

SOIL RESPIRATION STUDIES IN SOME TRINIDAD CACAO SOILS.

Introduction and Review of Literature.

In determining the ability of soil microorganisms to decompose organic matter by the rate of evolution of carbon dioxide, the terms "oxidative capacity", "carbon dioxide producing capacity", and "respiratory capacity of soils" are often used. They all designate the decomposition of organic matter by microorganisms with the production of carbon dioxide.

Wollny (1) in 1880 was the first to prove that decomposition of organic matter is almost entirely due to biological activity. He found that when manure was treated with disinfectants, very little carbon dioxide was produced. He suggested that the agents concerned were microorganisms. Wollny's work was confirmed by Dehérain and Demoussy (2), who measured oxidation capacity by the amount of carbon dioxide present in the atmosphere of a closed 100cc. tube containing the soil. They showed that in a basic soil, production (i) is due almost entirely to bacteria, (ii) it increases with temperature up to 65°C, then decreases, and increases again at temperatures above 90°C, (iii) it is influenced by the moisture content, the optimum content varying with the soil type, and also by the state of division of the soil and degree of aeration. Under unaerobic conditions organic matter is not completely decomposed, carbon dioxide production is small and cannot serve as good an indication of decomposition as under aerobic conditions.

In 1905 Russell (3), using the absorption of oxygen instead of the production of carbon dioxide as a measure of respiratory capacity, found that oxidation varied with fertility, and suggested using the former as a measure of the latter. He found that oxidation was influenced by soil temperature, moisture and content of calcium carbonate. Stoklasa (4, 5, 6, 7) passed air at a constant rate through 1 kgm. portion of sieved soil. Under given conditions of moisture, temperature and time, carbon dioxide evolution was found to furnish an accurate measure of bacterial activities. Temperature and the presence of organic matter were found to be of the greatest

importance. Evolution of carbon dioxide was highest in well aerated, neutral or slightly alkaline soil, well supplied with readily assimilable plant nutrients: it also ran parallel with nitrification. Rahn (8) found that drying of soil favoured production. Van Suchtelen (9) also emphasises the importance of aeration and moisture conditions. He found, too, that cultivation was favourable to production of carbon dioxide, well sieved soils producing 177 per cent. as much carbon dioxide as unsieved soils.

Russell E. J. and Appleyard A. (10) found that fluctuations in carbon dioxide content and nitrate content were sufficiently similar to justify the conclusion that they were related. A rise in carbon dioxide content was accompanied by a rise in the nitrate content. Since both carbon dioxide and nitrates are ~~both~~ produced in the same way, that is by microorganic activity, but are lost differently (the carbon dioxide by diffusion, most rapidly in dry conditions, the nitrates by leaching, mostly in wet conditions), the similarity of the curves for nitrate and carbon dioxide content indicates that they are essentially production curves. The carbon dioxide fluctuations were further shown to be closely correlated with fluctuations in bacterial numbers; the decomposition of organic matter was, therefore, considered to be chiefly a function of bacterial activity. The same workers (11) further demonstrated that temperature, moisture and the growing crop were important factors affecting the rate of production of carbon dioxide.

In all the laboratory experiments measuring carbon dioxide production up to 1915, air, freed from carbon dioxide, had been drawn through the soil and the carbon dioxide collected was considered to be the oxidation capacity of the soil. Microbiological activity, however, was shown to be greatly stimulated by passage of the air through the soil, and in 1916 Potter and Snyder (12) found that passing the air continuously over the soil gave results more comparable with those obtained in the field. The amount of air passing over the soil did not materially affect the amount of carbon dioxide evolved.