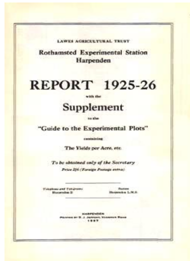
Report 1925-26 With the Supplement to the Guide to the Experimental Plots


Rothamsted Experimental Station
Harpenden
REPORT 1925-26
Supplement
"Guide to the Experimental Plots"

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Microbiology and Treatment of Sewage

Rothamsted Research

Rothamsted Research (1926) *Microbiology and Treatment of Sewage ;* Report 1925-26 With The Supplement To The Guide To The Experimental Plots, pp 43 - 44 **- DOI: https://doi.org/10.23637/ERADOC-1-84**

behave very differently under the same conditions. Dr. Rege finds that two factors determine whether a given waste material will decompose quickly to make a good manure : the amount of food or energy material (usually pentosans), this being beneficial, and the amount of lignin, which is detrimental. The relatively high proportion of lignin to pentosan accounts for the unsuitability of certain substances for conversion into manure, but it also suggests that they might become suitable if mixed with other waste material rich in pentosans.

Certain species of thermophilic fungi appear to be the chief agents affecting the decomposition. Dr. Rege has shown that strains of *Coprinus sp.* (*fimetarius?*), *Aspergillus sp.* (*fumigatus?*) and *Acremoniella sp.* (*velutina?*), all common soil forms, can act at temperatures exceeding 50°C, a degree of heat not infrequently attained in manure heaps. Thermophilic bacteria are known, but so far as is ascertained at present, the bacterial decomposition of cellulose does not rest at the humus stage, but runs right down to the final products, carbon dioxide and water.

Microbiology and Treatment of Sewage and other Effluents.

It has long been a reproach to science that, of the 230,000 tons of nitrogen consumed annually by the inhabitants of these islands in their food, only a small part ever returns to the land, the rest being lost or dissipated at great expense. Various sewage sludges have from time to time been tested at Rothamsted, but the only one of promise as a fertiliser (we express no opinion as to any other property), is the Activated Sludge, made by blowing air through the sewage. This contains, when dry, some 6 per cent. of nitrogen in an easily available form, and is worth on the farm up to £4 per ton. Since ordinary sludges contain only 1 or 2 per cent., it was at first thought that the richness of activated sludge was the result of some fixation of gaseous nitrogen, but experiments at Rothamsted (1921-22 Report, p. 50) showed that it came from a better recovery in the sludge of the nitrogen of the sewage, the proportion being 15 per cent. or more (rising in favourable conditions to 27 per cent.), as compared with 10 per cent. by precipitation and 4 per cent. by septic tank methods. Further work has shown that this higher efficiency of recovery is due to a great absorption of ammonia from the sewage.

This absorption is largely due to microorganisms, which assimilate the ammonia and convert it into protein and protoplasm. Bacteria and protozoa both take part, the bacteria assimilating the ammonia and the protozoa assimilating the bacteria; finally, the protozoa are entangled in the sludge and, when dry and dead, contribute largely to its fertilising value. The smooth working of the process depends on maintaining the proper balance between the numbers of protozoa and bacteria. A remarkable instance of failure at one large town studied this year was traced to the introduction of yeast from a brewery into the effluent; this yeast had stimulated the development of the protozoa, which, in turn, had reduced the bacterial population so much that they could not adequately purify the sewage. As soon as the discharge of yeast was stopped, more active purification was resumed.

An even more efficient absorption of the nitrogen from the sewage can be obtained by allowing the effluent to flow over straw or similar material, which furnishes the bacteria with energy material, causing them to multiply rapidly and assimilate large quantities of nitrogen from the sewage.

These relationships between the nitrogenous and the non-nitrogenous constituents and between the bacteria and the protozoa, furnished the key to some of the difficulties in dealing with sewage and other effluents.

LOSSES OF CROPS BY DISEASES AND PESTS.

The loss caused to fruit growers, farmers and market gardeners, by insect, bacterial and fungus pests, is far greater than is usually realised. No precise estimate is possible, but experts of standing consider that it can hardly be less than 10 per cent. of the crop; in money terms, some £15,000,000 per annum. The trouble is likely to grow worse; improved communications tend to carry plant diseases all over the world, and no method is certain to keep them out from any country.

In order that permanently satisfactory methods of treatment may be devised, it is very desirable to know fully the life history of the fungi and insects concerned and the physiological relationships between the disease-causing organism and the host plant; also to have detailed information about :—

1. The effect of cultivation and manuring on the susceptibility of the crop to disease;
2. The factors determining the rate of increase and of decrease of insect, fungus or bacterial populations;
3. Methods of direct action, such as poisoning, and where practicable, trapping, on the organisms causing disease.

This fundamental information is being obtained, and it is being applied to the control of insect and fungus pests by :—

1. Alterations in time of sowing, methods of cultivation, or manuring;
2. Breaking the life cycle of the organisms in some way (as by the suppression of weeds or other plants that act as hosts), or, in the case of insects, taking advantage of the natural enemies, parasites, etc., that prey upon them;
3. Discovering new insecticides or fungicides that will not injure the crop, but will kill or severely check the pest.

In addition attempts are made to avoid the difficulty altogether by :—

4. Finding some variety of crop plant immune from the disease.

Of these, the first and fourth are the simplest for the farm, though direct action is sometimes possible, as, for example, the use of the fungicide Bordeaux Mixture for potato blight, and various traps for insect pests, like the flea beetle.

Modifications in methods of culture to avoid pests and diseases are already familiar to farmers, e.g., the late sowing of turnips on light land to avoid mildew, though it often causes the crop to

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