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NOTES ON THE FUNGOUS FLORA OF IOWA SOILS

E. V. ABBOTT

The study of the fungous flora of soils is a field of research which has received very little attention from scientific investigators. Mycologists have been concerned principally with the fungi which are parasitic on plants, and have devoted little time to those forms found in the soil other than to observe certain stages of the life history of pathogens occurring in the soil. Soil bacteriologists have confined their studies of the soil flora largely to the physiology of certain species of bacteria, while the soil technologist has given no consideration to the microorganic population of the soil.

The widespread occurrence of fungi in soils, regardless of their location, classification, or cropping history, together with the knowledge which has been accumulated regarding the physiological functions of fungi, is convincing evidence that there is a true fungous flora of soils which must be considered in a study of soil biological processes. The work which has been carried out at this station has had for its purpose the determination of the soil fungous flora, so far as this is possible, and a study of the physiological functions of the organisms isolated.

Anyone who has had experience in the classification of fungi will appreciate the difficulties confronting the soil mycologist in attempting to make a specific determination of all forms which occur regularly in the soil. In the first place, the majority of published descriptions of species of fungi, such as those found in Rabenhorst and Saccardo, are very unsatisfactory and inadequate, and it is the opinion of the writer that most of them must be considered invalid where original cultures are not available for comparative purposes. Secondly, practically all of the descriptions available are of those forms pathogenic to plants, while relatively few descriptions of strictly soil forms occur in the literature. Progress is made more difficult by the attitude of some mycologists who believe that the benefits to be derived from the identification of soil fungi are not sufficient to justify the work involved, and who have been inclined to place soil forms in

"soil groups," without specific determination. Such a classification, of course, is entirely unsatisfactory to one interested in knowing definitely what organisms occur in the soil.

Notwithstanding the difficulties encountered in classification, however, some progress has been made in determining the fungous flora of Iowa soils. Repeated platings of various soil types representative of the principal soil areas of the state, have shown *Aspergillus* and *Penicillium* to be the predominating genera, a fact in accordance with the results of other investigators who have studied soils of widely differing origin. In the genus *Penicillium*, *P. expansum*, *P. pinophilum*, *P. funiculosum*, and *P. luteum* are always found, indicating that they are among the predominating soil forms of this genus. It has been interesting to note the frequent occurrence of *P. roqueforti*, which is identical morphologically with the species isolated from ripening cheese by Dr. Thom.

Of the *Aspergilli*, *A. flavus*, *A. fumigatus*, and *A. niger* appear in every plating, while *A. nidulans* and two or three unidentified species occur quite regularly. Approximately as many members of these two genera occur as of all the other genera combined. Species of *Mucor* occur in practically every plating, while representatives of the genera *Cladosporium*, *Trichoderma*, *Acrostagmus*, *Verticillium*, *Fusarium*, *Monilia*, and *Alternaria* are common. *Cladosporium herbarum* and several strains of *Trichoderma Konigi* occur with constant regularity.

Genera which occur less commonly are *Spicaria*, *Isaria*, *Chaetomella*, *Stachybotrys*, *Botrytis*, and *Oospora*. Dr. Waksman, who had done the most extensive work with soil fungi, isolated more than one hundred species belonging to more than forty genera.

In the physiological studies an attempt has been made to determine the specificity of fungi toward carbohydrates in the hope that tests might be devised for differentiating species. Bacteriologists find the ability of various organisms to utilize certain carbohydrates of great value in making specific determination, this being especially true of the colon-aerogenes group. Results which have been secured thus far seem to indicate that fungi are not as specific in their action toward such carbohydrates as dextrose, levulose, sucrose, lactose, galactose, glycerin, starch, and other compounds, as are the bacteria.

The only point of particular interest which has been noted is the production of an acid reaction by the "cheese" strain of *Penicillium roqueforti* in solution cultures, using dextrose as a source

of carbon, while the "soil" strain, which is identical morphologically, produces an alkaline reaction in the same medium.

In studying the action of fungi on the mineral constituents of the soil, it has been found that *Penicillium luteum* has the ability to oxidize free sulfur to the sulfate form. This organism has been found to be regularly present in all soils examined. When innoculated for twenty days, as much as one percent of the sulfur added was oxidized to sulfate. Similar results were secured in solution cultures.

This spring, in connection with some fertilizer experiments being carried out at the station, *Penicillium luteum* was observed to be the predominating organism on plates which had been poured from sulfur-treated soils in the greenhouse, the appearance of large numbers of this organism corresponding with a rapid increase in the acidity of the soils. This strain was isolated in pure culture and has been found to have the ability of oxidizing free sulfur in both soil and solution cultures.

Further research in soil mycology may be profitably undertaken in either taxonomy or physiology. It is the opinion of some investigators that little is to be gained from a taxonomic study of soil organisms, while others believe that profitable study of the functions of these organisms has nearly reached a limit until more definite information is at hand regarding the types which constitute the soil flora. While further studies of physiology are undoubtedly desirable, it cannot be denied that definite determination of the soil fungous flora would be a valuable contribution to our knowledge of soil microbiology.

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