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# Role of Nutrients in Plant-Disease Interaction

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## Abstract

In recent years, the importance of sustainable horticulture has risen to become one of the most critical issues in the plant industry. Besides, plant diseases continue to play a significant limiting role in horticulture 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 could affect the disease tolerance or resistance of plants to pathogens. However, there are contradictory reports about the effect of nutrients on plant diseases and many factors that influence this response are not well understood. There is a difference in the response of obligate parasites to Nitrogen (N) supply, as when there is a high N level, there is an increase in the severity of the infection. In contrast, in facultative parasites at high N supply, there is a decrease in the severity of the infection. Potassium (K) decreases the susceptibility of host plants up to the optimal level for growth, and beyond this point, there is no further increase in resistance. In contrast to K, the role of Phosphorus (P) in resistance is variable and seemingly inconsistent. Among the micronutrients, Manganese (Mn) can control several diseases as Mn has an essential role in lignin biosynthesis, phenol biosynthesis, photosynthesis and several other functions. Zinc (Zn) was found to have several different effects as in some cases, it decreased, in others increased, and in a few, it did not affect plant susceptibility to diseases. Boron (B) was found to reduce the severity of many diseases because of the function that B has on the cell wall structure, plant membranes and plant metabolism. Calcium (Ca) application can enhance host plants' resistance to diseases. Silicon (Si) has been shown to control several diseases, and it is believed that Si creates a physical barrier which can restrict fungal hyphae penetration, or it may induce accumulation of antifungal compounds. Integrative plant nutrition is an essential component in sustainable horticulture. It can be a cost-effective and environmentally friendly way to control plant diseases 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 or conventional organic pesticides are more successful and less expensive.

## INTRODUCTION

Sustainable agriculture is the management and utilization of the agricultural ecosystem in a way that maintains its biological diversity, productivity, regeneration capacity, vitality and ability to function, so that it can fulfil - today and in the future - significant ecological, economic and social functions at the local, national and global levels while does not harm other ecosystems. Therefore, it is crucial to find alternative measures to control plant diseases which do not harm the environment and at the same time, increase yield and improve product quality. It is certain that the use of pesticides has stabilized our food supply and permitted millions of people to live longer lives. However, Heavy use of pesticides has been associated with degradation of the environmental resources and quality of water. There is also widespread public concern about the use of pesticides and their potential effect on our food. Therefore, planting resistant varieties in the first place and then growing healthy, strong plants will help to eliminate the usage of pesticide when it comes to plant-pest interaction.

## Role of Nutrients in Plant-Disease Interaction

### Nitrogen (N)

Nitrogen key role in driving growth, development and yield is well known. N has an important role in plant defense against pathogens. Lack of nitrogen shows up as overall yellow-green leaves instead of dark green. Nitrogen taken up by plants is used in the formation of amino acids which is the building block for proteins. Nitrogen is a structural component of chlorophyll.

Ammonium nutrition enhances the content of sugar and amino acids, thereby increasing the availability of nutrients to the invading pathogen Conversely, under $NO_3^-$ nutrition, increased resistance to the pathogen is observed. One of the reasons is polyamine production which is known to increase plant resistance.

### Phosphorus (P)

Phosphorus improves resistance and tolerance to fungal diseases. The protection that P provides is often related to its role in plant development. P is vital in early root development. The role that P plays in promoting rapid root development in young plants is well established. Especially under adverse or stressful conditions, early root development is essential.

One of the best defenses against root diseases is a robust and well-developed plant root system. P is the most beneficial when it is applied to control seedlings fungal diseases where vigorous root development permits plants to escape the disease condition.
It has been shown that phosphate fertilization of wheat can have a significant effect and almost eliminate economic losses from Pythium root rot. Foliar application of P can induce local and systemic protection against powdery mildew in cucumber, roses, wine grapes, mango and nectarines.

### Potassium (K)

When there is a lack of enough potassium in plants, low molecular weight compounds begin to accumulate. This accumulation of soluble nitrogen-containing compounds (such as amino acids and asparagine) and sugars (such as sucrose) make a particularly favourable environment for numerous pathogens and insects. For example, aphids are severely nitrogen-limited, making potassium stressed plants an attractive host as an abundant nitrogen source.

The presence of enough potassium also promotes the production of defensive compounds (such as phenols) which are an important component in plant pest resistance.

This results in more resources available for hardening cell walls and tissues to better resist the penetration of pathogens and insect pests and to repair any damaged tissues. Airborne pathogens are more rapidly shut out from stomatal invasion when adequate K is present.

**Iron (Fe)**

Iron is involved in the synthesis of chlorophyll, and it is essential for the maintenance of chloroplast structure and function. Fe is involved in chlorophyll synthesis, and it is essential for the maintenance of chloroplast structure and function. Fe works as a cofactor for enzymes involved in a wide variety of oxidation-reduction reactions (i.e., photosynthesis, respiration, hormone synthesis, DNA synthesis). This function makes Fe an essential nutrient, and its deficiency causes iron chlorosis, which significantly constrains normal plant development.

**Boron (B)**

Boron plays a direct role in the cell wall structure, and, thus, likely directly affects pathogen susceptibility. Besides, B plays an essential role in carbohydrate transport through the phloem. Low B can cause phloem to collapse and leaf veins to become "corky". In addition to its role in the cell wall structure and plant metabolism, B is known to be toxic to pathogenic fungi.

**Sulphur (S)**

In summary, Sulfur-containing metabolites that are supposed to be involved in pathogen resistance are glutathione, glucosinolates, the gaseous release of volatile S, phytoalexins, S-rich proteins, and the formation of elemental S.

The S status of the crop is affecting many different plant features such as colour and scent of flowers, pigments in leaves, metabolite concentrations and the release of gaseous S compounds which are directly influencing the desirability of a crop for a variety of different organisms from microorganisms, over insects.

**Manganese (Mn)**

Manganese is probably the most studied micronutrient about its effects on disease. It is essential in the development of resistance in plants to both root and foliar diseases Manganese is used in plants as a significant contributor to various biological systems including photosynthesis, respiration, and nitrogen assimilation. Manganese is also involved in pollen germination, pollen tube growth, root cell elongation and resistance to root pathogens. Manganese fertilization can control several pathogenic diseases such as powdery mildew, downy mildew, take-all, tan spot, and several others. Manganese controls lignin and suberin biosynthesis which Both are significant biochemical barriers to fungal since they are phenolic polymers resistant to enzymatic degradation.

**Fertilizers and Soil conditioners**

The following is technical information regarding products that improve the nutrition level of the plants and structure of the media. Application of these products results in a vigorous seedling which has excellent resistance to and abiotic, biotic stresses.

## ICL Fertilizers Products

**Start&Gro**

Start&Gro is the starter fertilizer offered by ICL Specialty Fertilizers for potted, bedding and all container nursery plants. Start&Gro is designed to be premixed in the substrate to fertilize crops for the first weeks of the cultivation. Useful features include Balanced NPK analysis, Free-flowing, Good mixability, 100% water-soluble, Not dusty, High chelated trace elements level.

### Osmocote Start

Osmocote Start offers a good fertilizer for annual plants with a short growth cycle, such as violets, primulas, impatiens and marigolds. It is also ideal for salt-sensitive vegetable crops and cuttings that have difficulty with rooting. Osmocote Start offers a good fertilizer program for annual plants with a short growth cycle, such as violets, primulas, impatiens and marigolds. Osmocote Start is also ideal for more salt-sensitive vegetable crops and cuttings that have more difficulty with rooting. In contrast with traditional fertilizers, Osmocote Start avoids the risks of an excessive salt level; your crop will always receive the right nutrients. The high potassium level of Osmocote Start ensures compact and even growth. Osmocote Start can be mixed with the growing media. Topdressing is possible as long as you ensure that no granules remain on the leaves. Safe to use, no salt stress, Better development of roots and crop colour. Features include Uniform release: 100% coated, very efficient due to greatly reduced leaching, no de-mixing of nutrients; every granule contains all the required elements, Easy to apply, dust-free.

### Osmoform NXT

Osmoform NXT is based on the new granulation technology SILK (silica-based), which includes slow-release nitrogen and potassium. The slow-release K is embedded in a 3-dimensional matrix, which slowly dissolves during the time. The product sticks to the surface of the growing medium, Quick plant reaction, strong greening up effect, very efficient nitrogen release, contains magnesium and trace elements with high iron content, Includes silicium for stronger plants, Long lasting effect up to 8-10 weeks, Easy application. Osmoform contains NPK, magnesium and a package of trace elements. The nitrogen composition is balanced to have a quick plant reaction after application and a long-lasting effect afterwards. Osmoform NXT contains 1.2 - 2.8 mm granules. And is developed for top-dressing applications in container nursery stock crops but can also be used for other purposes where a long-lasting effect of nitrogen and potassium is required. The nitrogen and potassium in the product are releasing over approximately 8-10 weeks after application—slow release of nitrogen and potassium, no loss of fertilizer when plants fall over. In the case of top dressing, it is essential to spread the amount of fertilizer evenly over the surface of the growing media. In case of the application over the plants, it is recommended to remove the granules from the leaves. Store under dry conditions. Partly used or damaged bags should be closed well.

## Grayson Smoke-based Products

### Smoke master

It triggers natural germination, through direct effects of heat in breaking seed-coat imposed dormancy. A relatively small number of investigations has indicated that products of fire rather than direct effects of heat may stimulate germination. Thus, water-soluble products of charred are promotive to germination of the native.

### Smoke water

Liquid smoke extracts are an important tool in the germination of many Australian native species. While the mechanism is unclear, the chemical signature of smoke (aqueous or otherwise) interacts with the seed structure to stimulate germination, possibly by signal molecules or by hormones. Some plant varieties remain dormant until exposed to smoke-based stimuli; a study indicated that smoke signatures are the most critical trigger to the germination rate and cumulative germination of several varieties of *Grevillea* seeds.

### Regen Shield

Liquid Smoke Condensate plus Polysorbate 80, Acetic Acid and Water (Acidic Smoke Extracts).

Smoke extracts may produce a natural barrier to the liverwort growth while acting to promote plant growth of desirable plant species. Spray applications of acidic smoke extracts (Regen Shield) seemed to demonstrate a benefit to the tested plants. However, the underlying processes that cause this benefit have not been discussed in the literature. Likewise, the mode of action on the liverwort is unknown.

## CONCLUSIONS

Nutrient management through amendment improved genetic efficiency, and modification of the environment is an essential cultural control for plant disease. Disease resistance is genetically controlled but mediated through physiological and biochemical processes interrelated with the nutritional status of the plant or pathogen. The nutritional status of a plant determines its histological or morphological structure and properties, and the function of tissues to hasten or slow penetration and pathogenesis. Various nutrients also condition pathogen virulence and their ability to survive; however, most nutrients influence disease potential more than inoculum potential.

The intricate relationship of the plant's nutritional status with plant pathogens, the abiotic environment and organisms in the environment is dynamic, and the severity of most diseases can be significantly decreased by proper nutrient management. Also, there are still some plant diseases where the efficiency of chemical fungicides is limited. For example, currently, no fungicides are available to control Verticillium wilt. Therefore, fertilizer strategies which improve the plants potential and resistance against fungal diseases are still of high importance. Knowledge of the relationship of plant nutrition to disease provides a basis for reducing disease severity in intense as well as integrated crop production systems.

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