Bull. Ecol. Res. Comm. (Stockholm) 17: 274 (1973).

Short communication

Separation of Microbial and Root Respiration

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Tracers, such as ^{14}C, which can be used to follow the fate of photosynthesized carbon through the plant-soil-system should make feasible the separation of root and microbial respiration without unduly disturbing the system. There is a slight delay in respiration of $^{14}CO_2$ by roots after pulse labelling above ground plant portions, with a longer delay before microbial evolution of $^{14}CO_2$ from exudates or sloughed root materials becomes important. Labelling above ground portions by exposure to $^{14}CO_2$ in a temperature controlled canopy with a silicone-sealed partition to exclude soil or root CO_2 (Warembourg & Paul, 1973) results in translocation of the photosynthate to the roots. Here it may be respired, laid down during growth or exuded. Exudates, sloughed materials and dead roots will be decomposed at varying rates resulting in a slow extended liberation of ^{14}C. Organisms feeding directly on labelled internal solutes probably could not be differentiated.

The time course of $^{14}CO_2$ evolution after pulse labelling (F. Warembourg, unpublished data) indicated a 4-6 hour delay between initial exposure and active evolution of the tracer by the roots. The ^{14}C is evolved in increasing proportions during the labelling period. At cessation of ^{14}C exposure and reexposure to ^{12}C, the ^{14}C content of respired CO_2 drops in a curve analogous to its rise resulting in a bell shaped curve for activity. The presence of microorganisms or exposure to plants in soil yields extended periods of ^{14}C evolution which can be quantified.

The above concept was tested by comparison of sterile and non-sterile root systems and by addition of exudate from sterile plants exposed to $^{14}CO_2$ to non-sterile plants growing in a ^{12}C atmosphere. The time sequence of root and microbial respiration was demonstrated with the increased activity over longer periods, or a second peak of activity being attributed to microbial respiration.

In the field, differentiation is more difficult for the above and below ground plant parts can not be so easily separated. However, sampling wells can be inserted at various depths in the soil. The air in these wells is analyzed for total CO_2 by gas chromatography and $^{14}CO_2$ by scintillation counting, this makes it possible to utilize the time sequence of $^{14}CO_2$ evolution to estimate the source of the respired CO_2.

Reference

Warembourg F.L. & Paul E.A. 1973. The use of $^{14}CO_2$ canopy techniques for measuring carbon transfer through the plant-root-soil system. Plant & Soil (in press).