A Technique for Field Use of Radioactive Phosphorus[1]

CHESTER C. JAYNES

Associate Professor of Agronomy, Texas Technological College, Lubbock.

Highlight

Dry ice was used in the field to solidify solutions of radioactive phosphorus. Cubes of the frozen material were dropped into holes formed adjacent to grass plants, the root systems of which were being studied by use of the radioactive tracer method.

Radioactive phosphorus is often used as a tracer in studying the root systems of plants (Subcommittee, Range Research Methods, 1963). Its use enables the scientist to study the extent of growth of root systems readily and with little labor. One of the principal values realized in using radioactive phosphorus is the minimum disturbance to root systems. The equipment required for field handling and detection of P^{32} is not necessarily expensive, and when handled in accordance with the prescribed safety rules, it is not as dangerous as certain other radioactive materials.

Field use, however, presents certain problems involving placement of the material in the soil. Radioactive phosphorus is often mixed with distilled water, transported in glass containers to the research area, and then injected into prepared holes in the soil. Syringes and tubes have been employed in the operation (Burton et al., 1954; Mathis et al., 1965; McClure and Harvey, 1962). This practice requires considerable handling; spillage with its accompanying undesirable contamination can occur. Another method often employed includes the preparation of an agar gel containing the P^{32} material. The agar preparation while still in liquid form is poured into small paper cups capable of holding a given quantity of material. The preparation is allowed to solidify, after which it is squeezed from the cups into holes in the soil. This method requires the use of laboratory space and apparatus to prepare the agar gel.

A simple method of placing radioactive phosphorus in designated locations in the soil has been used in root studies of perennial grasses on the Agronomy Farm at Texas Technological College. All work was done in the field in an isolated location where contamination would not be dangerous to men or animals. Prescribed isolation rules were followed. The procedure was as follows:

Radioactive phosphorus solutions were compounded in five-gallon quantities. Ordinary glass with a minimum thickness of 3.5 mm will stop the beta rays emitted by P^{32}. Next, a bed of dry ice two inches thick was formed in the bottom of a lead-lined wooden box measuring 1.5 × 10 ft and six inches deep. Paper cups having a capacity of 20 ml. were placed in rows on the dry ice and filled with P^{32} solution which solidified in approximately 30 minutes. The frozen cubes were then removed from the bed of dry ice and the paper cups torn away (Fig. 1). The frozen material was promptly dropped into holes in the soil. Holes were formed to various designated depths and were placed at various distances from plants in the experimental area. They were formed by a Bull hydraulic soil sampling machine and had a diameter large enough to permit the cubes of frozen radioactive material to drop unimpeded to the bottom of each hole. Dry ice kept the cubes frozen until they were used.

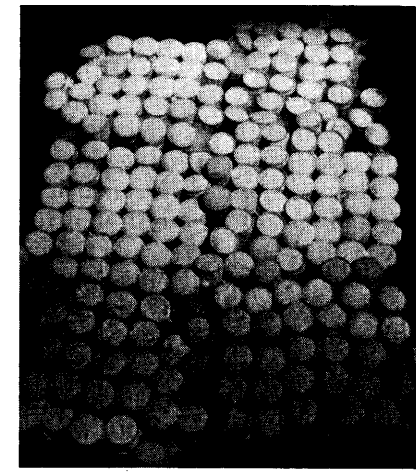

FIG. 1. Cups of frozen P^{32} material on squares of dry ice.

The use of P^{32} in studying root systems of plants is a useful technique and the method described here does not violate procedures for safe handling of radioactive phosphorus. It permits the tracer technique to be used where laboratory space and equipment are not available for preparing radioactive materials for use. It permits the technique to be used in field plots easily and quickly with little expense. It reduces the chances for contamination of the sides of holes as might be the case when the solution method with its tubes and syringes is used to place P^{32}

[1] Contribution from the cooperative research program between Texas Technological College and the Texas Agricultural Experiment Station. Received July 6, 1968; accepted for publication September 6, 1968.

in the soil, and it also lessens the opportunity for above-ground contamination.

Disadvantages of this method include:

1. Removal of the frozen material from the paper containers requires extra time and additional exposure to the radioactivity of the material. If it is determined that paper cups disintegrate rapidly and in the process do not inhibit the natural growth of roots in the area of P^{32} placement, the cup and contents could be dropped intact into the soil. Ice trays could be used in place of paper cups.

2. The cubes of radioactive material must be kept frozen. If kept for several days in the field before use, additional dry ice would be needed.

LITERATURE CITED

BURTON, G. W., E. H. DEVANE, AND R. L. CARTER. 1954. Root penetration, distribution and activity in southern grasses measured by yields, drought symptoms, and P^{32} uptake. Agron. J. 46:229–233.

MATHIS, G. W., C. C. JAYNES, AND G. W. THOMAS. 1965. Root development of plains bristlegrass as measured by soil placement of radiophosphorus. J. Range Manage. 18: 30–33.

MCCLURE, J. W., AND C. HARVEY. 1962. Use of radiophosphorus in measuring root growth of sorghums. Agron. J. 54:457–459.

SUBCOMMITTEE RANGE RESEARCH METHODS. 1962. Basic problems and techniques in range research. Nat. Acad. Sci.—Nat. Res. Council, Washington, D.C. Publ. No. 890. 341 p.