HOME COURSE IN SCIENTIFIC AGRICULTURE

THIRTEENTH ARTICLE. SOIL RENOVATION.

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THERE is a vast difference in the natural fertility of soils. Some do not produce well from the start unless special attention is given to making them productive, others produce large crops for a short time and then rapidly diminish in fertility, while others, known as strong soils, remain productive for many years without attention to their fertility. But even the strongest soils will wear out in time unless they are intelligently managed.

Plants in their growth make use of thirteen chemical elements, nine of which they secure directly from the soil. These are called the mineral plant foods. They are phosphorus, potassium, calcium, magnesium, sodium, iron, silicon, chlorine and sulphur.

The growing plant requires four other elements, as follows: Hydrogen, which it secures from water; oxygen, which it secures partly from water and partly from the air; carbon, which is secured from carbonic acid gas in the air, and nitrogen.

Nitrogen is in many respects the most important of all the plant food elements. It is not found in appreciable quantities in the rock particles of the soil. Ordinary plants depend for their nitrogen entirely on decaying organic matter. As decay proceeds ni-

Photo by Delaware agricultural experiment station.

THE SOY BEAN, A GOOD SOIL BUILDER.

trates are formed from the nitrogen contained in organic matter. The nitrates are exceedingly soluble, and unless soon made use of by growing crops they are washed out of the soil. Nitrogen is therefore usually the first element to become exhausted.

Fortunately there are certain species of bacteria that can use atmospheric nitrogen, of which there is an inexhaustible supply. One family of plants, the legumes, has learned to exchange work with these bacteria, and these plants are thus easily supplied with an abundance of nitrogen in a form they can use. When these nitrogen fixing bacteria are present in a soil on which a leguminous crop is growing the bacteria invade the roots of the legume and live there. Their presence is usually made manifest by swellings—the so called tubercles—on the roots of thrifty plants of clover, alfalfa, beans, peas and other legumes. The tissues of leguminous plants become very rich in nitrogenous compounds, and when they decay in the soil they set free large amounts of nitrates for the use of crops.

The cultivation of leguminous crops is one of the most important and economical means of maintaining a supply of nitrogenous plant food in the soil. Nitrates may of course be supplied in commercial fertilizers, but fertilizers containing nitrogen are very expensive, and it usually pays better to supply nitrogen by growing legumes or by the application of stable manure, which is rich in nitrogen when properly handled. In good farm practice both stable manure and leguminous crops are used as sources of nitrogen.

In order to produce a ton of dry hay on an acre of land it is necessary that the growing grass pump up from that acre approximately 500 tons of water. The soil must not only be in condition to absorb and hold water well, but it must be porous enough to permit water to flow freely from soil grain to soil grain. The presence of large quantities of decaying organic matter (humus) adds enormously to the water holding capacity of the soil. Not only that, but the shrinkage of the particles of decaying organic matter and the consequent loosening of soil grains keep the soil open and porous.

Furthermore, humus of good quality is exceedingly rich in both nitrogen and mineral plant food. The maintenance of fertility may almost be said to consist in keeping the soil well supplied with humus. The first step in renovating wornout soils is to give them an abundant supply of humus of good quality. Perhaps the best source of humus is stable manure containing both the liquid and the solid excrement, especially when the stock is fed on rich nitrogenous foods. Even a poor quality of barnyard manure which has had much of the plant food leached out of it has a considerable value because of the humus it makes.

Another cheap and valuable source of humus, but one which must be used understandingly, is crops grown to turn under as manure. The legumes are especially valuable for this purpose because of the nitrogen they contain, but other crops, such as rye and even corn sown thick, may sometimes be made to supply large quantities of humus of fair quality. Crops thus used are called green manures.

A proper circulation of air in the soil is just as important as any other factor of plant growth. Nearly half of the volume of ordinary soils is occupied by air spaces. Plant roots must be supplied with air, and the soil must be porous enough to permit of free circulation. A good supply of humus and proper tillage will accomplish this result in clay soils. Sandy soils are usually too porous, needing humus to help them retain water.

Another reason why air must circulate freely in the soil is that large quantities of oxygen are required to insure proper decay of organic matter to supply plant food. Also carbonic acid gas is produced by the decay of organic matter, and this must escape easily to make room for the atmospheric oxygen needed in the soil. One of the most important objects of plowing is to loosen up the soil for aeration.

Considerable evidence has been accumulated during recent years to show that during the growth of the plant certain unknown organic substances are given off which, when they accumulate in the soil to any extent, are harmful to the further growth of plants of the kind that produced them. It is possible that some of the benefits known to arise from systematic crop rotation may be explained on this basis. These harmful substances seem to be disposed of rapidly by certain soils, usually those in which organic matter is readily converted into humus.

In connection with the study of these poisonous organic products it has been found that they may be destroyed or at least rendered harmless in a variety of ways. Barnyard manure or decaying organic matter, such as a green crop of rye or cowpeas, turned under has a very marked effect in freeing the soil from them. Almost all of the common commercial fertilizing materials act more or less in the same way. Thorough and complete airing of the soil by plowing and thorough surface tillage will often destroy or overcome these poisonous substances. When the same crop is not grown oftener than every three or four years on the same land the injurious sunstances a crop throws off seem to have time to disappear before the same crop is grown again; hence the benefit from crop rotation. When the soil is well supplied with humus there is seldom any trouble from this source, and the same crop may be grown year after year with good yields, though continuous cultivation of the same crop may invite injury from certain insects and fungous diseases which live over in the soil or in the remains of the crop.

Improper methods of tillage add very greatly to the evil effects that result from lack of humus. In many parts of the country the land is plowed only three or four inches deep. In most cases work done in subsoiling is practically wasted, and it is doubtful if it ever pays. A much better method is to plow a little deeper each year until a depth of eight or ten inches is reached. This gives a deep layer of good soil, particularly if the supply of humus is kept up.

When new soil or that which has lain undisturbed for several years is broken up it is always best to plow deep from the beginning, for the deeper layers will be about as fertile as any, except the top inch or two. It is wise, too, never to plow the same depth twice in succession. In general, fall plowing should be from seven to nine or ten inches and spring plowing from five to seven inches deep. There are special cases in which these rules do not apply.

We plow the soil in order to loosen up its texture and get air into it; also to turn under stubble, manure, etc., to make humus. Killing weeds is another object accomplished by plowing. After a soil has been thoroughly pulverized to great depths, so that there is no danger of turning up packed clay, the deeper the plowing the better the crops. But the cost also increases with depth, so that ordinarily it does not pay to plow more than about ten inches deep.

Some crops prefer rather a loose seed bed. Other crops, such as wheat and alfalfa, prefer a fairly compact seed bed; hence frequent harrowing and rolling after plowing is good practice before seeding to these crops. Nevertheless it pays to plow the land for them, even if we have to compact it again before seeding.

Sandy soils are usually not injured by handling when wet, but the case is different with clay soils. The effect produced by working clay soils wet is known as puddling. The proper time to plow land is when it is just moist enough to break up mellow, neither wet enough to leave a slick surface where rubbed by the moldboard nor dry enough to break up in large clods. If continued rain follows wet plowing little harm follows, but hot, dry winds would soon leave only a mass of unmanageable clods. In spring and midsummer plowing particularly it is of the utmost importance to run the harrow immediately after the plow. This prevents the formation of clods. In late fall plowing the clods are no disadvantage, for they will be broken up by freezing and thawing.

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TUBERCULOSIS AMONG TURKEYS.

One who knows the habits of turkeys might wonder that they should be afflicted with tuberculosis.

They sleep in the trees. They are out in the air all day; they roam the clean, beautiful green fields. Now whence the disease? But tuberculosis does not just find its cause in bad air or poisoned hen coop ground that wiggles with microbes.

Its cause is found in anything that weakens the constitution and makes it ripe for the reception of the germ. Inbreeding makes the turkey ripe for

Photo by C. M. Barnitz.

DYING OF TUBERCULOSIS.

tuberculosis, as it does the pigeons that "go light" and other fowls and animals.

The country is in the turkey graveyard belt because turkeys have been inbred to death.

Inbreeding has brought tuberculosis and blackhead to the turkey, and these diseases have much in common. In both there are wasting away to extreme emaciation, progressive diarrhea, the sleepy listlessness, the dragging foot, but in tuberculosis the caeca, or two branched pouches of the intestines, and the liver are not always affected as in blackhead.

Of seven postmortems on blackhead victims last summer in every case these organs were affected, abnormal

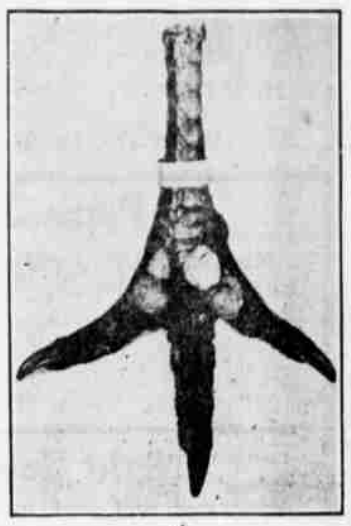

Photo by C. M. Barnitz.

TUBERCLE ON TURKEY FOOT.

in size and with the characteristic yellow ulcers and yellow deposits that invariably attend this disease.

Well defined cases of tuberculosis are nearly always attended with tubercle. These cheesy growths, or "warts," appear on the wing joints, face, head, in the foot web and at times on the liver, lungs, caeca and the intestines.

There is no cure for tuberculosis, but it may be prevented by keeping up the vigor of the flock with fresh blood, sanitary precautions, good feeding and careful breeding.

DON'TS.

Don't use all your time on experiments and shirk your work. Enough has already been discovered to keep you busy for a lifetime.

Don't forget that spring is best time to spray the fruit trees for scale and the poultry house for mites and microbes.

Don't expect to keep the boy on the farm unless there are inducements. He will take pride in thoroughbred poultry on the side.

Don't mosey along in the same old rut every day, when progress points to a better way. Hoopskirts and tallow dips were once the go, but now they are teetotally too slow.

Don't expect to make a mint the first year you are in business. In poultry, as in every other legitimate avocation, you must learn to labor and to wait.