils. We have under experiment now some muck soil which is used for producing onions, and on which the growth was not satisfactory. Analysis shows that it carries sufficient acid to require ten tons of freshly burned lime to neutralize the acid in the soil one foot deep over one acre. On this we have applied quicklime on small plots at varying rates up to ten tons per acre and the ground limestone up to twenty tons per acre. A similar experiment has been placed on a heavy clay soil. Another season's observation on the experiments now placed with the screenings, ground limestone, and with quicklime, will be of interest. In the meantime we are of the opinion that it will pay farmers whose lands are sour, and who live close to stone-crushing plants, to haul some of the screenings on to their ground, and give it a trial. Those who have to bring in either the ground limestone or the quicklime by freight, should ascertain the nearest source of supply, as otherwise the cost of hauling may unduly increase the cost of the material.