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Report for 1931

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Soil Organisms

Rothamsted Research

Rothamsted Research (1932) *Soil Organisms* ; Report For 1931, pp 80 - 84 - **DOI:**
<https://doi.org/10.23637/ERADOC-1-65>

The effect of superphosphate was so slight that for practical purposes it may be regarded as without effect on the replaceable bases.

The final replaceable calcium was reduced at the rate of 0.8 mol. CaO per mol. of ammonium sulphate added throughout the experiment, and increased at the rate of 0.5 mol. for the equivalent amount of sodium nitrate. The relatively low value for the ammonium sulphate effect is due to the low base content of the very acid soils and the low calcium bicarbonate content of the water. To increase the replaceable calcium of the ammonium sulphate plots to that of the sodium nitrate plots required 2.8 mol. of CaO per mol. of ammonium sulphate when the lime was applied at intervals of about 10 years. A rule is proposed for calculating the effects of various nitrogenous fertilisers on the lime content of the soil.

Most of the added lime was recovered many years later when the original lime content was low, but added lime was rapidly lost by leaching from soils of relatively high replaceable calcium content.

A new method was devised determining the "degree of unsaturation" or "exchangeable hydrogen" of soils. A mixture of soil and calcium carbonate is extracted with *N*.NaCl, and the difference between the calcium and the bicarbonate contents of the extract is taken as a measure of the replaceable calcium and hydrogen.

(e) ORGANIC CHEMISTRY

XXXV. M. M. S. DU TOIT AND H. J. PAGE. "*Studies on the Carbon and Nitrogen Cycles in the Soil. IV. Natural and Artificial Humic Acids.*" *Journal of Agricultural Science*, 1932, Vol. XXII, pp. 115-125.

The preparation of natural humic acids from soil, peat (Dopp-lerite) and "Adco," and of artificial "humic" acids from sucrose, cellulose, dextrose and glycine (Maillard), hydroquinone and lignin, and their purification are described.

Their elementary compositions and their behaviours under conductimetric titration with ammonia have been studied. The artificial products from sucrose and furfural did not behave as acids but all the natural products, and the artificial products from cellulose, hydroquinone and lignin possessed the properties of colloidal acids.

Preliminary investigations into the "humification" of furfural and ω -hydroxymethyl furfural, and into the interaction of dextrose with amino bodies, are described.

SOIL ORGANISMS

(Bacteriological, Fermentation, General Microbiological, and Mycological Departments)

(a) BACTERIA

XXXVI. H. L. JENSEN. "*A Comparison of Two Agar Media for Counting Soil Micro-organisms.*" *Journal of Agricultural Science*, 1931, Vol. XXI, pp. 832-843.

A statistical test was made of the variation between bacterial and actinomycete colony numbers on parallel plates on dextrose-casein agar, the medium used for the counts involved in the author's

work on manure decomposition. (See Papers XLVI to XLVIII). The medium was compared in this respect with Thornton's mannitol-asparagine agar, and like the latter medium, gave generally satisfactory results, though on both media counts of actinomycetes tended to give subnormal variance.

(b) PROTOZOA

- XXXVII. L. DE TELEGDY-KOVATS. "*The Growth and Respiration of Bacteria in Sand Cultures in the Presence and Absence of Protozoa.*" *Annals of Applied Biology*, 1932, Vol. XIX, pp. 65-86.

Experiments were carried out on carbon dioxide production from sand treated with peptone and glucose solution, or with glucose and ammonium sulphate solutions of different C/N ratios. The media were inoculated with various types of bacteria and protozoa. It was found that while the presence of protozoa increased the carbon dioxide production, especially in the case of mixed bacteria cultures, and also caused greater bacterial efficiency, yet the number of bacteria was lower; an increase in the number of protozoa beyond a certain point, however, reduced the output of carbon dioxide. Reducing the concentration of glucose from 0.6 to 0.2 per cent. resulted in a greater percentage production of carbon dioxide, and an intensification of the effect caused by the presence of protozoa. An increase in the C/N ratio in the presence of protozoa was followed by a marked increase in carbon dioxide production, while in their absence there was no definite effect. Where the C/N ratio was reduced to less than 10/1 there was a fluctuation of numbers in bacterial cultures.

(c) FUNGI

- XXXVIII. W. B. BRIERLEY. "*Biological Races in Fungi and their Significance in Evolution.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 420-434.

A discussion of biological races and fungal variation in relation to the species concept and the evolution of new species. An "orbital conception" of systematic categories and evolutionary relationships is put forward.

(d) BIOLOGICAL ACTIVITIES

- XXXIX. D. WARD CUTLER AND B. K. MUKERJI. "*Nitrite Formation by Soil Bacteria, other than Nitrosomonas.*" *Proceedings of the Royal Society (B)*, 1931, Vol. CVIII, pp. 384-394.

Four species of non-spore-forming bacteria capable of oxidising ammonia into nitrite have been isolated from Rothamsted soil and all differ widely from *Nitrosomonas* or *Nitrosococcus*.

These organisms are able to carry out this reaction in artificial media as well as in soil, and some are able to assimilate nitrite.

Rapid growth takes place on nutrient agar, and the presence of 0.1 per cent. sucrose stimulates nitrite production.

F

- XL. N. W. BARRITT. "*The Liberation of Elementary Nitrogen by Bacteria.*" *Biochemical Journal*, 1931, Vol. XXV, pp. 1965-1972.

Much confusion exists in the literature regarding the liberation of nitrogen by bacteria. This is due chiefly to inaccuracies in analytical methods and insufficient attention to the occurrence of nitrates or nitrification.

In addition to the liberation of nitrogen by reduction of nitrates it is shown that free nitrogen may be formed by the interaction of amino compounds and nitrites when the reaction falls below pH 6.0. In this way fermentation of carbohydrates by producing an acid reaction may result in the liberation of free nitrogen.

Ammonium nitrite in culture solutions is quite stable at ordinary temperatures and does not give rise to free nitrogen.

- XLI. N. W. BARRITT. "*The Biological Filtration of Dilute Sucrose Solutions.*" *Biochemical Journal*, 1931, Vol. XXV, pp. 1419-1446.

Bacterial oxidations involve organic synthesis which in the case of sucrose involves from 25 per cent. to 33 per cent. of the material. This synthesis accounts for the incomplete absorption of oxygen in the 5-day oxygen absorption test and the accumulation of film in a biological filter.

The use of sectional filters showed the relation of nutrition gradient to the structure and functioning of the filter. The rate of purification is proportional to growth of film which is determined by the concentration of the nutrient. Growth of film tends to limit aeration which is essential to oxidation and this imposes limits on the size of the particles constituting the medium of the filter. The use of gravel passing $\frac{1}{2}$ inch mesh is to be avoided since it favours the development of anaerobic conditions, indicated by a lowering of pH in the upper sections due to the formation of organic acids.

The growth of the film and the efficiency of the filter depend upon definite nitrogen and phosphorus requirements, viz., a C/N ratio of 15 and C/P₂O₅ ratio of 10. Nitrogen fixation occurs in the filter but not to a sufficient extent to ensure adequate purification.

Nitrification occurs when the concentration of oxidisable organic matter falls below the equivalent of 0.03 per cent. sucrose.

- XLII. S. H. JENKINS. "*The Biological Oxidation of Carbohydrate Solutions. I. The Oxidation of Sucrose and Ammonia in Sectional Percolating Filters.*" *Biochemical Journal*, 1931, Vol. XXV, pp. 147-160.

A study was made of a percolating filter which consisted of six independent sections. The solution fed to the filter contained sugar plus ammonia. When the biological film was mature the amounts of sugar and nitrogen oxidised by each section were found. The results showed that the first section was most effective in oxidising sugar, while the last section was least effective. However, if the last section was placed in the position occupied by the first, and thus received a more concentrated solution of sugar it became quite as efficient as the first section. The oxidation of ammonia was found to proceed

mainly in the lower sections although nitrification could occur to a limited extent in the upper sections of the filter in the presence of 0.06 per cent. of sugar.

- XLIII. A. G. NORMAN. "*The Biological Decomposition of Plant Materials. IV. The Biochemical Activities on Straws of some Cellulose-Decomposing Fungi.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 244-259.

A number of fungi isolated from rotting straw were tested for ability to utilise different carbohydrate constituents. In general all substances but lignin were attacked to a degree relatively proportional to the apparent total loss of organic matter. The nitrogen factor, i.e., nitrogen immobilised by 100g. of straw, was determined in each case. The differences are considerable and varietal. They are not related to any particular straw constituent.

- XLIV. E. H. RICHARDS AND A. G. NORMAN. "*The Biological Decomposition of Plant Materials. V. Some Factors Determining the Quantity of Nitrogen Immobilised During Decomposition.*" *Biochemical Journal*, 1931, Vol. XXV, pp. 1769-1778.

The amount of additional nitrogen immobilised during decomposition of plant materials represents only the equilibrium between immobilisation and ammonification. Besides the added nitrogen, plant proteins may also be attacked, or microbial nitrogen may be liberated and re-utilised. The term "nitrogen equivalent" is suggested as a measure of the efficiency of the microbial tissue in decomposition, and defined as the nitrogen immobilised in the course of removal of 100g. of organic matter from any material.

- XLV. A. G. NORMAN. "*The Biological Decomposition of Plant Materials. VI. The Effect of Hydrogen-ion Concentration on the Rate of Immobilisation of Nitrogen by Straw.*" *Biochemical Journal*, 1931, Vol. XXV, pp. 1779-1787.

The rate of immobilisation of available nitrogen in dilute solutions of various hydrogen ion concentrations was studied by percolation of the solutions through straw filters. Slightly alkaline conditions favour immobilisation and more organic matter is fermented away than under neutral or slightly acid conditions. The alkaline filter showed an initial lag not observed in either of the others. This lag is due to a primary flora relatively inactive in cellulose decomposition. The loss of hemicellulose is more gradual in filters than in compost heaps.

- XLVI. H. L. JENSEN. "*The Microbiology of Farmyard Manure Decomposition in Soil. I. Changes in the Microflora and their Relation to Nitrification.*" *Journal of Agricultural Science*, 1931, Vol. XXI, pp. 38-80.

When farmyard manure was added to soil the energy material contained in it produced a rapid increase in bacteria, actinomycetes and fungi which resulted in a part of the manure nitrogen being locked up in the form of protein. Only after the numbers of microorganisms passed their maximum did the production of nitrate

become active. After passing the maximum this nitrification diminished gradually, leaving, after a year, a considerable portion of the manure in an unavailable form. This fraction was contained partly in the cells of the micro-organisms themselves and partly in the ρ -humus which is very resistant to decomposition and which tended to increase slightly during the period.

XLVII. H. L. JENSEN. "*The Microbiology of Farmyard Manure Decomposition in Soil. II. Decomposition of Cellulose.*"
Journal of Agricultural Science, 1931, Vol. XXI, pp. 81-100.

Addition of farmyard manure to approximately neutral soil (pH 6.5-7.0) gave rise to an abundant development of cellulose decomposing bacteria of the genus *Vibrio*. When it was added to faintly acid soils (pH 5.7-6.2) these organisms were partly replaced by *Spirochaeta cytophaga*. At lower pH values only fungi were active in the decomposition of the cellulose. Similar results were obtained by adding filter paper or straw to soils of different reactions. Cellulose decomposing bacteria did not form humus-like compounds when growing on filter paper in sand culture but at least two fungi *Mycogone nigra* and *Stachybotrys* sp. gave rise to such compounds when growing in sand and in sterilised soil.

XLVIII. H. L. JENSEN. "*The Microbiology of Farmyard Manure Decomposition in Soil. III. Decomposition of the Cells of Micro-organisms.*" Journal of Agricultural Science, 1932, Vol. XXII, pp. 1-25.

The addition of microbial substances to soil resulted in a rapid but temporary increase in bacteria and especially actinomycetes. A fraction of the microbial substance was readily nitrified but there remained a very resistant residue. This was not identical with fungal chitin which is readily nitrified. In the case of *Mycogone nigra* and *Stachybotrys*, the humus-like substance contained in their mycelia formed part of this resistant residue.

THE PLANT IN DISEASE : CONTROL OF DISEASE (Entomological, Insecticides and Fungicides, and Mycological Departments)

(a) INSECTS, AND THEIR CONTROL.

XLIX. H. F. BARNES. "*Observations on Gall Midges Affecting Fruit Trees.*" Journal of the South-Eastern Agricultural College, 1931, No. 28, pp. 170-177.

Notes on the bionomics and control of *Dasyneura pyri* Bouché, *Contarinia pyrivora* Riley, both on pear; *Thomasiniana oculiperda* Rübs. on rose and apple, and *Dasyneura* sp. on black currant. This information, which deals with recent literature and the author's own investigations, brings up to date the section dealing with the same subject in a previous paper (Barnes, *Material for a Monograph of the British Cecidomyidae or Gall Midges*, Journal of the South-Eastern Agricultural College, 1927, No. 24, pp. 65-146).