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Plant nutrients in plant protection

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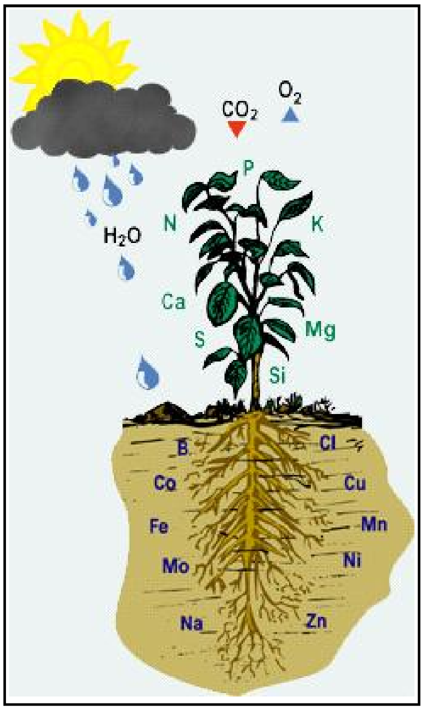
Nutrients are used to build and repair tissues, regulate body processes and are used as energy and overall growth and development of plant. In addition, plant diseases continue to play a major limiting role in agricultural production. The control of plant diseases using classical pesticides raises serious concerns about food safety, environmental quality and pesticide resistance, which have dictated the need for alternative pest management techniques.



Nutrients also play an important role in disease control has been recognized could affect the disease tolerance or resistance of plants to pathogens. The role of some nutrients and their importance in disease control discussed below.

Nitrogen:

The excess of nitrogen is one of the most common causes of excess disease (suppresses facultative and promotes obligate) pressure in agriculture today. In many instances, it is not only the excess, but mainly due to imbalance. Excess nitrogen is directly related to obligate types of parasitic fungi rust and powdery mildew. This excess leads abundance of low molecular weight compounds such as amino acids and sugars, with a lack of conversion of the compounds to more complex ones such as protein and starch. High levels of amino acids leads to prone for sucking insects such as aphids.

Nitrogen applications can also have an effect on soil borne pathogens such as take-all root rot disease in wheat and barley. This fungus as an optimal growth at pH 7.0 and higher, therefore is more of a problem on calcareous soils and is not a problem on acidic soils. Higher application of tends to result in lower silica contents simply because of the growth rate verses supply and the silica is diluted more. Also effect the production of phenolic compounds needed for lignin. However, facultative parasitic fungi and bacteria (fusarium and bacterial wilt) are actually suppressed by higher levels of nitrogen.

Phosphorus:

Plants need it for photosynthesis, respiration, energy storage and transfer, cell division and enlargement, and several other processes. Phosphorus promotes early root growth and development, hastens crop maturity, increases winter hardiness and improves crop quality. And it helps suppress plant disease, especially root diseases in wheat and barley.

Potassium:

Potassium to disease resistance in plants is much less complex than nitrogen. Increase rates of potassium availability have a positive suppression on both facultative & obligate fungi. High applications of potassium with low levels of calcium can increases the disease incidence. Higher applications of potassium during initial stage of crop commonly done. Especially in soils where the type of clay present is not effective in potassium absorption and release, resulting in potassium "luxury feeding, coupled with high N, fast growth and cool soil temperatures could very well result in low calcium and excess prone to disease.

Nitrogen promotes the production of amino acids and sugars and potassium plays an important role in the conversion of these low molecular weight compounds to stable, higher molecular weight compounds that have more to do with suppression of disease (required for the enzymatic conversion of simple sugars into starch) and also very important for the synthesis of protein. Lignin is another important component of cell wall structure to make a plant more resistant to disease.

Calcium:

Calcium is very important in a plant's ability to naturally suppress disease, however, as with most plant functions; these calcium mechanisms must also be supported. Most of the calcium found in plants cell wall. Plants which require large amounts of calcium (apples, tomatoes, potatoes) whereas dicots contain higher levels of calcium.

Powdery mildew is obligate, it can be suppressed by thick cell wall which act as a physical barrier and not allow the spore to enter into the cell. On the other hand, various facultative parasitic fungi, such as fusarium wilt, which enters through the xylem and dissolve the cell wall. Bacterial diseases such as bacterial leaf blight are capable of directly entering the plant through the stomata, therefore by passing the cuticle layer and the epidermal cells. However, bacterial disease infects the plant by producing polygalacturonases and pectolytic enzymes. Calcium is most effective in reducing the activity of these enzymes and also suppresses the bacterial infections by hypersensitive response to bacterial invasion, in that case the plant transfers the huge amounts of calcium from the apoplasm into the cytoplasm leading to nhanced K and H exchange results in acidification of the cytoplasm, leads to death of the host cells at infection sites. By this way the plant "sacrifices" a part of it to avoid and protect from disease spreading. This mode of action can also happen with various fungal parasites also.

Boron:

Boron is very important in the proper development of cell walls and the nutrient pipelines. In severely deficient plants the cell wall does not form properly as malformation can be seen. In relation to plant disease, boron plays an important role in the polymerization of galactomannans and other pectic substances, important calcium protected defense layer is produced by the presence of boron. It also plays a role in the production of phenolic compounds used in the production of lignin. Phenol production is very light sensitive, which means more light the more production and vice versa, however, this production is even more effective even at lower light conditions with adequate levels of boron (cloudy days).

It is know that grass species (wheat, etc.) contain higher levels of silica, whereas dicots contain higher levels of calcium. With respect to boron levels most of the grasses require from 5 to 10 ppm of boron, while dicots require from 20 to 70 ppm.

Copper:

The role of copper in disease suppression is twofold. First copper enters into the plant and become part of the biological system of the plant. Copper containing enzymes are important for the production of polyphenol compounds that are involved in lignin biosynthesis. Other compounds are also manufactured in the process; alkaloids, the formation of brown melanotic substance that are formed when tissues are wounded (*i.e.* apples and potatoes). These compounds can also act as phytoalexins, which inhibit spore germination and fungal growth. Second when used as fungicides, direct suppression of disease on the surface of the leaf when which is used in the form of fungicides. The disease causing organism lands on the surface of the leaf, though the Copper-based fungicides are insoluble and helps in effective control of fungi.

Silicon:

Certain plant species, especially grasses (wheat, rice etc.) have naturally higher levels of silica than plants, addition of silica to naturally low silica-containing plants such as grapes and cucumbers can also have a very positive effect in disease suppression. Silica works by forming a physical barrier in the epidermal cells against the penetration of fungalhyphae, or insects such as aphids. Silica not only acts as a physical barrier, but that in a soluble form it is thought that it aids in the translocation of phenolic compounds to the cell wall. A copper-containing enzyme is very important in the production of these phenolic compounds. Silica can be made available as much as required, but if this copper enzyme is low, phenolic compound production is low and therefore this mechanism is made less effective. There is evidence that silica can concentrate at points of disease entry. For example, in wheat tissue work, it has been demonstrated that 3 to 4 times the silica is present at the points of the leaf surface that mildew spores attack, verses levels where there is no mildew.

Silica does have its limitations, in that it is preferentially transferred in the xylem to mature leafs. Most disease attacks young growth because of an excess of low molecular weight compounds in the plant, lack of lignin formation and other factors. Also that once silica polymerizes it forms unexhangable compounds and cannot be retranslocated.

Conclusion:

Integrative plant nutrition is an essential component in sustainable agriculture, because in most cases it is more cost-effective and also eco-friendly to control plant disease with the adequate amount of nutrients and with no pesticides. Nutrients can reduce disease to an acceptable level, or at least to a level at which further control by other cultural practices are more successful and less expensive.

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