Nitrogen

Fundamentals:

- Elemental Form: Nitrogen (N)
- Plant Nutrient Form: elemental nitrogen (N)
- Plant Uptake Form: nitrate (NO_3^-) or ammonium (NH_4^+)

Importance and Roles in Plants:

Of the three macronutrients (the others are Potassium and Phosphorus), nitrogen is the main plant nutrient, the most well-known, and taken up by plants in the greatest amounts. It is used by plants in general for plant growth and is associated with size of plant parts. Nitrogen is necessary for the synthesis of chlorophyll, the molecule that is crucial to the process of photosynthesis. Nitrogen is also used to synthesize amino acids, which are then used to build plant proteins. It is also used by the plant in efficiency of water use.

Deficiency Symptoms:

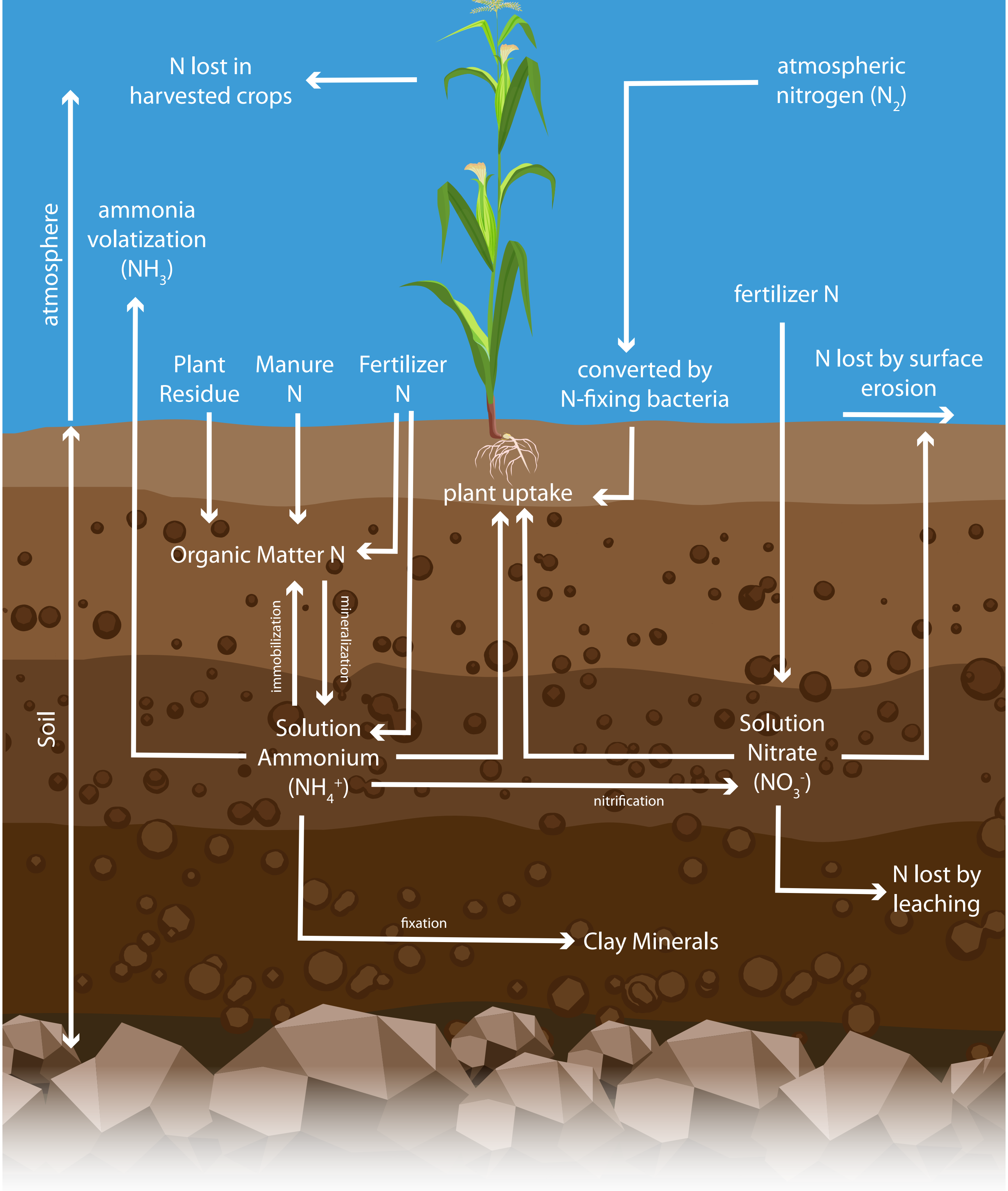
Most people have an idea that nitrogen helps plants grow big and the leaves dark green. Deficiency is the opposite. Nitrogen-starved plants have leaves that are, in general, small and stunted, and in colour pale, light green, perhaps yellowish, or chlorotic. A reddish-purple tinge is sometimes also associated with nitrogen deficiency as well as the typical chlorosis (see Diagrams 1 + 3).

To correct nitrogen deficiency, begin as always with a lab test. This is a good idea because deficiencies of some other nutrients are similar to nitrogen deficiency, in particular iron and sulphur. Take soil or tissue samples to the Plant Science Lab, at the TerraLink Abbotsford location. Unlike lab tests for many other nutrients, nitrogen can be tested very quickly so that you can react equally quickly with one or more corrective remedies. Make sure to ask an Agronomist at either the Abbotsford or Delta offices of TerraLink for advice. Two of our crops even have their very own lab tests to determine nitrogen deficiency. In silage corn, just prior to knee-high stage, you can bring samples to have a Pre-sidedress Nitrate Test done, so that you will know rapidly whether a sidedress application of nitrogen is sensible at this crop stage or not. After knee-high, the corn plants are usually too high to drive tractors and sidedressers through your field without causing damage. In raspberries, a Post-harvest Nitrate Test is equally as fast, to help you decide how to manage the amount of nitrogen remaining in your soil following harvest.

Diagram 1: Nitrogen deficiency in blueberries. Blueberry Nutrition Management. Strik, Bernadine. Oregon State University. 2011.

Nitrogen Fertilizers:

To help you with increasing soil nitrogen levels or to correct deficiency, TerraLink carries a wide range of suitable nitrogen fertilizers. We carry nitrogen in both "simple" ingredients and in high-nitrogen blends, in granular, wettable powder and liquid forms. Granular simples include 46-0-0 (urea), 21-0-0+24(S) (ammonium sulphate), stabilized nitrogen, polymer-coated urea and methylene urea. Liquid simples include 23-0-0 (liquid urea), Diagram 2: Nitrogen Cycle



UAN 32-0-0 (urea-ammonium nitrate) and Greenfeed 28-0-0 (liquid methylene urea). In both granular and liquid form, we stock high-nitrogen NPK blends for plant growth and size.

TerraLink is the western Canada representative for Plant-Prod Water Soluble Fertilizer. We carry many Plant-Prod blends that are high in nitrogen. If you are a greenhouse producer, check out our web site (www.tlhort.com) for soluble nitrogen simples such as 46-0-0 (greenhouse grade prilled urea), 34-0-0 (soluble ammonium nitrate), 21-0-0+24(S) (soluble ammonium sulphate), calcium nitrate and calcium-potassium nitrate.

If you are an organic producer, navigate our BioFert website for organic nitrogen fertilizers such as granulars 12-0-0 (Blood Meal) and 10-3-0 (Hi-N), or liquid organic nitrogen blends such as 3-1-2 (BioFish), 3-2-4 (Fruit & Berry), 3-1-4 (Tomato & Vegetable) and 3-1-5 (Lawn Food).

Behaviour in the Soil:

Both the negative ion nitrate (NO_3^-) and the positive ion ammonium (NH4+) exist dissolved in the soil solution at any time. Most plants predominantly take up nitrate but can also take up ammonium. An exception is Highbush blueberries, which have limited nitrate reductase activity (nitrate reductase is an enzyme that helps convert nitrate to amino acids, and thence to plant proteins), so although blueberries can take in nitrate nitrogen (NO_3^-), they cannot use it efficiently as a nutrient and depend primarily on ammonium nitrogen (NH_4^+). Accordingly, all TerraLink blueberry fertilizers are made with ammonium N.

As soil typically carries a net negative charge, anions (negative ions) tend to be very mobile within the soil, whereas cations (positive ions) are much less mobile, electrostatically clinging to cation exchange sites on clay or organic matter. Thus, nitrate is quite mobile and ammonium is not (the flip side of the coin is that nitrate, and any other anion for that matter, are much more likely to leach away and be lost). The implication for fertilizer application is that any nitrogen applied above the root

Diagram 3: Nitrogen Hunger in Corn

zone will have the ability to be driven down towards the roots. Compare this to nutrients that are relatively immobile in the soil (such as P and K), that must be fertilized as well as possible directly into the root zone.

Nitrogen is plant-available over a much greater range of acidity (soil pH) than, say, phosphorus. Nitrogen is available from about pH 5 through to well over pH 7.5. Conversely, nitrogen also affects soil acidity, an effect not known for other plant nutrients. In the naturally-occuring conversion of ammonium (NH_4^+) to nitrate (NO_3^-), hydrogen ions are released, which is one of the sources of soil acidity.

Interaction with other Nutrients:

Nitrogen interacts with some other nutrients in the soil. First, nitrogen can have a beneficial effect on phosphorus binding, also known as phosphorus fixation. When phosphorus is applied to soil, most of it becomes "fixed" or bound up by forming phosphorus-metal compounds. When ammonium (NH4+) is in high concentrations, it can retard phosphorus fixation.

Molybdenum can have an effect on nitrogen within plants. Molybdenum is a component in two enzymes that assist conversion of nitrate into nitrite, and thence into ammonium, which can then be used to build amino acids. When molybdenum is deficient this can slow the production of ammonium within the plant, simulating nitrogen deficiency. Molybdenum is also used by symbiotic bacteria in legumes that convert atmospheric nitrogen (N_2) to organic nitrogen forms within plants.

One of the most important nitrogen relationships is with carbon. In the soil, microbes that decompose organic material use much nitrogen in that process. When the carbon to nitrogen ratio is 15:1 or less, the soil can be thought of as "in balance". If, however the carbon to nitrogen ratio is more than 30:1, the microbes will use nitrogen in excess. This has a detrimental effect on the amount of plant-available nitrogen, resulting in possible nitrogen deficiency.

Nitrogen Cycling:

Unlike most other nutrients which originate from erosion of minerals in the Earth's rocky crust, nitrogen ultimately comes from the atmosphere, where most of the world's supply of nitrogen exists in one or more types of gaseous nitrogen (ex: N_2 or NH_3). See Diagram No. 2 for a simplified nitrogen cycle to refer to. Nitrogen enters the soil through four main ways: atmospheric N (primarily nitrogen gas or N_2) is converted to organic form within plants, by symbiotic bacteria that live on the roots of legumes and some other plants. Second, as plant matter dies and decomposes, whether from cover crops, weeds, shrubs and trees, it releases nitrogen into organic forms in the soil. Third, nitrogen from animal manure and decomposing animals is similarly released into the soil organic matter. And fourth, nitrogen from mineral and organic fertilizer enters the soil.

Some fertilizer nitrate N (NO_3^-) goes into soil solution. It can be taken up by plants in this form, or lost from the soil via surface run-off (erosion) or leaching. Alternately, some nitrogen fertilizer supplies ammonium N (NH_4^+) which can also exist in solution. From the soil solution, ammonium N is quite likely to quickly be taken up by plants, undergo a chemical process of nitrification (converts to nitrate N), undergo another chemical process of immobilization to convert it into an organic form, convert to ammonia gas and lost to the atmosphere or become attached to cation exchange sites in mineral clays. Nitrogen in the soil in organic form can also undergo mineralization, in which it can be converted back into ammonia N and again into the soil solution.

References:

Blueberry Nutrition Management. Strik, Bernadine. Oregon State University. 2011.

Soil Fertility Manual. International Plant Nutrition Institute, 2006.

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Fertilizing Blueberries, Spectrum Analysis. 2006