Although six isotopes of nitrogen are known, only those having mass numbers 14 and 15 are stable (Table 86–1). The mass-13 isotope is the longest-lived of the four radioactive nuclides, and it has been used as a tracer in chemical and biological research (e.g., Nicholas et al., 1961). However, the half-life of this isotope is so short (10.05 minutes) that for most tracer investigations it is necessary to use nitrogen compounds enriched with the naturally occurring stable isotope N\(_{15}\). The methods available for detection and determination of stable isotopes are much less sensitive, and considerably more complicated and time-consuming, than the methods for radioactive isotope analysis; and, they generally require the use of a mass spectrometer, which is an expensive instrument demanding both continual care and considerable experience for its successful operation. However, stable isotopes have advantages over radioactive nuclides in that their use as tracers is not complicated by health hazards, dangers of radiation damage to biological materials, or time limits to the duration of experiments; and, the availability of nitrogen compounds enriched with N\(_{15}\) (Table 86–2) permits investigation of many important problems of the nitrogen cycle which cannot be studied adequately by conventional methods.

The value of N\(_{15}\)-tracer techniques in research on nitrogen transformations in soils can be illustrated by considering their advantages in studies of nonsymbiotic nitrogen fixation (see Burris and Wilson, 1957). If a soil sample containing 0.1% N is incubated in normal air, an increase of 1% in the total-N of the sample due to nitrogen fixation cannot be reliably demonstrated by the Kjeldahl method without extensive replication of the analyses and statistical examination of the results. If, however, the sample is incubated in an atmosphere containing N\(_2\) with 60 atom % of excess N\(_{15}\), an increase of only 0.020% in the total-N of the sample due to nitro-