

Humus Producing Materials and the Making and Use of Compost

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Organic matter or humus as a constituent of soil bears a very important relation to the growth of plants. This is a fact that was discovered by a man early in his agricultural efforts. Just as he had a knowledge of the plants that were worth his while to grow, it is reasonable to suppose he early learned the difference between poor and productive soils, and what common substances he could add to them to increase their productivity. That he knew little of the reasons for the results he obtained is not particularly to his discredit. Even in our enlightened generation we have failed to work out the complete story. But we have added to it and today we know more of the rôle of organic matter in the soil than we knew yesterday. Tomorrow we may make a further advance in our knowledge for investigators are attacking the subject along some very promising lines.

The modern conception of fertilizers attaches even more importance to humus than was ever before accorded it and this regardless of the efforts of Liebig and other apostles to argue the all-sufficiency of inorganic forms of nitrogen, phosphorus and potassium. Good barnyard manure heads the list of fertilizers today as it has headed it for generations and will probably continue to head it for some time to come. Other fertilizers are highly important but they can not fully replace this humus supplying material.

Humus Defined

In the sense that it is now used the word humus applies to decaying organic matter or more strictly to decaying organic matter in the soil. The same word is used in the adjective form to mean organic materials that make humus when added to the soil. Common practice has made this usage acceptable.

Functions of Humus

One of the outstanding functions of humus is to improve the texture of soils. This is a physical function involving better aeration, water-holding capacity and drainage, and incidentally the lessening of heaving due to alternate freezing and thawing in the winter and spring. By the proper use of humus, stiff, impermeable soils may be made friable which, in addition to providing better water-absorbing capacity and drainage, also permits of better penetration by the roots of plants. Humus added to the soil gives it springiness and prevents the formation of a hard, unyielding surface. This is especially important in the making of golf courses. While clay soils may be loosened by the incorporation of organic matter, sandy soils may be made more cohesive, thus giving them better water-holding capacity and making them less subject to blowing. In addition to changing the texture of the soil, humus modifies its temperature relations. Organic matter incorporated with the soil darkens it, thereby giving it a greater heat-absorbing capacity and when it is applied as a top dressing it acts somewhat in the nature of an insulation.

An important physiological function of humus is to furnish suitable food for beneficial soil organisms which in turn, among other things, supply nitrogen in a form available to growing plants. In fact, it is only through the action of certain soil organisms—notably the azotobacter group of

bacteria—that humus can be made to yield nitrogen for the use of higher plants. Whether it is the nitrogen that organic matter yields or whether it is something else that is most responsible for its beneficial physiological action on plants is not known. Recent investigations, however, indicate that green plants will not thrive in a medium totally destitute of decaying organic matter. Why this is true has not been ascertained but certainly it is not for lack of nitrogen.

Some time, more will be known of the functions of humus in the soil, but it may be said with considerable certainty that future discoveries—no matter how valuable they may be—will only tend to emphasize the importance of decaying organic matter to plant growth.

Sources of Humus-Making Materials

While humus may be produced from decaying animal matter, very little is added to the soil from this source. Most of it is supplied by animal-made manures and by partly decayed vegetable debris such as peat, sod and leaf mold. It is a common practice to mix one or more of these materials with soil or sand or both, thus making what is called compost. A little good barnyard manure may be made to go a long way by composting it with other decaying organic materials. Compost is a highly satisfactory source of humus and has proved the salvation of many golf courses.

Barnyard Manure

The only serious objection to barnyard manure as a humus material is that the supply is too limited. If it were not for this, there would be little interest taken in other kinds. The others at best are but substitutes. Good barnyard manure properly rotted and comminuted comes more nearly filling the requirements of a humus-producing material than any other form of organic matter that is commonly available. In the form of spent mushroom soil it is nearly ideal. In this condition it is well decomposed, of good texture, easily broken up, free from viable weed seeds and disagreeable odors and usually all it needs is to be put through a screen to make it ready for mixing with the other constituents of compost. Spent mushroom soil is what remains of a good quality of horse manure after it has been in a mushroom cellar for a year. It has lost little of its fertilizer value and is highly desirable for the golf course.

It is not a difficult matter to convert barnyard manure into a form suitable for topdressing turf. All that is necessary is to pile it in ricks and give it time to decompose. Surplus straw should be removed with a fork or screen. For incorporating with the soil of fairways, manure should be used alone unless the soil is very sandy and little attention is necessary in preparing it for this purpose. For topdressing fairways it should also be used alone except on very sandy soils where clay should be mixed with it. But as a topdressing it should be free from undecomposed straw and from large lumps. As a topdressing for putting greens, loam and sand may be mixed with manure to advantage. The charge that manure is unsafe to use on turf because of the weed seeds it contains is not well founded, and besides it is entirely possible to determine whether or not it contains viable weed seeds, by putting a representative sample in a box and giving it conditions of heat and moisture favorable for the germination of seeds. No conjecture on this point is necessary. If seedlings appear weed seeds are present; if seedlings do not appear weed seeds need not be feared. Seeds of the most troublesome weeds are soon killed by composting.

The fertilizer value of barnyard manure can not be reckoned from its nitrogen, phosphoric acid and potash content, nor from the organic matter it contains. In addition to available nitrogen, phosphoric acid and potash and organic matter, it carries numerous beneficial organisms and their products. Very probably there are also other beneficial agents in it, all of which are valuable but their importance can not be directly measured.

The duty of a limited quantity of barnyard manure can be greatly increased by composting it with peat, sod or other decaying plant material. A little manure will inoculate a large compost heap.

Peat or Muck

The terms peat and muck are very often used interchangeably. Peat, however, is the more comprehensive of the two and is applied to the remains of plants decomposed or partly decomposed in water. In consistency it varies from a scum to a solid substance in which the texture of the plants has almost, if not entirely, disappeared. All "muck soils" are of peat origin. Peat deposits are numerous, especially along the seacoast and in vicinity of large lakes. They are quite generally found in poorly drained areas. The color and texture of peat and its availability have suggested its use as a material to add to soils to increase their productivity. For generations its agricultural possibilities have been closely looked into and within recent years it has been put on the market as a fertilizer—both in a treated and in an untreated condition. The results it has given have been far from consistently good.

Peat as it occurs naturally is frequently very toxic to plant growth. Some of it is highly acid in its reaction. Just what relation, if any, exists between toxicity and acidity is not well known but the subject is being studied. Peat is also practically free from nitrifying bacteria and other beneficial and soil organisms. Because of its probable toxicity and acidity and freedom from organisms, it should be thoroughly weathered and composted with manure and probably lime before it is used as top dressing for turf. Weathering and lime correct its toxicity and acidity and manure inoculates it with the proper kind of organisms for nitrification. Lime promotes nitrification when the proper organisms are present. Even when peat is known to be non-toxic its use alone as a top dressing is not advised. While it has a high water absorbing capacity, it loses moisture quickly when exposed to the air and wind and unless it is kept damp it becomes so light that it is easily blown away. Furthermore, peat unmixed with manure decomposes so slowly that it produces very little fertilizer effect. At best it can be properly considered only as a partial substitute for good manure or mushroom soil for use on turf.

Where peat can be procured cheaply and where good barnyard manure is not abundantly available it may be used advantageously on greens and fairways if it is composted with manure and otherwise treated as heretofore indicated. Golf clubs can not afford to pay good manure or mushroom soil prices for raw peat even if it has a low moisture content and is non-toxic. Even compost containing peat should not be used as a top dressing for putting greens without first being tested by putting a sample in a box or tray and sowing grass seed in it. If the young seedlings thrive, it is safe to assume that the peat is not toxic. It is said that bone meal, fish scrap, tankage and similar animal products may be used advantageously to reinforce peat and to inoculate it with nitrifying organisms, but little of a definite nature is known on this subject.

Sod, Leaves and Leaf Mold

In making compost, sod is very useful. It is composed of the dead leaves and roots of grass and the soil in it is usually of very good texture and quality. Some soil is needed in compost and almost an ideal combination can be made by mixing sod and manure. Equal parts by volume of sod and manure is about the right proportion for compost, but the matter of proportion is indeed very flexible. Six months to a year in a compost pile is necessary for sod to rot properly. The pile should be worked over and screened considerably in advance of the time the compost is needed, and the coarse material put aside for further composting.

The term leaf mold is applied in a very general sense to leaves, twigs, roots and similar vegetable matter in various stages of decay. Much of the leaf mold that is used is made up largely of leaves only partly decomposed. Such material is useful for supplying humus if it is well composted with manure, but alone it does not make a suitable top dressing for turf. Darwin says earthworms play a very important part in the making of leaf mold—much greater, in fact, than is ordinarily supposed. Leaf mold commonly gives a relatively high acid reaction, the degree of acidity depending somewhat on the stage of decomposition, the kind of leaves, and the kind of soil underlying them. Well decayed leaves often give a neutral or even an alkaline reaction because of the lime they contain. Red oak leaves have higher acidity than maple leaves, and leaves that have fallen upon acid soil produce leaf mold that is more highly acid than that produced from leaves decomposing on an alkaline soil. Like sod, leaf mold contains an appreciable proportion of soil which is useful in making compost. Equal parts by weight of leaf mold with the soil that usually goes with it and manure make a desirable combination and as leaves decay slowly a little lime or finely pulverized limestone should be added.

Street Sweepings

At one time street sweepings were quite extensively used as a fertilizer. Now they are not so much in demand. With the advent of the modern asphalt pavement and the automobile, street sweepings are not what they once were; in fact, sweepings from an asphalt covered street are very likely to be toxic to grass and other plants, probably because of the asphalt and oil that is collected with them. It seems advisable, therefore, to issue a warning against their use, especially for top-dressing turf. Where they have been used and injury to the grass has resulted it is suggested that a light application of pulverized limestone be added. Calcium is known to unite with asphalt and it is believed that it will neutralize the harmful effects of the latter on vegetation.

Pulverized Sheep Manure

As a source of humus, sheep manure as it is put on the market is an expensive product and is not considered very satisfactory. While it is in a very convenient form to use and is free from viable weed seeds, it falls far short of producing the results that are necessary to justify the price that is asked for it.

Compost

Barnyard manure, sod, leaf mold and peat—in fact almost any vegetable matter that will decay readily—may be used in making compost. Clay, loam and sand may also be included; likewise lime and organic and inorganic commercial fertilizers—the fertilizers especially, if the compost

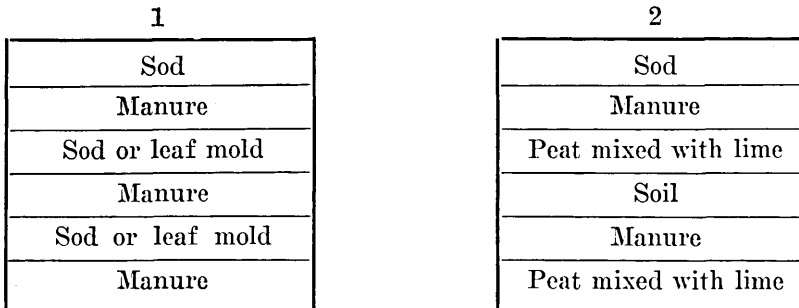
is not rich. Composting is an old practice of gardeners and florists. It brings about changes in the materials involved—some well known, others only slightly if at all understood. The final result, however, is a product very beneficial to plant growth.

Mixen was the name by which compost was known several generations ago, but it is entirely obsolete now. Nevertheless, the term has good features. It is simple, euphonious, and descriptive. However, it smacks of common origin and lacks the pedigree of its successor, "compost." This is probably responsible for its demise.

There are no very hard and fast rules to lay down for the making of compost. The materials to be used necessarily depend to a considerable extent on what is available. Barnyard manure, however, should always be a conspicuous constituent of every compost pile. No commonly available material will take its place especially in supplying the various organisms that are highly important in bringing about proper decay.

In addition to organic matter, soil of some kind should be added. Whether clay, loam or sand depends largely on the kind of soil with which the compost is to be incorporated or upon which it is to be applied. The common range of soil to organic matter is from one-fourth of the former to three-fourths of the latter to equal parts of each. However, local conditions may call for proportions outside this range.

Two common and very satisfactory methods of constructing compost piles are illustrated by the following diagrams:



The piles may be built as high as desired. Six to eight feet is suitable for convenience. If leaf mold is used, some lime should be mixed with it—about 5 or 10 pounds to a cubic yard. In diagram No. 2 the lime should be mixed with the peat at the rate of about 25 pounds to the ton, but it should not be mixed with the manure or allowed to come in direct contact with it until the compost pile is cut down and worked over for use. By varying the depth of the layers, it is easily possible to make compost of the desired consistency. However, layers exceeding 8 inches are usually too deep for the best disintegration.

If compost piles are built in sheds or are otherwise similarly covered, there will be less loss from weathering than if they are built in the open but sufficient moisture must be provided to bring about the necessary decomposition and other changes.

It is said to be possible to inoculate peat with nitrifying organisms by composting it with bone meal, fish, scrap, tankage and similar fertilizers composed of animal products. However, the evidence indicates that they are not as satisfactory as manure for this purpose. If manure can not be had or is not sufficiently abundant, it is suggested that they be tried

as a partial substitute for it. Five pounds of these fertilizers to a cubic yard is the approximate quantity which should be used. But, it should be distinctly understood that there is as yet no thoroughly satisfactory substitute for manure.

In making compost there are some important points to be borne in mind.

1.—The compost pile should be so constructed as to bring about the proper decay of vegetable matter. This means that the materials should be laid down in layers about 6 inches thick or otherwise reasonably well mixed. This aids in decomposition and in the production of a uniform final product.

2.—Covering compost piles protects them from loss by weathering, but considerable moisture must be present in the materials to promote proper decay and other beneficial changes.

3.—Barnyard manure carries beneficial inoculating organisms and should be present in every compost pile, especially where peat is used. Bone meal and tankage and similar animal products are said to aid in the introduction of nitrifying organisms.

4.—Lime corrects acidity, stimulates bacterial activity and promotes decomposition. Some lime in compost piles is often helpful. If much raw peat is present, it is very useful. It should not be mixed with the manure.

5.—Soil of some kind improves the quality of compost, chiefly by giving it better texture which involves among other qualities cohesiveness and water-holding capacity. It helps to unite the organic matter with the surface of the soil upon which it is applied.

Compost for Top Dressing Turf

A rational system of green keeping involves the use of good compost as a topdressing. It should be followed in most cases as a matter of routine at least twice a year—spring and fall. More frequent applications are often advantageous especially where the soil of the greens is naturally poor. For topdressing sandy soil fairways, compost should have a large proportion of clay. Even three parts of clay to one of organic matter is not excessive where the soil is nearly pure sand. For putting greens, such a large proportion of clay is not desirable even where the soil is very sandy and on clay soil fairways it is questionable whether even a small percentage of clay or soil of any kind adds materially to the value of the compost. For putting greens on clay soil compost should contain loam and sand rather than clay. A liberal proportion of sand will do no harm.

Where good manure compost is used, putting greens rarely require any other fertilizer. It is superior to the mineral fertilizers in the quality of the turf it produces and it can be used at any time during the growing season without injury to the grass. If quick stimulation is desired, it may be necessary to accomplish it by the use of nitrate of soda or sulphate of ammonia but, as is well known, care must be taken in applying these fertilizers, otherwise burning of the turf will result. They may be mixed with compost before being applied, but even if this is done the necessity of careful handling is not obviated.

Applications of compost one-fourth inch in thickness are usually more satisfactory than heavier applications and they should be made early in the spring and again in the fall considerably in advance of the end of the growing season. Sometimes it is desirable to make them shortly after the hot weather of summer has passed. The compost should be worked

into the turf with a switch broom, a street broom, or any suitable implement. Flexible wire door mats tied together lengthwise make an excellent device for this purpose. The frequency with which compost should be applied to putting greens must necessarily be determined by local conditions. There is a general feeling that greens can be over-fertilized with it and there is little doubt that this can be done. The evidence seems to indicate that too frequent applications or too heavy applications result in a vigorous growth of soft grass too slow for good putting. On this question, however, there is need for more definite data than are now available.

Compost as a Germinating Layer

In addition to its use as a top dressing for turf, compost is a valuable medium with which to mix seed before sowing. For this purpose it may contain as much as three parts of loam to one part of organic matter, and in fact a considerable preponderance of loam is desirable. The subject of germinating layers for putting greens has been investigated somewhat carefully, and it has been found possible to obtain a more uniform stand of grass by the proper use of a germinating layer than by any other common method of sowing. Fred W. Taylor, it will be recalled, used the shredded peat moss imported from Holland. This material, in his opinion, was the best available, but subsequent investigations have proved that compost with a large proportion of loam is good, if not better. By mixing seed with compost and spreading the mixture evenly over the seed bed, it is possible to obtain a uniform and highly satisfactory stand of grass with one-quarter of the seed that is used by the ordinary method. A germinating layer properly used makes uniform distribution possible and provides suitable conditions for the germination of the seed and the development of the young seedlings. One advantage of compost over shredded peat moss is that it holds moisture better and it is not necessary to water it constantly while the seed is germinating.

Compost and the Construction of Compost Heaps

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Compost is important for construction and repair work such as new greens and tees, and in some cases fairways, where it is desired to store the plant food and humus in the soil for the future use of the grass plants, to improve the water holding capacity and the mechanical texture or structure of the soil.

Method No. 1. *Compost heap of manure and sod.* Lay down a bed six to eight feet wide of manure a foot thick. Cover this with a layer of old sods or loam about six inches thick, followed by another layer of manure, and so on, until the heap becomes four or five feet high. Finish off the heap with a layer of soil about four inches thick. Leave heap stand for about two months, then break it down vertically, turn over and mix thoroughly. Continue this operation at intervals of four to six weeks, until the heap is thoroughly mixed and the manure and sod completely broken down. In the meantime, make sure that the heap is always kept moist and cut down all weeds on the top before they go to seed.

Method No. 2. *Compost heap of manure and muck or humus.* If muck or humus is available on the property, and labor cost warrants its