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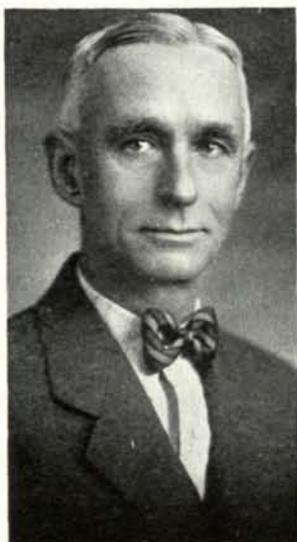
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The Life and Activities of Soil Bacteria

BY JAMES A. SMITH

*Read at the Fourth Annual Convention of the National Association of Greenkeepers of America
at Jefferson County Armory, Louisville, February 4-7, 1930*

AN EXCLUSIVE FEATURE



JAMES A. SMITH
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In this very instructive paper on soil bacteria read at the National Greenkeepers' Conference at Louisville in February, Mr. Smith divided his subject into two parts—I, Manures, and II, Compost. By so doing he was able to show just what conditions produced bacterial activity both favorable and otherwise, without which there is no plant life.

This tremendously interesting and important information is printed here for the first time and is an exclusive feature for readers of the National Greenkeeper.

Manures

SINCE the present source of additional soil humus will be manures, until they are exhausted, I feel it the duty of each greenkeeper to know that he is well informed upon the processes which makes manure valuable in the soil.

For many years we have taken the value of manure for granted and have not considered them at any time at their actual value. Ripened manures make a perfect home for our nitrobacteria but until ripened they have practically no value at all. There are many text books, easy to read, which will give you all the information you will need on this subject.

Ordinary horse manures are usually gathered from wood floors which have allowed the greater proportion of the liquid manures to be lost. The bedding, litter and solid matter with which the animal is bedded and which accumulates from the manger will absorb a portion of these liquid manures. Usually in the morning when the stable is cleaned, all that is left of the liquid manure is that which has been absorbed by this bedding and litter and by the fibrous matter of the solid manures.

The horse unlike the cow does not fully digest its food, making most of the manure voided nothing but fibrous matter. This manure so found is in the great majority of cases

thrown upon a loose pile with abundant access to air. Within three days the small amount of liquid manure which comes from the barn, as absorbed by the solid matter, has been acted upon by the bacteria which comes from the intestines of the animal so that not only the liquid manures are lost through the floor but those which have been absorbed by the litter have been completely thrown off. This will constitute about one-half of the original value of the manure.

What is left, until it has been ripened, has little or no value. In order that the straw and solid material coming from the manger may be completely decomposed we must call in the greatly disliked denitrifying bacteria which must break down our solid manures. This is one instance where denitrifiers are essential on the farm.

Denitrifiers can only work in wet conditions with a freedom from air. That we may hasten the decay of this solid matter, all manures received by the greensmen, unless thoroughly decomposed or ripened, should be ricked or put in a pile, the sides of which are squared up, allowing the least possible opportunity for the pile to dry out. "Probably the best protection against drying and allowing the admission of air would be that of covering the manure pile with from three to four inches of earth. The pile must at all times be kept thoroughly wetted to encourage the action of our denitrifying bacteria." Lyon, Fippin and Buckman state on Page 593 "The mass becomes decayed, humus is produced and available plant food is evolved".

Fungus May Destroy Pile

IF this pile of fresh manure is allowed to become dry and air admitted, the denitrifiers temporarily stop work and our nitrobacteria begin the production of nitrates which will be lost by leaching in the partially decayed pile. There is also a possibility of "fire fanging" with a total destruction of that portion of the pile exposed to the air, by a fungus development. The mycelium of this fungus, having a grayish color, has been frequently seen by you in the apparently burnt manures. The portion of the manures once affected by this fungus have no further value.

When the ripening is completed and all cellulose material is broken down we then have the home for the nitrobacteria. In this ripened manure they accumulate in the greatest possible numbers.

Lipman's "Bacteria In Relation to Country Life" Page 309 says that ten tons of fresh manure will produce 3,600 pounds of ripened manure if properly cared for in the pile in which denitrifying bacteria are constantly encouraged. Should the fresh manures be improperly cared for by exposing them to the air in a very loosely built heap, this authority says that we can have but 2,100 pounds of ripened manure, 1,500 pounds having been lost through the action of nitrobacteria or fungus in the pile while ripening.

Care in Ripening Process Necessary

SINCE many users of manure are getting but approximately one ton of ripened manure out of each ten tons purchased, the necessity of care through the ripening process is very evident and especially so if we will stop to think that ripened manure contains only about one-half of one per cent nitrogen.

Hall on Page 213 under "Fertilizers and Manures" says that ripened manures in cultivated ground are completely lost as a soil humus in from two to five years. In greens construction, this period of time could be safely doubled because of a lack of nitrifying action in many of our firm soils. Considering this, we should see the need of very large amounts of ripened manures worked into our new greens construction. They originate from straw and similar litter, hence they would be of a very fluffy, light texture.

Your first addition to a green must be your last as there is no further humus addition except as it may occur in good top dressings, the soil humus of which may possibly enter the soil through drift.

Our fairways have the possibility of enrichment in soil humus through clippings left on the ground. Since clippings are entirely removed from greens there must be more attention paid to our soil humus content, both in the soil making up the construction and in our top dressings.

Compost

I AM quite pleased to see the Bulletin of the Greens Section endorsing the area compost idea by which we prepare compost through the use of farm tools on possibly an acre of land. Since manures will be the amendment used for some years, this compost area can only be valuable if certain methods of handling are used.

In October the ground should be carefully worked and fined, preparatory to applying the ripened manure. In no case should new manures be used. After manures have been spread, the area should be thoroughly disked and spring-toothed so as to make a perfect mixture of earth and manure. With the cool weather coming on, the nitrobacteria present in the manure will have an opportunity to produce but a few nitrates during the fall and will not become active until the following May.

During the fall and winter the manures will become more nearly a soil humus, ready for active bacterial feedings with warm soil in the spring.

As early in the spring as possible this area should go under very frequent cultivation both

with a disk and spring-toothed harrow so that all weed seed may be given a chance to germinate and by the cultivation, killed. This constant cultivation not only more thoroughly mixes the manure and earth but so aerates the soil that our nitrobacteria can begin their rapid development of nitrates. By July they will have produced the greatest amount of nitrates possible to make during the summer and because of lack of rainfall during that month these nitrates will be present in the soil.

Screen Compost in July

AT THAT time, when the ground is dry enough to screen, a full year's supply of top dressings should be taken and stored under cover. Top dressings so saved will not merely be earth but an earth well filled with immediately available nitrates for feeding. This top dressing so stored should be put away in the driest possible condition.

If your course has not already ample storage for this quantity, additional storage would be a splendid investment. Each month following July sees a rapid decrease in the amount of nitrates present in the soil. Top dressings



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taken late in the fall contain practically no nitrates due to leaching.

The loss of nitrates in cultivated soil has probably accounted for some of our poor fall dressings. If the area devoted to top dressings were put in corn in the spring, and if during the season, this area had had but a light manure dressing, there would have been made approximately 165 pounds of nitrates, the amount of nitrates which would be made depending almost entirely on the quantity of manure applied. Of this 165 pounds of nitrates made, possibly 25 pounds would be used by the corn and 140 pounds would be leached out by the end of the season due to rainfall.

Hall's "In the Soil" Page 106 says "Nitrates formed during the summer or autumn of one year are practically removed from the soil before crops of the following year can utilize them." Store all of your top dressings during July.

More About Humus

By CHRISTOPHER BAIN, *Greenkeeper, Oakwood Country Club, Cleveland*

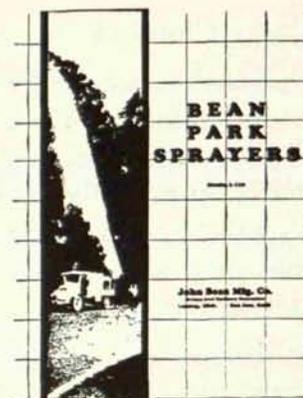
"ALL soil humus is organic matter, but all organic matter in the soil is not humus."

The above from Mr. Smith's very able and interesting article in the January issue gives in a sentence, a statement of fact that should appeal to all greenkeepers.

The farmer by means of rotation of crops keeps his soil in a state of good fertility, having both manurial and cleansing crops; or as Mr. Smith has it soil conditions are such that the nitro-bacteria is kept healthy and active.

We greenkeepers, however, are laboring under a disadvantage of having to continue year in and year out propagating one crop only—that of grass—and herein we find that "all organic matter in the soil is not soil humus."

A green may show a thin, poorly developed and stunted growth, and immediately the cry goes up that the ground is exhausted from continuous grass growing, while as a matter of fact the ground is rich in plant food, only the soil has become clogged from the poisonous waste which plants excrete from their roots. Until such impurities are removed no vigorous growth may be expected.



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The question then arises as to the best method of incorporating humus, or what have you, to relieve or release the plant food known to be in the soil—Mr. Smith states that with "firm and hard packed soils in your greens no artificial feeding which you can apply can permanently revive them." Here I disagree with the writer—I readily grant that the texture of the soil of all greens should, like Caesar's wife, be above suspicion—unfortunately in years past the art of greenkeeping was not so advanced as at the present day with the result that many greenkeepers have greens which are more or less hard and packed yet continue to grow luxuriant grass but fall short in having that cushion so necessary to the pitched ball.

Personally I believe applications of charcoal, also lime plus judicious fertilizing will give results—wood ash is also recommended but as it contains some 35 per cent of lime why not apply lime with soil or sand as a filler, as more potent.

I would be glad to hear the opinion of your readers.