Nutrient Management – a crucial factor for crop production with higher productivity for food security

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Introduction:

It is the science and practice directed to link soil, crop, weather, and hydrologic factors with cultural, irrigation, and soil and water conservation practices to achieve optimal nutrient use efficiency, crop yields, crop quality, and economic returns, while reducing off-site transport of nutrients.It involves matching a specific field soil, climate, and crop management conditions to rate, source, timing, and place (commonly known as the 4R nutrient stewardship) of nutrient application.

Nutrient management is important for the following facts:

1. Nutrient management helps to reduce contamination to waterways by plant nutrients.
2. Improve the soil fertility.
3. Enhance the plant productivity.
4. Reduce the cost of chemical fertilizers.
5. Providing balanced nutrition to crops.
6. Promotes carbon sequestration and prevents the deterioration of soil, water, ecology, and also leaching of nutrients from the soil.

Important parameter for nutrient management

Fertilizer type: Important considerations are ratio of ammonium to nitrate-N, trace element charge, content of calcium and magnesium, and potential acidity or basicity. Ideally no more than 50 percent of the total nitrogen supplied to plants grown in soilless media should be in the ammonium form. Ammonium toxicity can occur in soilless media due to high levels of ammonium or urea fertilizer. The toxicity occurs on some plants when the soil is cool and waterlogged, when the ammonium is converted to ammonia.

Fertilizer rate: Traditionally fertilizer rate (ppm) has been the main focus of greenhouse fertilizer programs, but rate interacts with the other five factors on this list to determine the success of a fertility program.

Frequency of application: How many times water-soluble fertilizer is applied is often overlooked as a factor in developing a good fertilizer program. What does the term "constant liquid feed" (CLF) really mean - every watering, once a week, or twice a week? At a given ppm level, more frequent applications will lead to a higher fertility level simply because fertilizer is applied more often.

Volume of fertilizer solution applied: As the volume of water-soluble fertilizer increases the quantity of nutrients delivered to the plant also increases. Doubling the volume applied also doubles the amount of each nutrient potentially available to the plant.

Leaching fraction: Leaching fraction is the proportion of fertilizer solution or irrigation water applied that is lost from the plant container by leaching. The lower the leaching fraction, the greater the quantity of nutrients and salts retained in the growth medium. Leaching fraction is strongly affected by volume applied (i.e., factor 4). Avoiding excess leaching is critical to reducing both fertilizer costs and ground water contamination.

Plant growth rate and environmental conditions: In general, nutrient requirements of greenhouse crops are greatest during periods of rapid growth. Two major influences on growth rate are the inherent growth pattern followed by the plant and the environment in which it is grown. Too much fertilizer during slow growth periods may lead to excess soluble salts; failure to provide enough fertilizer during periods of rapid growth will lead to deficiency.

Potential Acidity and Basicity of Greenhouse Fertilizers

Fertilizers may raise or lower the pH of the growth medium. Fertilizers are rated as to their potential acidity or potential basicity. This value is determined largely by the amount and sources of nitrogen in a formula. Fertilizers that contain more urea and ammonical nitrogen are acidic in reaction, while those that contain primarily nitrate nitrogen are basic. The numbers used to express these potentials refer to the pounds of limestone (calcium carbonate) that it takes to either neutralize (potential acidity) or be equivalent in reaction to (potential basicity) on ton of that fertilizer. In theory, by alternating fertilizers, the medium pH should be able to be stabilized. In reality, the pH of the medium is a dynamic system and is influenced by many other factors such as irrigation water alkalinity, fungicide drenches and root exudates

Important nutrient management strategies

General Plant Nutrition

The 16 elements required by all plants are carbon (C), hydrogen (H), oxygen (O), phosphorus (P), potassium (K), nitrogen (N), sulfur (S), calcium (Ca), magnesium (Mg), iron (Fe), boron (B), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), and chlorine (Cl).The elements C, H, and O are supplied largely from air (carbon dioxide (CO_2) and oxygen), and water (H_2O). The nutrients N, P, K, S, Ca, and Mg are referred to as the macronutrients because they are required in larger quantities by the plant compared to the remaining elements. The other seven elements are referred to as micronutrients because they are required in small amounts, usually a few parts per million (ppm) in the plant tissue.

Phosphorus is absorbed as $H_2PO_4^{-1}$ or HPO_4^{-2} by an active energy-requiring process. P is very mobile in the plant. Deficiencies therefore show up on the older leaves of the plant because P is translocated out of these leaves to satisfy needs in the new growth. P deficiency shows up as stunting and a reddish coloration resulting from enhanced levels of anthocyanin pigments. Deficient leaves will have only about 0.1% P by dry matter. Normal most-recently-matured leaves of most vegetables will contain 0.25 to 0.6% P on a dry weight basis

Potassium is absorbed in large quantities by an active uptake process. Once in the plant, K is very mobile and is transported to young tissues rapidly. Deficiency symptoms for K show up first on lower leaves as a marginal flecking or mottling. Prolonged deficiency results in necrosis along the leaf margins and the plants can become slightly wilted. Deficient plant leaves usually contain less than 1.5% K.

Nitrogen can be absorbed by the plant in either the nitrate (NO_3) or ammonium (NH_4^+) forms. The NO_3 form is usually the preferred form in which to supply most N to greenhouse crops. The NH_4 form seems to be absorbed easier than NO_3 at cool temperatures (less than 55F). Uptake of $NH_4$is best at a media pH near neutrality with uptake reduced as pH is dropped.

Sulfur is absorbed mainly in the form of sulfate (SO_4). Sulfur is not very mobile in the plant so deficiency generally begins in the new growth. Deficiency symptoms consist of a general yellowing of the leaves. Deficiencies of N and S appear similar but N deficiency occurs on the lower leaves; S deficiency occurs on the upper leaves.
Calcium, unlike most elements, is absorbed and transported by a passive mechanism. The transpiration process of the plants is a large factor in the uptake of Ca. Once in the plant, calcium moves toward areas of high transpiration rate such as the rapidly expanding leaves.
.**Magnesium** is absorbed by the plant in lower quantities than Ca. The absorption of Mg is also highly affected by competing ions such as K, Ca, or NH_4. Unlike Ca, Mg is mobile in the plant and deficiencies appear first on the lower leaves.Mg is usually found in concentrations of 0.2% to 0.8% in normal leaves. Conditions that lead to deficiency include poorly designed fertilizer programs that supply too little Mg or ones that supply excess K, Ca, or NH_4.
Iron can be absorbed by an active process as Fe^{2+} or from iron chelates which are organic molecules containing iron sequestered within the molecule. Uptake of iron is highly dependent on the iron form and adequate uptake depends on the ability of the root to reduce
Manganese is absorbed as Mn^{2+} ions and the uptake is affected by other cations such as Ca and Mg. Manganese is relatively immobile in the plant and symptoms of deficiency show up on the upper leaves. Deficiency of Mn resembles that of Mg, however, Mg appears on the lower leaves of the plant. Mn deficiency consists of interveinal chlorosis; however the chlorosis is more speckled in appearance compared to magnesium deficiency. Normal concentrations of Mn in leaves ranges from 30 ppm to 125 ppm for most plants. High concentrations of Mn can be toxic to plants. Toxicity consists of marginal leaf necrosis in many plants. Concentrations of Mn on the order of 800 ppm to 1000 ppm can lead to toxicity in many crops. Excess Mn in the nutrient solution reduces uptake of Fe.
Zinc uptake is thought to be by an active process and can be affected by concentration of P in the media. Zn is not highly mobile in plants. Deficiency of Zn results in leaves with interveinal chlorosis. Sometimes Zn deficiency will lead to plants with shortened internodes. Normal leaves contain about 25 ppm to 50 ppm Zn. High concentrations of Zn can lead to toxicity where root growth is reduced and leaves are small and chlorotic. Zinc deficiency can

be increased by cold, wet growing media or by media with a very high pH or with excessive P.

Copper is absorbed by plants in very small quantities. The uptake process appears to be an active process and it is strongly affected by Zn and pH. Copper (Cu) is not highly mobile in plants but some Cu can be translocated from older to newer leaves. The normal level of Cu in plants is on the order of 5 to 20 ppm.Copper deficiency of young leaves leads to chlorosis and some elongation of the leaves. Excess copper, especially in acidic media, can be toxic.

Molybdenum is absorbed as molybdate MoO_4^{2-} and the uptake can be suppressed by sulfate. Tissue contents of Mo are usually less than 1 ppm.A deficiency of Mo first appears in the mid leaves and the older leaves. The leaves become chlorotic and the margins roll. Unlike other micronutrients, Mo deficiency occurs mostly under acidic conditions.

Boron uptake by plants is not well understood. Boron (B) is not mobile in the plant and seems to have many uptake and transport features in common with Ca.Boron deficiency affects the young growing points first, e.g., buds, leaf tips, and margins. Buds develop necrotic areas and leaf tips become chlorotic and eventually die. Tomato leaves and stems become brittle. Normal leaves contain 20 ppm to 40 ppm B while high levels may lead to toxicity. **Chlorine** deficiency is very rarely observed in crop plants. This is because Cl is needed in very small amounts and Cl is present in the environment in the fertilizers, water, air, and media.

Conclusion:

It is here by conclude that the nutrient management is very much crucial important factor for crop production with higher productivity so there for proper nutrient source with good physical condition material are applied for higher productivity in crop production and govt imitative with subsidy are considerable factor also farmer awareness programme .

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