Description of Magnesium

- essential nutrient
- \( \text{Mg}^{2+} \) soluble form
Plant Use of Magnesium

- harvests solar energy and drives photochemistry
- building block of chlorophyll
- essential for the metabolism of carbohydrates
- enzyme activator in the synthesis of nucleic acids (DNA and RNA) and during Calvin cycle
- regulates uptake of the other essential elements
- serves as a carrier of phosphate compounds throughout the plant
- enhances the production of oils and fats
- activates protein complexes by binding to sites
- plays a role in energy balance contributing to ADP and ATP structure
Symptoms of Deficiency

- The predominant symptom is **interveinal chlorosis** (dark green veins with yellow areas between the veins).
  - The bottom (older) leaves are always affected first.
  - As the deficiency becomes more acute, the symptoms progress up the plant.
- Chlorotic leaves generally turn red and then develop spotted necrotic areas
- Decrease in overall biomass
Symptoms of Deficiency

- Iron deficiency also causes chlorosis - but in newer leaves
- Potassium deficiency also causes chlorosis and necrosis but along edges of leaves so they curl
- Magnesium deficiency causes chlorosis and necrosis starting with the oldest leaves

http://mygarden.rhs.org.uk/

How Plants Access Magnesium

- Magnesium uptake by plants occurs as $\text{Mg}^{2+}$ (soluble) from soil solution
  - diffusion from high to low concentrations
  - Effects on uptake of $\text{Mg}^{2+}$
    - low soil pH
    - moisture of soil
    - temperature
    - light intensity
    - levels of competing minerals (e.g. Ca, K)
How Plants Access Magnesium

- Genes discovered to regulate transporters and partitioning of Mg$^{2+}$.
- Concentration of exchangeable Mg in soil.
Conditions Affecting Plant Uptake

- Deficiencies occur mainly on sandy acid soils in high rainfall areas, which are subject to leaching
- Heavy applications of potassium in fertilizers
- Magnesium deficiency can be overcome with dolomite (a mixed magnesium-calcium carbonate), magnesite (magnesium oxide) or epsom salts (magnesium sulfate)
**Solutions to Magnesium Deficiency**

<table>
<thead>
<tr>
<th>Material</th>
<th>Chemical formula</th>
<th>Percent Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dolomitic lime</td>
<td>$\text{CO}_3 + \text{MgCO}_3$</td>
<td>8-20%</td>
</tr>
<tr>
<td>Epsom salts</td>
<td>$\text{MgSO}_4 + 7\text{H}_2\text{O}$</td>
<td>10%</td>
</tr>
<tr>
<td>Potassium magnesium sulfate</td>
<td>$\text{K}_2\text{SO}_4 + 2\text{MgSO}_4$</td>
<td>11%</td>
</tr>
</tbody>
</table>

- **Cheaper solution**
  - Dolomitic lime can be added to correct soil pH
- **More expensive solution**
  - Apply soluble Mg$^{2+}$
Minerals are returned to soil when the leaves and branches fall to the ground and decay, thereby completing one of the earth’s most important natural services. Prior to falling to the ground, leaves will yellow as some nutrients (including nitrogen, potassium, and magnesium) are released from their bound form in protein, chlorophyll, and other molecules and transferred to the plants new growth areas for reuse.

- allow yellow leaves to remain on the plant for a few days for the maximum transfer of nutrients
- do not remove all leaf litter from the soil around outdoor plants so that nutrients can be recycled
Mutualistic Relationship for Increased Availability

- Increasing Magnesium supplement to livestock diet and allowing manure to fertilize the soil


