BRIEF PAPERS

A SIMPLE GAS ANALYSIS APPARATUS FOR THE MEASUREMENT OF PLANT RESPIRATION

(WITH TWO FIGURES)

For the quantitative measurement of the respiratory gaseous exchange in plants various forms of gas analysis apparatus have been used. As examples of those most commonly employed for the purpose may be mentioned the Bonnier and Mangin apparatus and the Haldane gas analysis apparatus. In the Bonnier and Mangin apparatus the operations of sampling and cleaning are rather troublesome. Drying the measuring tube after each analysis consumes time, and errors are likely to be introduced if the subsequent analyses are carried out in a wet tube. The Haldane gas analysis apparatus, however, possesses a high degree of accuracy but requires considerable experience before it can be used with discrimination. Moreover, the construction of the apparatus is complex and an accidental breakage in the glass parts is not easily repaired.

In the course of investigations on the gas storage of fruits the need was felt for a simple and effective means of gas analysis. With this object in view a simple apparatus was constructed in this laboratory and has been in use for some time with satisfactory results.

The principle of the apparatus consists, in brief, in measuring the pressures exercised by the various constituents of a gaseous mixture. As the partial pressure of a component is proportional to its concentration in the gaseous sample and the sum of the various partial pressures is equal to the total pressure exerted by the gas sample, the percentage content of the component, say x, is easily calculated:

\[ x = \frac{h \times 100}{H_0} \]

where \( h \) = the partial pressure of the component under consideration, and \( H_0 \) = atmospheric pressure in mm Hg.

The apparatus (fig. 1) consists essentially of a manometer (made out of a 3 mm. bore glass tubing), one limb of which has a 200-mm. metal-enamelled scale attached to it. The "0" mark on the scale corresponds with a circular mark \( (X) \) on the burette \( (B) \), the volume of which between the stopcock \( (G) \) and the circular mark \( (X) \) is 5 cc. The manometer tube and the burette \( (B) \) are inclosed within a glass jacket the water in which is kept stirred by means of an air-blower \( (A) \). A leveling bulb \( (L) \) is provided with which sampling is done and the mercury level in the manometer adjusted. The two bulbs \( (C) \) and \( (D) \) are similar to the "combustion pipette" employed by Haldane.
(2), except that the ignition tubes inside the pipette have been removed. One bulb is filled with fine glass tubings of suitable length and contains a 30 per cent. solution of KOH so that 5 cc. of air can be introduced into it, whereas the other contains stick yellow phosphorus which is kept under water. The use of phosphorus (1) instead of potassium pyrogallate as an absorbent for oxygen obviates the necessity of keeping the gaseous sample in a state of continuous agitation, which is often very tiring. The phosphorus bulb is kept covered from the light by means of a metal shield which is taken off only during analysis.

The air in the apparatus is first freed from CO₂ and oxygen in order that all of the capillaries may be filled with nitrogen. Sampling is done by the washing method (1), by interposing a 3-way stopcock between the inlet of the burette and the respiration chamber. The gas samples are drawn in and sent out by means of the mercury leveling bulb, the number of washings depending upon the amount of gas available. As a rule, two or three washings give satisfactory results. After the final washing is completed, exactly 5 cc. of the sample is taken into the burette, the mercury being adjusted to the mark (X) by means of the leveling bulb. The subsequent process consists
in sending the gaseous sample back and forth several times into the KOH bulb. When the CO₂ has been completely absorbed the gas is finally brought back into the burette, the potash level is set, and the stopcock (G) half turned. It will now be found that the gas has shrunk in volume. By means of the leveling bulb the mercury is again brought to the mark (X) and the lowering of pressure is read. The oxygen is absorbed by a similar process except that the gaseous sample need not be continuously agitated. Through the stopcock (F) the pressures in the absorption bulbs are equilibrated with atmospheric pressure. The lowering of pressure after each absorption represents the partial pressure of the component absorbed from which the percentage content of the constituent is easily computed.—B. N. SINGH and P. B. MATHUR, Benares Hindu University, India.

LITERATURE CITED