Effects of Organic Matter In Soil

By PROFESSOR M. H. CUBBON
Massachusetts State College, Amherst, Mass.

ORGANIC matter is the most important material in soil. Several properties (factors) are due directly to organic matter. The favorable properties are as follows:

1. Organic matter increases water-holding capacity of soil.

2. Organic matter improves physical condition in soil.

3. Organic matter allows more soluble plant food to be held by the soil.

4. Organic matter furnishes energy for bacteria.

The harmful influence of organic matter in soil includes: low nitrogen-high carbon content which causes a temporary shortage of nitrate nitrogen in the soil.

ORGANIC MATTER AND WATER-HOLDING CAPACITY

THERE is no doubt about organic matter increasing the water-holding capacity of soil. Soils without organic matter, or with the average 5%, never hold more than 40%, or 2/5 of their weight, of water. Twenty-five per cent or one-quarter of the weight, is more nearly the desirable water content than is 40%.

Organic soils (muck and peat) hold from 200 to 350%, or 2 to 3½ times their weight of water. A muck soil with 250% water does not appear to be as wet as a mineral soil which has only 25% water, by weight. Therefore mineral soils with plenty of organic matter will hold more water without seeming wet than will soils without much organic matter.

The difficulty with this situation is that it is extremely hard to increase the organic matter content of soil enough to show much increase in water-holding capacity. A test made with field soil in Iowa indicated that any practical application of manure increases the water-holding capacity of soil only moderately. A twenty-ton per acre application of manure is considered large for general purposes. Of this twenty tons, only about five are dry organic matter, the remainder being water.

Counting only the dry matter, 5 tons per acre are equal to 206 pounds per thousand square feet. Anyone who has had experience adding peat moss to greens will realize how difficult it is to work 200 pounds of peat into a thousand square feet of surface. In order to get that much organic matter into the soil many applications must be made. This is a slow process on established greens.

ORGANIC MATTER IMPROVES PHYSICAL CONDITION OF SOIL

PHYSICAL condition of the soil is probably as important as anything else about a green. A poor physical condition does not allow air to enter the soil, or plant roots to elongate, and usually water stands in or on the soil. The "mud-pie" effect means a poor sanitary condition, just the opposite from good growing conditions. The soil is said to be puddled and such a soil when dry is extremely hard. In fact, puddled soil behaves more like concrete than like soil, especially since it does not allow water to enter or leave easily, and when dry does not absorb water.

What are the things needed for a good mudpie? Soil and water, of course. The soil must be fine enough to be sticky or plastery. Then when the soil is mixed with water it makes a good paste that can be molded into various shapes. You know how it works. When this mixture dries, the soil remains set, almost the same as cement. Such soils are often the driest of all because water cannot soak into them. Water runs off just as it would from a roof. Walking and tramping on a soil when wet is the best way to puddle that soil. Clays are special offenders.

Organic matter helps to improve the physical condition by making it more difficult for clay to bake and pack. Because organic matter is so light and airy it helps air to get into the soil and prevents water from standing and becoming stale.

Sandy soils have too few fine particles in them to make the soils sticky or inclined to bake. That is why sands are so much in demand. But sandy soils wash badly, holds little water, and even less plant food. Organic matter helps to remedy all three of these conditions. The common saying is that organic matter gives body to sandy soils.

ORGANIC MATTER ALLOWS MORE SOLUBLE PLANT FOOD TO BE HELD IN SOIL

PRACTICALLY all of the nitrogen, and also a large amount of the phosphorus, are held in the organic matter in the soil. Whether nitrogen is put on in the form of inorganic or organic fertilizers, the part that stays in the soil is tied up with the organic matter. This nitrogen becomes available to plants, sometimes slowly and sometimes rapidly.

Recent findings have shown that soluble phosphorus is practically controlled by the amount of organic matter in the soil. In the southern states no shortage of phosphorus exists if the owners see to it that plenty of organic matter is put into the soil. This is a very important matter, especially in acid soils where phosphorus is very insoluble.

One thing we can be absolutely certain of, the plant food that is in the organic matter can be made soluble by bacteria much more quickly than the plant food in the soil minerals becomes available. When chemical plant food is added to a soil containing plenty of organic matter, more of the plant food is held by the soil against washing than is the case where little or no organic matter is present.

ORGANIC MATTER FURNISHES ENERGY FOR BACTERIA

THE carbon and oxygen carried by organic matter provide energy for most of the organisms in the soil. Since it is the job of bacteria to make plant food available, they must have something to live on while doing the work. Thus it is that bacteria break down organic matter, use the carbon and oxygen for strength and life, and turn the nitrogen and other plant food into forms usable by plants.

True, this is a wasteful process, so far as total organic matter is concerned. But if organic matter were not worked on by bacteria none of it would reach the point where plants could use it, and what would be the use of having organic matter in the soil? The bacteria give in return for this energy available plant food and soil conditions favorable for plant growth. Carefully worked experiments show that bacteria are not very wasteful of organic

matter, considering all the returns from their activity.

HARMFUL EFFECTS OF ORGANIC MATTER

THE addition of organic matter to soil where plants are growing often causes the plants to turn yellow and look sickly. Yellowing in plants is due to lack of nitrogen, ordinarily. That is what happens when certain kinds of organic matter are put on the soil. If there is less than one part nitrogen to twelve parts of carbon in the organic matter, the bacteria that work on the organic matter take nitrogen from the soil, thus causing a shortage for plants.

Addition of peat moss to soil will usually have this effect. Extra nitrogen must be added if the grass is to have plenty. If, however, the added organic matter has as much as, or more than, one part nitrogen to twelve parts carbon, no nitrogen shortage occurs.

Most soils reach a balance of about 1 part nitrogen to 12 parts of carbon. The affect of straw or shavings on soil is not a poisoning one, but rather a shortage of nitrogen. The point is that bacteria must have a balanced diet, and if forced to they are able to take nitrogen away from the soil even to the extent of robbing the plants.

If organic matter is mixed with soil and no water added, it quite often happens that the soil suffers from a lack of moisture. The organic matter under such conditions does not allow water to come to the surface from lower depths in the soil. Very few greens would have this difficulty to face because the organic matter cannot be worked deeply into the soil, and water is almost always available.

HOW TO INCREASE ORGANIC MATTER IN SOIL

NATURE always intended the soil to be covered with plants. That is her way of keeping up organic matter. Certain investigators have found that soils recover organic matter and fertility if weeds are allowed to grow unhindered. Many have shown that the best way to increase (or maintain) organic matter is to allow grass to grow continually. It should be easy to keep up organic matter in greens soils if the above is true. If only the clippings could be left on the greens what an increase of organic matter there would be!

Since clippings cannot be left on the greens what can be done to increase organic matter? Adding organic matter of course helps some. The average soil to a depth of six inches on an area of one thousand square feet contains about 2000 pounds of organic matter. Surely the addition of 25 pounds of organic fertilizer per thousand square feet will scarcely be noticed by the increase in organic matter. This just isn't a practical way to increase organic matter.

Of course if frequent applications are made some increase may be expected. But the applications must be very often indeed. Under greens conditions with considerable fertility present the bacteria are going to work on new organic matter in whirl-wind fashion.

There are certain bacteria which can produce organic matter instead of breaking it to pieces. All these bacteria need to keep going is plant food—nitrogen, phosphorus, potash, calcium, sulphur, etc. Add chemical fertilizers therefore, and let the bacteria (brownies if you like) do the work and build up organic matter. Thus it is that the addition of chemicals has often increased organic matter. The increase is of course greater when grass is kept growing continually on the soil. The importance of these bacteria in helping to maintain organic matter must not be overlooked, especially if the soil is not too acid.

LOOKS OF SOILS ARE DECEIVING

SOMETIMES soils appear to have much organic matter when in reality looks are deceiving. In an experiment in Ohio an area of soil that was limed was darker in color than adjoining soil not limed. The limed soil produced larger crops too.

Analyses of these two soils for organic matter showed that the unlimed soil contained more organic matter than did the limed soil. The active organic matter was of course greater in the limed soil. Why worry, then, about increasing the total amount of organic matter? Better have the organic

matter in an active condition, and the best way to do that is to fertilize and lime the soil.

When a new material, whether organic or inorganic, is added to the soil, activity of organisms is much increased. The activity is a desirable thing except when there is a shortage of nitrogen.

It is assumed by some that organic matter can be increased by the addition of nitrogen to the soil. If that is true, most greens' soils should be very rich in organic matter. I believe this is true, but only when the soil receives phosphorus and potash in addition to nitrogen. In other words, a complete fertilizer is necessary to produce the amount of grass roots to definitely increase the organic matter content. Even if some of the bacteria do act like "brownies" or "fairies," remember that they must eat.

USE OF CHARCOAL ON GREENS

In some parts of the country wood charcoal has come to be used regularly for building and top dressing greens. Its ability to produce a good physical condition in heavy soils is well known and successfully taken advantage of. Besides the good physical effect, charcoal holds considerably more water than does the same weight of mineral soil. Results from using charcoal have been uniformly good.

Charcoal seems to do more than just improve the physical condition of the soil. It seems to have a fertilizing value as well. Recent tests show charcoal to have considerable water soluble salts in it. One of these salts is phosphorus. In fact, most charcoals have more soluble phosphorus than do soils. This helps to explain the good effects of charcoal on acid soils where soil phosphorus is quite insoluble.

The finer the charcoal the more basic in reaction. It is more than likely that some of the good effects of topdressing greens with charcoal are due to a neutralizing of soil acidity, or, to a supply of soluble calcium. This phase of charcoal utilization needs more work done on it. Sweetening of soil usually means the getting rid of soluble toxic material such as iron and aluminum in acid soils. The phosphorus carried in charcoal does this job of removing aluminum and iron very nicely.

Since charcoal absorbs water in large amounts, it should also absorb other things such as plant food. Evidence is that much soluble plant food is held in charcoal and prevented from leaching out of the soil. This justifies the use of charcoal even at considerable expense.