The Importance of "N" in Plants

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Nitrogen (N) is an essential macro element required for the success of all known life forms, including cannabis plants. N acts as a key catalyst to support photosynthesis and other important biochemical reactions required for healthy cannabis growth. For example, N is a key elemental component in chlorophyll—the biomolecule which allows plants to absorb energy from light (i.e., photosynthesis) to facilitate growth. Photosynthesis utilizes light energy to generate other N-containing molecules, including high energy chemical structures called adenosine triphosphate (ATP). ATP allows cells to conserve and use the energy released in metabolism to drive all the necessary biochemical reactions to support internal energy transfers—facilitating cellular division (i.e., growth) throughout the entire life cycle of the cannabis plant.

N is a significant component of nucleic acids such as DNA, the genetic material that allows plant cells to grow and reproduce. There are four main nitrogenous bases found in DNA: cytosine (C), adenine (A), guanine (G), and thymine (T). The double helix DNA molecular strands are linked together by these four nitrogenous bases via hydrogen bonds (Fig. 1). Adequate N availability is vital in order to maintain the cannabis plant's genetic integrity from one generation to the next. N is also a key component of amino acids, the building blocks of proteins. Proteins are used by plants to support plant cell structure. Other proteins are allocated to synthesize enzymes to facilitate the key biochemical reactions on which life is based. Healthy cannabis development is explicitly linked to its genetic make-up and enzymatically-facilitated biochemical reactions – which is dependent on sufficient plant N uptake.

Plant Nitrogen Uptake

Most plants take up nitrogen continuously throughout their lives, and plant nitrogen uptake usually increases as plants increase in size. Cannabis plants must establish an extensive root system to take up enough N for healthy growth – and plants with underdeveloped roots often show signs of nitrogen deficiency even when adequate nitrogen is present in the soil. A nitrogen-deficient cannabis plant will develop slowly because it cannot effectively manufacture structural and genetic materials required for growth. Nitrogen-deficient plants can appear pale green or yellowish because of inadequate chlorophyll development. Older fan leaves can also become necrotic as the plant reallocates N to meet demands for the newer growth.

Plant available nitrogen exists in three general forms: organic nitrogen compounds, ammonium (NH_4^+) ions and nitrate (NO_3^-) ions. However, the biogeochemical dynamics that occur belowground greatly differ between different N forms. For example, ammonium ions chemically bind to the negatively charged cation exchange in soil and other soilless media and behave like other positively charged elements (i.e. cations). Nitrate ions do not bind to the soil or media surfaces because they carry negative charges. Nitrate typically exists in solution (i.e. in dissolved form) where it will readily leach out or precipitate as salts in soil and soilless media. In both cases, soil microbes can be utilized to continually cycle and liberate inorganic nutrients back into plant available forms to significantly increase plant N uptake. In organic growing practices, up to 99 percent of the nitrogen that is potentially available to plants is bound in organic forms, either as 1) plant residues, 2) living soil organisms (such as soil bacteria and fungi), or 3) as more complex organic matter molecules. Organic nitrogen is not directly available to plants, and must be converted to plant available forms by microorganisms.

Microbial inoculants represent the next generation of green revolution technologies which will improve agriculture management across many crops to help farmers increase production. Harnessing the natural power of soil microbes in cannabis production can greatly increase plant nutrient uptake and thus maximize the phenotypic potential of the cannabis plant. Optimizing cannabis plant nutrient use efficiency (defined as yield per unit N input) is a challenge that most indoor and outdoor cannabis producers commonly face. The future success of cannabis productivity depends on innovative biological solutions to naturally and sustainably deliver nutrients to cannabis plants.