Chapter 1

Origin and Distribution of Nitrogen in Soil

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I. INTRODUCTION

The nitrogen cycle in soil is an integral part of the overall cycle of nitrogen in nature. The primary source of soil nitrogen is the atmosphere, where the strongly bonded gaseous molecule N₂ is the predominant gas (79.08% by volume of the gases). The plow layer of a rich prairie soil may contain as much as 3 tons of combined nitrogen per acre; in the atmosphere over this same area there will be about 35,000 tons of elemental nitrogen. Only a very limited number of microorganisms have the ability to utilize elemental nitrogen; all other living organisms on the earth require combined nitrogen for carrying out their life activities.

The combined nitrogen in soil is largely bound to organic matter and mineral material; in general, only a few pounds per acre will exist in available mineral forms (as nitrates and exchangeable ammonium) at any one time. In some soils, such as the dark-colored brunizems of the Corn Belt section of the United States, sufficient quantities of nitrogen are present for a century of cropping, even without any external additions. However, when land is cultivated, the nitrogen content of the soil declines rapidly, and new equilibrium levels are established which are characteristic of the climate, cultural practices, and soil type. At equilibrium, the nitrogen removed by harvested crops must come from external sources.

Systems of agriculture which rely heavily on soil reserves to meet the nitrogen requirements of plants cannot long be effective in producing high yields of crops. In the past, biological nitrogen fixation was the chief means of supplying nitrogen for cultivated crops; in recent years, nitrogen fertilizers have become available, which, when used to augment the nitrogen supplied by natural processes, can increase yields and improve the quality of crops. A major concern of present-day farmers is the effective use of nitrogen fertilizers.

An outline of the nitrogen cycle in soil is depicted in Fig. 1. Under natural conditions, gains in nitrogen occur through fixation of elemental nitrogen by microorganisms, and from the accession of ammonia and nitrate in rain water; losses occur through crop removal, leaching, and volatilization. Within the soil, an internal cycle is operative, through