Assessment of Soil Nitrogen Availability

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I. INTRODUCTION

Before the dramatic upsurge in N fertilizer use began in about 1945, the level of crop production had become increasingly dependent on the capacity of the soil to supply N. Because of the limited supply and high cost of N fertilizers, farmers were dependent almost entirely on biological N fixation and judicious use of manures and crop residues to sustain crop yields.

By 1945, N fertilizer use in the USA had risen to about one-half million metric tons, 80% or more of which was used in states other than those comprising the cornbelt and the major wheat-producing areas (USDA, 1966). By 1976, N fertilizer use had risen to about 10.4 million metric tons, of which about 55% was applied to corn (Zea mays L.) and wheat (Triticum aestivum L.), representing approximately a 40-fold increase in N use for those crops since 1945 (USDA, 1977). In contrast, the average N use for all other crops grown in the USA increased approximately 10-fold during this period.

In response to the rapidly changing N situation, agronomists and soil scientists throughout the world began developing methods for assessing the N-supplying capacities of soils as an aid in predicting N fertilizer needs. Research conducted on this problem up to about 1970 has been summarized and evaluated by Bremner (1965), Harmsen and Van Schreven (1955), Harmsen and Kolenbrander (1965), Jenkinson (1968), Stanford and Legg (1968), Keeney and Bremner (1966a) and Dahnke and Vasey (1973). Most of the earlier studies emphasized developing methods of soil N evaluation based on short-term incubation under controlled laboratory conditions and calibration with yield responses to N in the field and greenhouse (for examples, see Olson et al., 1960; Stanford & Hanway, 1955; Fitts et al., 1953; Clement & Williams, 1962; Cook et al., 1957; Saunder et al., 1957; Synghal et al., 1959; Cooke & Cunningham, 1958; Gallagher & Bartholomew, 1964).

In a few laboratories, services for recommending N fertilizer use based on short-term N mineralizations were instituted (Hanway & Dumenil, 1955; Olson et al., 1960). These ventures were relatively short lived, however, for two important reasons: (i) it became increasingly apparent that the contribution of N mineralized during the cropping season often was obscured by...