Studies on Nitrogen Fertilizer Utilization Using N\textsuperscript{15}

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The value of tracer techniques in studying the absorption of plant nutrients and in detecting changes in the distribution of various elements among fractions of the soil has long been recognized. Far more extensive use in soil investigations has been made, however, of the radio-active isotopic tracers than of the stable isotopes of carbon and nitrogen. Among those workers who have used such techniques, Norman and Werkman (3) employed organic material labelled with \textsuperscript{N}{15} to determine the nitrogen recovered from plant materials decomposing in the soil. Norman and Krampitz (2) used tracer techniques in studying the relative rates of utilization of various sources and amounts of combined nitrogen. More recently, this type of study has been extended to field-type investigations. Bartholomew, Nelson, and Werkman (1) have studied the efficiency of ammonium sulfate fertilizers applied to oats in field culture at differing stages of maturity.

One problem of importance in the Southwest is a suitable method for disposing of wheat straw following combining of grain crops. In studies on this problem at the Oklahoma Station, it was felt that valuable information could be obtained by means of isotopic tracers using the heavy isotope of nitrogen. In the course of this investigation, it became necessary to produce organic matter which contained a \textsuperscript{N}{15} ratio above the normal. It appeared that, in growing plants to produce this organic matter, it might also be possible to secure additional information on the efficiency of use of nitrogen fertilizer by growing the plants under controlled conditions of fertilization and environment. This paper reports the incidental study on efficiency of use of nitrogen fertilizer.

EXPERIMENTAL

Materials.—The soils employed in this study were a virgin and a heavily cropped Chickasha silt loam, representative of the medium textured soils of Central Oklahoma. Sufficiently large samples were taken to be representative of the two conditions, and each was composited separately. The soils were screened to remove roots and undecomposed organic matter. Analysis showed that the two soils differed appreciably in total organic matter content, the virgin soil containing 2.86% as contrasted with 1.56% for the cropped soil.

Nitrogen fertilization was applied as ammonium sulfate labelled with the stable isotope of N and containing 32 atom per cent \textsuperscript{N}{15}. Levels of application were at a rate equivalent to 120 pounds of nitrogen per acre for both soils; on the cropped soil a third treatment at a rate of 60 pounds per acre was included. The nitrogen was added in solution, the soil thoroughly mixed, allowed to partly dry, and remixed. A composited sample was taken for nitrogen analysis and determination of the isotope ratio.

RESULTS AND DISCUSSION

The nitrogen composition and isotope ratios of the variously treated soils at the beginning of the experiment are shown in Table 1. The virgin soil contained 1.46 mg of nitrogen per gram (including 0.06 mg of added fertilizer nitrogen) compared with 0.87 mg in the cropped soil receiving an equivalent amount of added nitrogen. The increase in \textsuperscript{N}{15} above the normal ratio was similar for the cropped soil receiving an application of 120 pounds of nitrogen per acre and the other soils receiving half that quantity. The experiment determined isotope ratio for the cropped soil receiving a heavier level of application was slightly lower than for the other two treatments.