Teff Compendium

Nutrient deficiency symptoms

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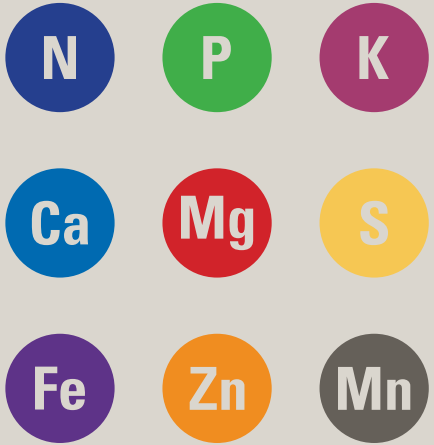
Experimental design

The experiment was conducted in a green house in 3 liter pots, filled with perlite. Each nutrient was tested in three levels: zero, low and optimal level.

The treatments were based on the nutrient omission method where all but one nutrient was omitted at a time. The nutrients that were tested were N, P, K, S, Ca, Mg, Fe, Zn, Mn, Mo and Cu.

The application rates of each nutrient were none or "zero concentration" of the tested nutrient, "low concentration" – contains 10% of what is considered adequate concentration of the tested element – and adequate "optimal concentration" of the tested element.

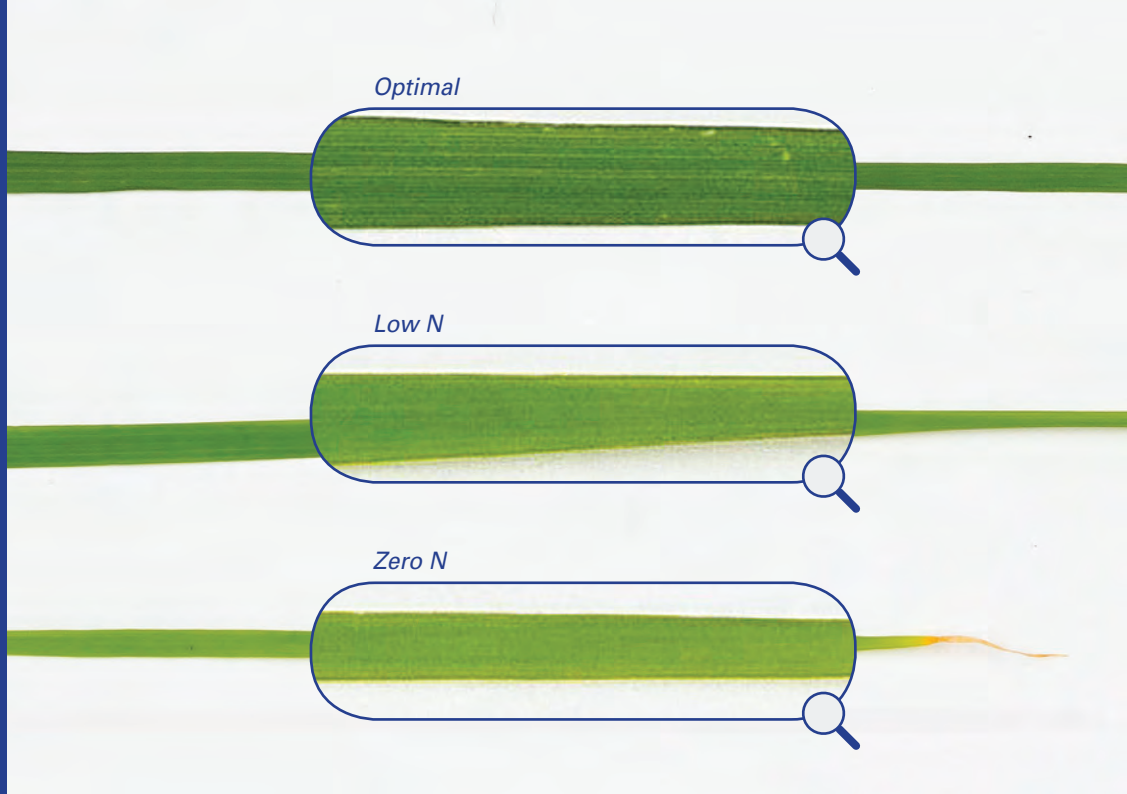
The optimal nutrient solution was derived from the original protocol developed by Hoagland and Arnon (1938), where a typical growth solution consisting of the essential macro-elements: N, K, P, Ca, Mg and S; and micro-elements: a soluble form of Fe, B, Cu, Mn, Ni, Zn, Mo, Cl.



N

Nitrogen (N) general deficiency symptoms

Older leaves, generally at the bottom of the plant, will yellow; other foliage is often light green. Stems may also yellow and become spindly.



N

Nitrogen (N) is an essential element of living cells and a component in proteins, enzymes and the metabolic processes involved in the synthesis and transfer of energy. Nitrogen, a key element of chlorophyll, helps plants with rapid growth, increasing seed and fruit production, and improving the quality of leaf and forage crops.

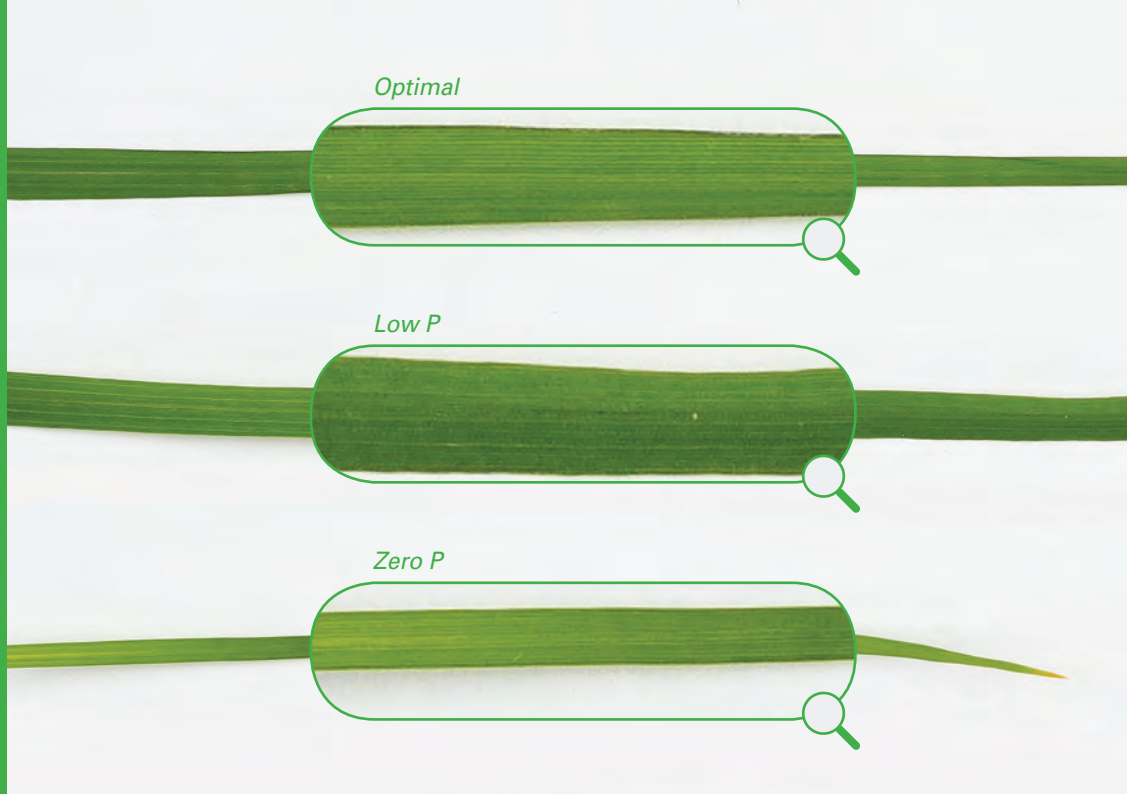
Zero N

Optimal

P

Phosphorus (P) general deficiency symptoms

Small leaves may take on a reddish-purple tint; leaf tips can look burnt and older leaves become almost black.



P

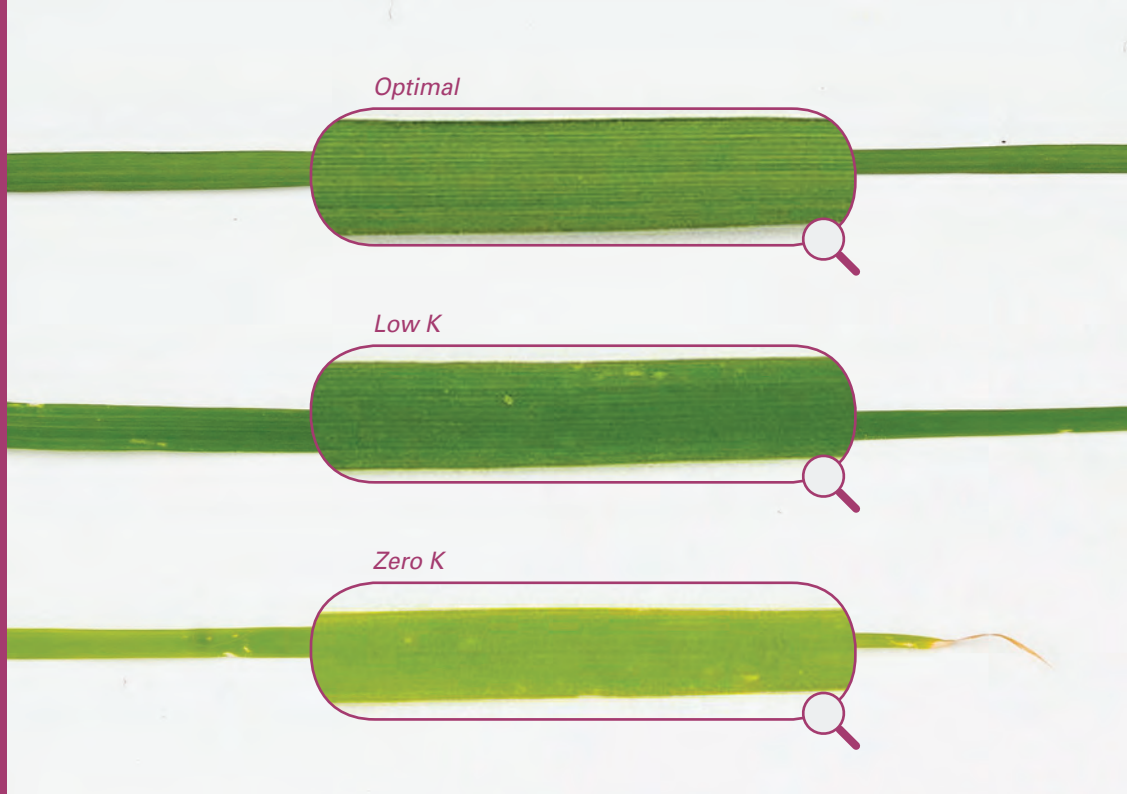
Phosphorus (P) is an essential element in the photosynthesis process. Phosphorus is a vital component of DNA and ATP. It helps with proper plant maturation, withstanding stress, blooming, root growth, and is involved in the formation of oils, sugars and starches.

Zero P *Optimal*

K

Potassium (K) general deficiency symptoms

Older leaves may look scorched around the edges and/or wilted. Interveinal chlorosis (yellowing between the leaf veins) develops.



K

Potassium (K) is absorbed by plants in larger amounts than any other mineral element except nitrogen and, in some cases, calcium. Potassium is essential in nearly all processes needed to sustain plant growth and reproduction. It helps in the building of protein, photosynthesis, the fruit quality and reduction of diseases. Potassium gives resistance to drought, excess water, and high and low temperatures.

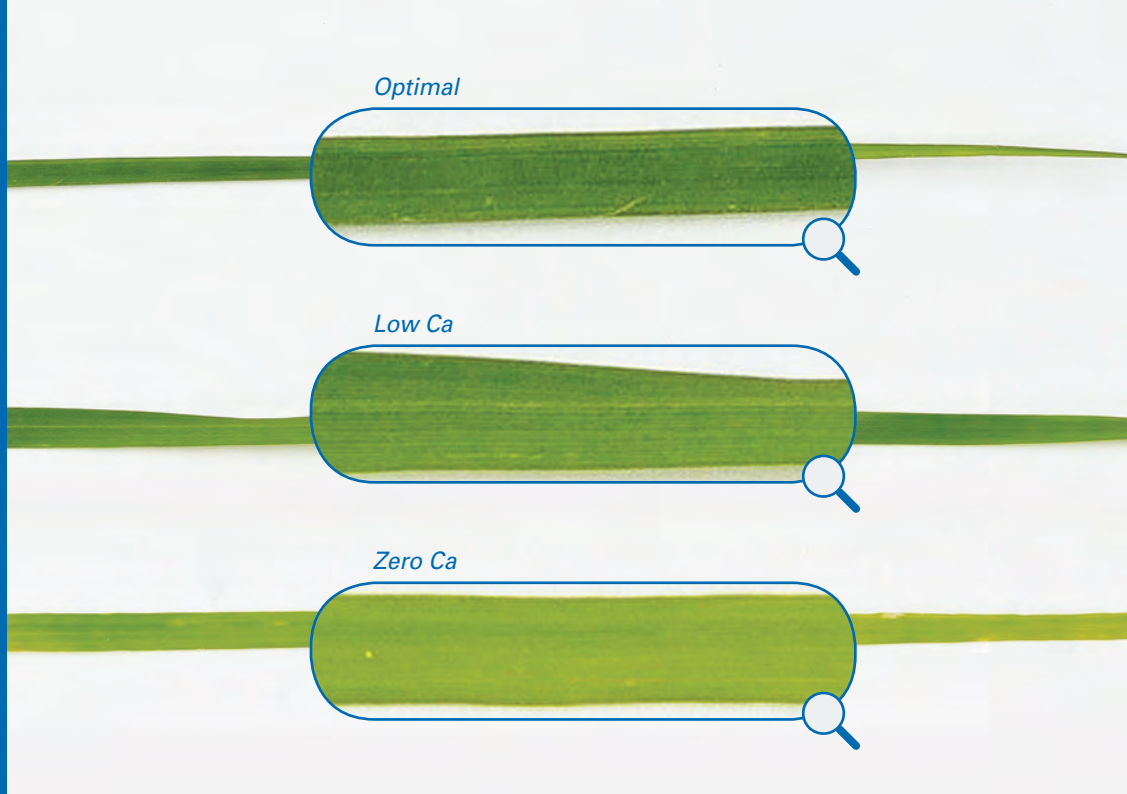
Zero K

Optimal

Ca

Calcium (Ca) general deficiency symptoms

New leaves are distorted or hook-shaped. The growing tip may die. Contributes to blossom end rot in tomatoes, tip burn of cabbage and brown/black heart of escarole & celery.



Ca

A secondary nutrient, **calcium (Ca)** is needed for cell wall development and growth. Plants need calcium for enzyme activity, metabolism, and for nitrate (a useable form of nitrogen) uptake. Calcium improves the absorption of other nutrients by roots and their translocation within the plant. It also improves disease resistance.

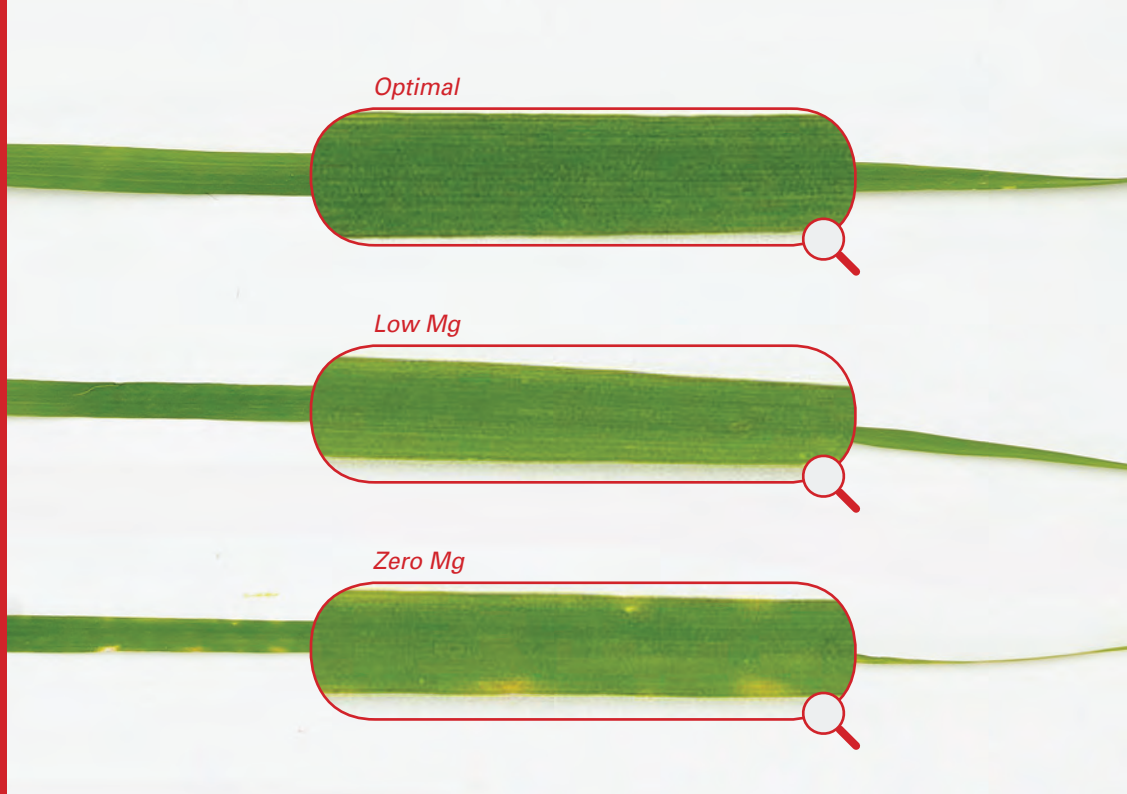
Zero Ca

Optimal

Mg

Magnesium (Mg) general deficiency symptoms

Slow growth and leaves turn pale yellow, sometimes just on the outer edges. New growth may be yellow with dark spots.



Mg

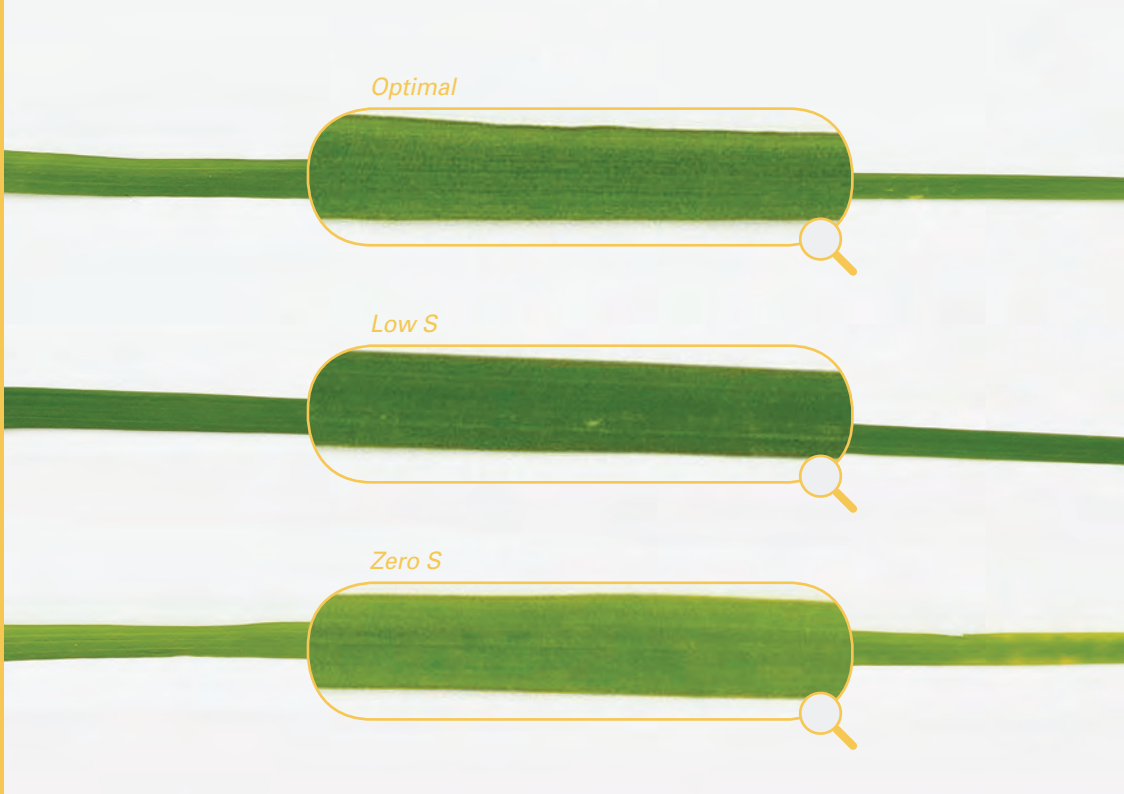
A secondary nutrient, **magnesium (Mg)** is an element of chlorophyll in all green plants and is essential for photosynthesis and protein formation. It helps activate many plant enzymes needed for growth. Magnesium is essential for phosphate metabolism, acting as a phosphorus carrier in plants and is necessary for cell division.

Zero Mg *Optimal*

S

Sulfur (S) general deficiency symptoms

New growth turns pale yellow, older growth stays green. Growth is stunted. Shoot tips stay alive; light green upper leaves; leaf veins lighter than surrounding areas.



S

A secondary nutrient, **sulfur (S)** is essential for protein production and the nitrate-reductase process, during which nitrate-nitrogen is converted to amino acids. Sulfur promotes activity and the development of enzymes and vitamins. It also helps in chlorophyll formation, improves root growth and seed production, and helps with vigorous plant growth and resistance to cold.

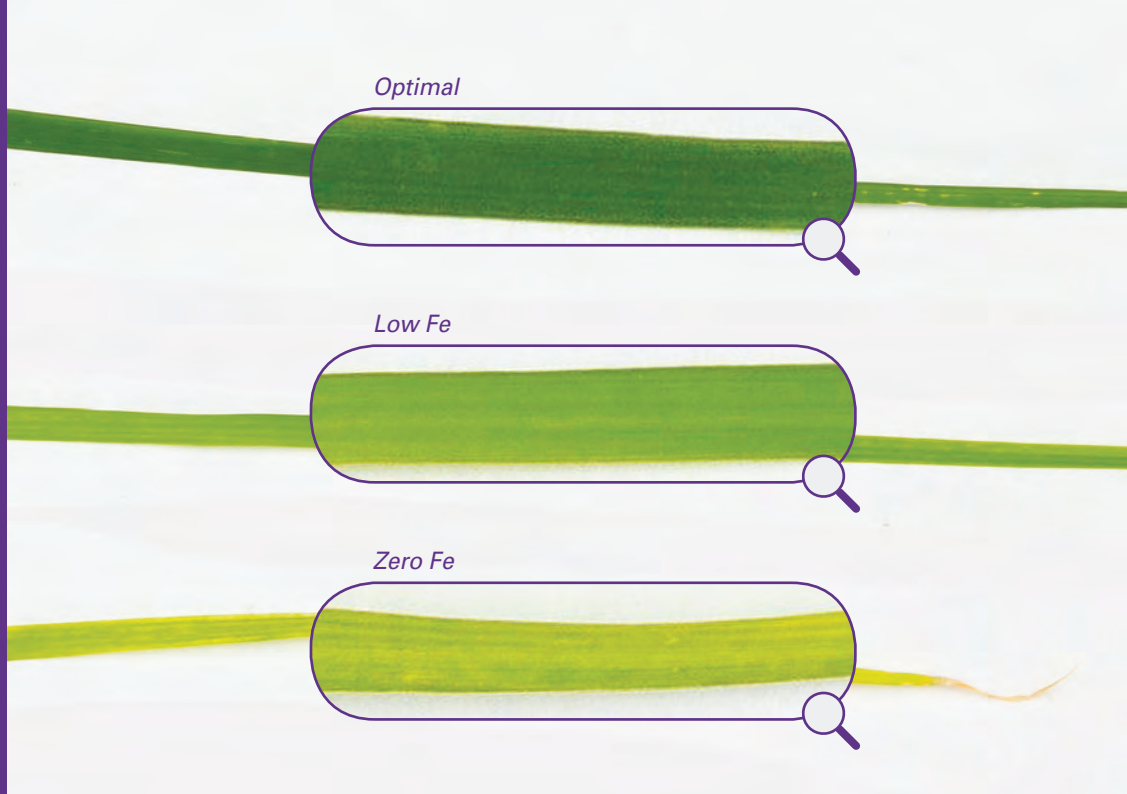
Zero S

Optimal

Fe

Iron (Fe) general deficiency symptoms

Shoot tips stay alive; new upper leaves turn yellow between veins (large veins remain green); edges and tips of leaves may die.



Fe

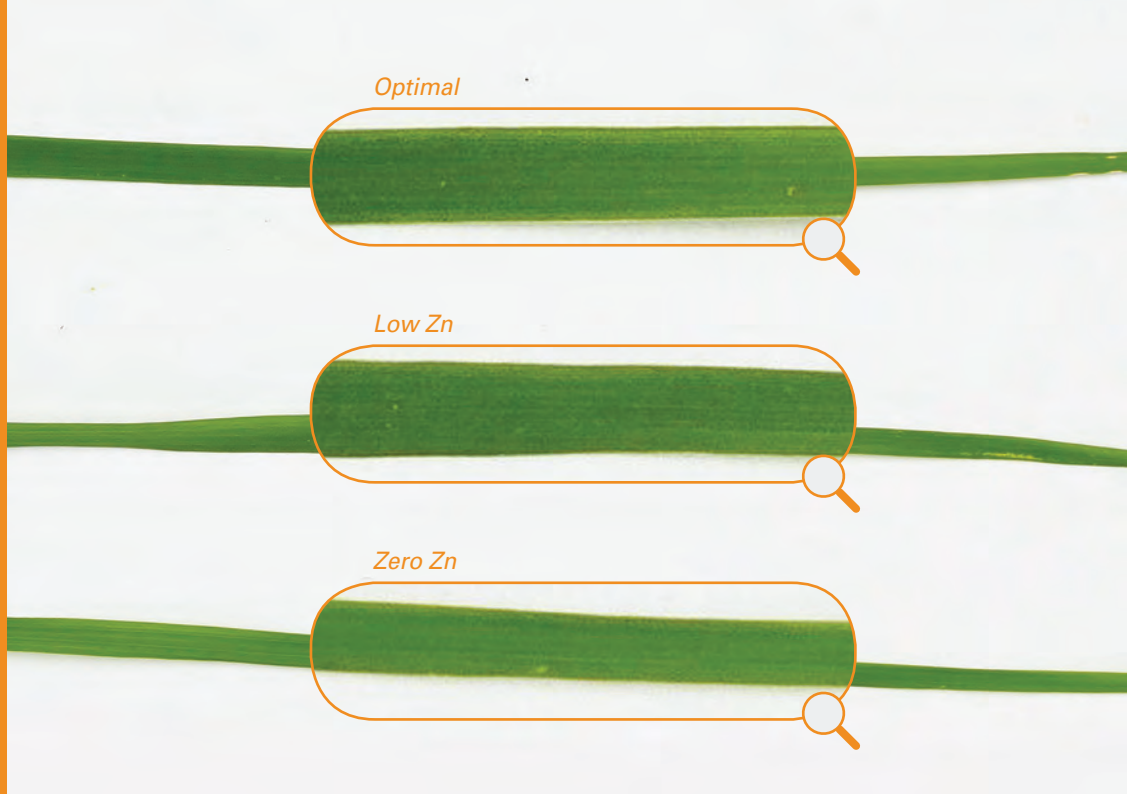
A micronutrient, **iron (Fe)** is essential for chlorophyll and lignin formation. Iron is a component of many enzymes associated with energy transfer, nitrogen reduction and fixation.

Zero Fe *Optimal*

Zn

Zinc (Zn) general deficiency symptoms

Yellowing between veins of new growth. Terminal (end) leaves may form a rosette.



Zn

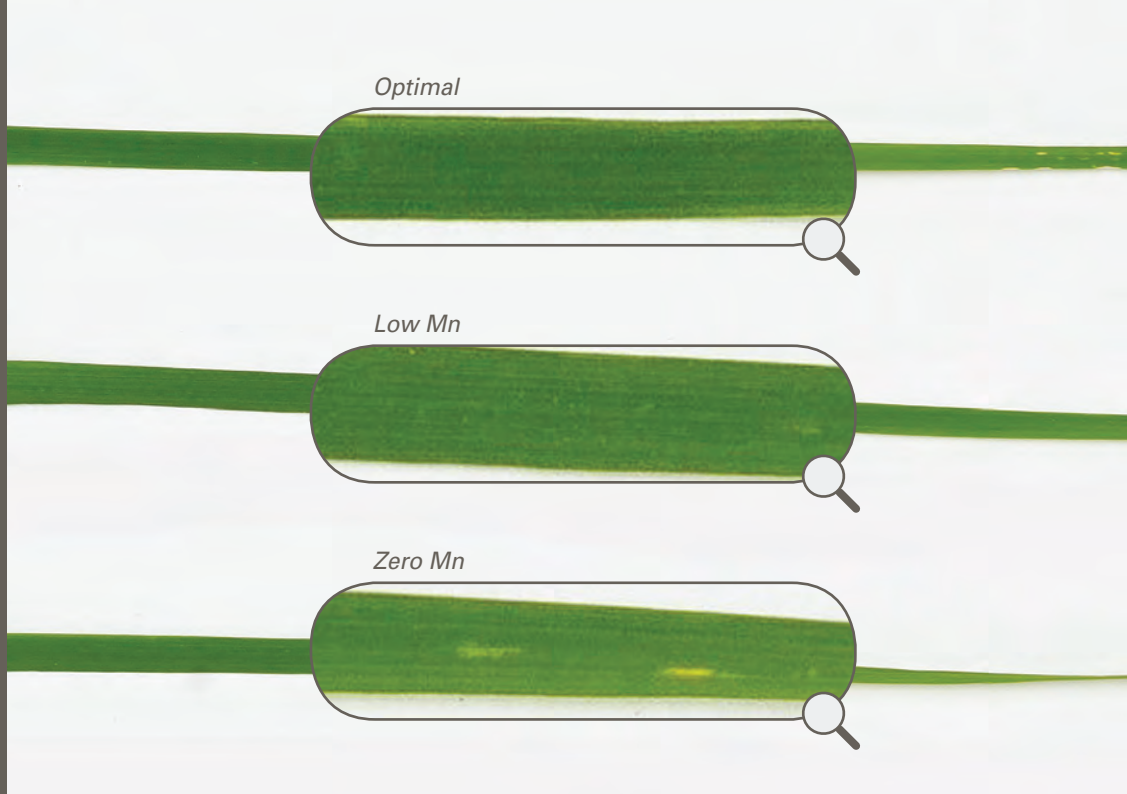
A micronutrient, **zinc (Zn)** is essential in the transformation of carbohydrates and it regulates absorption of sugars. Zinc is involved in the enzyme system that regulates plant growth.

Zero Zn *Optimal*

Mn

Manganese (Mn) general deficiency symptoms

Growth slows. Younger leaves turn pale yellow, often starting between veins. May develop dark or dead spots. Leaves, shoots and fruit are diminished in size. Failure to bloom.



Mn

A micronutrient, **manganese (Mn)** functions with enzyme systems involved in the breakdown of carbohydrates and nitrogen metabolism.

Zero Mn

Optimal

This work, funded by the International Potash Institute (IPI), Switzerland, was executed at the CFPN by Mr. Fanosie Mekonen as part of his MSc thesis, titled "Response of teff (Eragrostis teff Zucc. Trotter) to nutrient stress and potassium fertilizer application under greenhouse and field conditions," submitted to the College of Agriculture, Hawassa University, Ethiopia.

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International Potash Institute (IPI) is a non-governmental and non-profit organization based in Zug, Switzerland. Founded in 1952 by German and French potash producers, it is now supported by potash producers in Europe and the Near East. IPI is governed by a Technical Secretariat and Board which convene several times each year. A major part of IPI's work is carried out by its team of field agronomists, or coordinators, who work closely with researchers, government offices, extension and agribusinesses around the world. IPI's mission is to develop and promote balanced fertilization for higher yields and more nutritious food, ensuring sustainable production through the conservation of soil fertility for future generations.

The Israeli-based Center for Fertilization and Plant Nutrition (CFPN) is dedicated to improving global food security by researching fertilizers and plant nutrition. Established under a cooperation agreement between the Israeli Agricultural Research Organization (ARO) and ICL, CFPN is developing advanced solutions for fertilization and plant nutrition to enable farmers to manage fertilizer sustainably.

For more information please visit www.cfpn.center

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