Advantages and Disadvantages of Nitrogen-15 Isotope Dilution to Quantify Dinitrogen Fixation in Field-Grown Legumes—A Critique

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Problems associated with accurately quantifying dinitrogen (N₂) fixation in field-grown annual legumes have impeded progress in selecting superior strains of rhizobia, legume cultivars, and agronomic conditions that reduce dependence on fertilizer and soil N. Without an accurate quantification of N₂ fixation in the field, no baseline exists to assess the present agronomic significance and impact of N₂ fixation, to modify the host plant and rhizobium to increase rates of N₂ fixation, and to transfer with confidence this capability to the farmer, regardless of the country and technology of his farming operation.

Legume breeders and microbiologists require techniques for selecting plants with the ability to support more N₂ fixation and rhizobia with greater N₂-fixing efficiency. These techniques must be rapid, inexpensive, non- or only partially destructive of the plant, and suitable for screening large populations. Several techniques are commonly used to quantify N₂ fixation, all based on the different substrates reduced by nitrogenase: dinitrogen (N₂), H⁺, and acetylene (C₂H₂). Before examining the specific advantages (chapter 2 in this book) and disadvantages (chapter 3 in this book) of nitrogen-15 (¹⁵N) isotope dilution, a technique that has great promise, it is worthwhile to review the merits of alternative methods presented by Weaver (chapter 1 in this book).

ADVANTAGES OF NITROGEN-15 ISOTOPE DILUTION

Isotope dilution employs relatively inexpensive, stable ¹⁵N. Thus, half-lives of isotopes, policing of laboratories, and disposal of hazardous...