

Nitrogen Gains

There are several ways that nitrogen is made available for plant growth. Three of the most important of these gains are fixation, mineralization and nitrification. These processes increase the available nitrogen either by converting a gaseous or chemically bound form into usable nitrogen compounds like ammonium and nitrate.

Fixation

Fixation is combining pure nitrogen with hydrogen or oxygen to make ammonium or nitrate. There are several methods of fixation: atmospheric, industrial and biological.

Atmospheric Fixation occurs during lightning storms. During a storm, lightning creates high heat. This intense heat changes the nitrogen that is present in the atmosphere to nitrate. Rain then carries the nitrate to the soil. Because 80% of the atmosphere is pure nitrogen, atmospheric fixation can contribute as much as 10-15 pounds of nitrogen per acre per year.

Industrial Fixation is the process of manufacturing nitrogen containing fertilizer. In the same way that nature creates nitrate using the intense heat of a storm, ammonium can be formed through a combination of air, natural gas, heat and pressure. That ammonium is then made into nitrate. Industrial fixation is the biggest source of nitrogen gains. The fertilizer industry fixes several million tons of nitrogen each year by way of commercial fertilizers.

Biological Fixation is another significant source of nitrogen for legumes such as soybeans and alfalfa. A group of microbes called Rhizobium bacteria naturally exist in the soil and have the ability to convert nitrogen to ammonium. However, these bacteria only do this when they infect legume roots to create nodules. In exchange for food from the host legume plant, the bacteria supply ammonium nitrogen for the plant which is further changed to plant protein. Because of this process, nitrogen fertilizer is seldom needed for legume crops.

Mineralization

Mineralization is a microbiological process that naturally occurs in soil through the decomposition of plant residues, soil organic matter and animal wastes. In mineralization the soil microbes convert proteins and other compounds containing nitrogen to ammonium. Note that the nitrogen is released, not created. Nitrogen is always present in the plant residue, but it is generally unavailable for crop use. Mineralization makes it possible for the plants to use this nitrogen. Mineralization can release as much as 100 pounds of usable nitrogen per acre per year under ideal conditions.

Nitrification

Nitrification is also a biological process that occurs in two steps. In mineralization, microbes change nitrogen to ammonium. In nitrification, however, microbes convert ammonium to nitrite and then into nitrate. This process happens quickly under warm, moist conditions. Therefore, you will rarely find high levels of ammonium in the soil unless the process has been inhibited by a nitrification inhibitor or by unfavorable air temperature, moisture, aeration and/or pH factors. Like fixation and mineralization, nitrification is a means of providing nitrogen for plant growth.

Summary

Although it is difficult to predict weather, plant decomposition, and other biological factors, doing so will enable you to create an effective nitrogen fertilizer program. Nitrogen gains can be significant. Therefore, after forecasting the natural gains of atmospheric fixation, biological fixation, nitrification and mineralization, it is wise to plan commercial (industrially fixed) nitrogen fertilizer use accordingly.