# MICRONUTRIENTS AND PLANT DISEASE

**Forget the simple solution! This will take planning. Seeding date, tillage and seedbed preparation, soil pH, crop rotation, and moisture regulation can all have an effect on disease by regulating the availability of macro- and micronutrients required for disease resistance.**

*By Dr. Don M. Huber*

PROPER nutrition is as important for a plant to combat disease as it is for humans to maintain health. Diseases not only reduce the efficient use of nutrients by plants, but are generally more severe when plants are nutritionally deficient. Although we generally think of disease control as an action against the causal agent of disease (pathogen), in practice, many of the recommended controls for plant disease act by improving the nutrient status of the plant so it is actually more resistant to disease.

**Disease is the result** of interactions involving the plant, the pathogen (disease-causing agent), and the environment (moisture, temperature, nutrients, etc.). Whether a disease is latent or severe depends on the specific interaction of these factors.

All of these individual factors are influenced by, and also influence, the availability of specific essential mineral nutrients. One of the best understood diseases in this regard is the root, crown, and foot rot disease of cereal crops known as 'take-all.'

**Take-all is caused** by a soilborne fungus, *Gaeumannomyces graminis,* and is the most serious disease of wheat and barley world-wide. Since genetic resistance and chemical controls have not been available to control 'take-all,' research for the past 100 years has focused on numerous cultural conditions which can be used to manage this disease. The underlying mechanism of control common to all of these cultural practices is the increased availability of specific micronutrients (e.g. Mn) essential for the plants' active defense against the pathogen (disease resistance).

Such diverse recommendations as oats preceding wheat in the rotation, a firm seed bed, planting date, and the form of nitrogen fertilization all increase the availability and plant uptake of manganese. Manganese availability and uptake is required for the plant to maintain the physiologic barriers to penetration which are characteristic of resistance to the fungus causing the 'take-all' disease.

A simple solution to this disease would appear to be the application of a manganese fertilizer. But soil-applied manganese fertilizers are not generally efficient because of microbial oxidation which renders them unavailable for plant uptake.

Foliage sprays of manganese are used to overcome most above-ground deficiency symptoms; however, foliage-applied manganese is not moved into the root system so resistance to a root or crown rot is not improved.

**The take-all fungus** is able to immobilize manganese in the root zone by oxidizing it to the form which is not available for plant uptake.

The nutritional availability of manganese can be enhanced by various cultural practices. Manganese oxidizing bacteria in the root zone are suppressed by most oat varieties. The reduced take-all of wheat or barley after oats reflects this. If the root (soil) environment is made more acid, as through the plant uptake of ammonium nitrogen, there may still be adequate, although reduced, manganese available for plant uptake in spite of the pathogen.

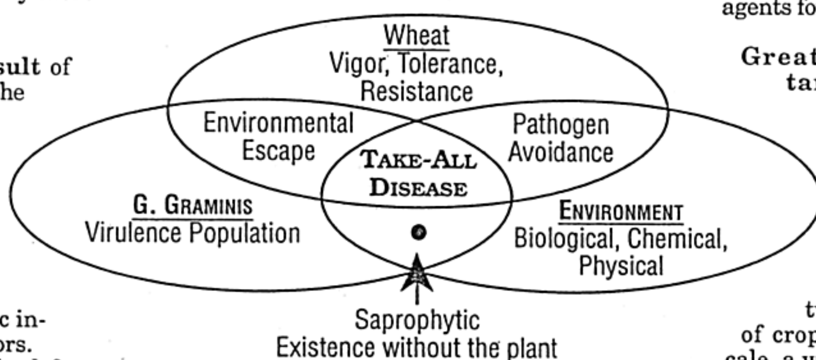
Some soil bacteria can reduce manganese to the plant available form, and several have been identified which prevent the fungus from oxidizing manganese in the root zone. These are being studied as potential biological control agents for take-all.

**Greater genetic resistance** to take-all may someday be developed. This may be possible through breeding programs where genes controlling these factors can be transferred between different species of crops such as with triticale, a wheat-rye cross.

**The probability and ease** of such genetic manipulation is increasing through techniques of genetic engineering.

With the recognition of the role of nutrition in the mechanism of disease control, we can anticipate the development of increased genetic resistance, improved cultural controls, and more effective biological controls of take-all. AGC

**WHETHER A DISEASE IS LATENT OR SEVERE DEPENDS ON THE INTERACTION OF THESE FACTORS**




*You can modify soil environment. Planting into a firm, compared to a loose, seedbed can increase the amount of manganese taken up by a plant by 8-15 ppm.*

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