

DOES NUTRITION HAVE AN EFFECT ON DISEASE MANAGEMENT?

Importance of plant nutrition

Nutrition, although frequently unrecognised, always has been a primary component of disease control and management¹. Early settlers moved onto fresh soils and as readily available nutrients were depleted, disease severity increased. Crop rotation and fallowing practises made crop production possible by increasing the supply of readily available nutrients and controlling weeds which competed for nutrients and water.

Nutrition of the plant can be drastically altered by many pathogens and it is frequently difficult to clearly differentiate between biotic and abiotic factors which interact to “cause” a nutrient deficiency or excess. All of the essential mineral elements are reported to influence disease incidence or severity^{2,3,4}. The effect of mineral nutrients on disease has been determined by three factors. These are through observing the effect of fertilisation on disease severity, comparing mineral concentrations in resistant and susceptible cultivars or tissues and through correlating conditions influencing mineral availability with disease incidence or severity and a combination of all three.

Researchers have been trying to find correlations between mineral nutrients and pest and disease management. Summaries of their finding all point in the one direction: plants with optimal nutritional status have the highest resistance to diseases and that susceptibility increases as nutritional status deviates from this optimum⁵.

The role of minerals

Fertiliser use at excessive rates has deleterious effects on crop growth as does a deficiency of an element. As regards to crop diseases, the most important impact is that of nitrogen which has an effect on vigour and plant growth. These two factors have an important impact on plant susceptibility to many diseases. Vigorous plants with rapid growth are generally more sensitive to obligate parasites and some pathogens are specifically more aggressive towards vigorous plants. However, most of the necrotic pathogens attack less vigorous plants with nitrogen deficiency. Therefore either having high levels of Nitrogen or low levels of Nitrogen can both be detrimental to plant health and crop yields.

Phosphorous application seems to favour plant protection against diseases, either by correcting a deficiency in soil Phosphorous, and thereby inducing better growth of the plant, or by speeding up the maturation process, disfavouring some pathogens like Downey mildew that affects the young tissues.

Potassium can increase the efficiency of use of other nutrients by plants, particularly of Nitrogen. Potassium has a beneficial effect on the quality of a wide range of crops, especially in terms of improved protein quantity and quality. Potassium can decrease the incidence of plant diseases and reduce abiotic stresses, particularly cold stress. The element may have a direct action on pathogen penetration, lesion size and on inoculum density. An indirect effect of Potassium on disease development is to stimulate the healing process (interaction with the scar parasites), to increase the resistance to cold, and also to delay maturity and senescence of fruits. In an even more simple fashion, susceptibility of plants to diseases decreases in response to Potassium in the same way plant growth responds to increasing Potassium supply⁶.

Calcium may have an effect on the cell wall of plants by making them more resistant to pathogen penetration. A deficiency in Calcium increases the sensitivity of plants to many fungi as these fungi find it easy to penetrate cells deficient in calcium. It is more apparent with an element such as Calcium that the nutrient deficiency triggers an abnormality in the plant and the fungal infection is a secondary

event. Further to this, plant tissues low in Calcium are much more susceptible than tissues with normal Calcium levels to parasitic diseases before harvest (Botrytis) and during storage (fruit rots)⁶.

With a Zinc deficiency, a leakage of sugars onto the surface of leaves increases the severity of infections of powdery mildew. This does not mean however that Zinc is a cure for powdery mildew; however Zinc applications can reduce the severity of such pathogens. The same applies to Boron as Boron deficient plants are more susceptible to powdery mildew and the fungus also spreads more rapidly over the plant.

Copper has been extensively used as a fungicide, but the amounts required are at least 10 – 100 times higher⁶ than those required by the plants and that are used, for example, as foliar sprays to correct a Copper deficiency. Manganese appears to directly affect the pathogen.

The mineral approach

One definition of balanced nutrition/ fertilisation is “the nutrient mix which gives the optimum economic return”. If any nutrient, whether a major nutrient or a micro-nutrient is deficient, crop growth is likely to be affected. The use of target minerals to supply the necessary elements to plant parts in order to overcome certain nutrient deficiencies is critical in crop production and through the use of soil and leaf analysis, growers can gain a better understanding of these nutrient interactions and help improve crop health as well as yields and productivity. Therefore using leaf analysis and tailored fertiliser programs encompassing soil and foliar applied minerals becomes a proactive strategy in reducing pest and disease attack and hence may reduce the requirements for hefty chemical bills.

It is important not to underestimate the importance each mineral has on crop health, pest and disease management as well as crop productivity. Fertilisers are the most underestimated component of budgets and when there is a budget cut, fertiliser applications are the first to be reduced. However all the overwhelming evidence proves the importance of minerals and fertilisers in plant growth, health and productivity. The best way to fight plant and soil diseases are to put the health of the plant first and combat pests and diseases second, the concept being healthy soil and finely tuned foliar supplements offer the fastest safeguard to increase the resistance of healthy plants to parasite attack.

Summary

It is now evident through all the data collated over many decades that plant nutrition has a primary effect on disease management. The dual benefits of fertiliser applications with regards to improvement in production as well as improved disease resistance appears to highlight the increased advantages in using foliar fertilisers and reallocating funds in farm budgets to ensure that fertiliser applications are fundamental aspects of vineyard and orchard management.

If fertilisers did not have any impact on pests and diseases, then why do growers constantly use Copper Zinc and Manganese containing products to control diseases in the vineyard or orchard and why is phosphorous acid (containing Potassium and Phosphorous) used to control and manage Pythium, Phytophthora and Downy mildew? And why is Calcium the primary mineral responsible for the reduction of Erwinia in vegetable crops and Botrytis incidence in wine grapes?

Perhaps it is important to revisit farm fertiliser budgets and review the true necessity for huge chemical budgets.

References

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