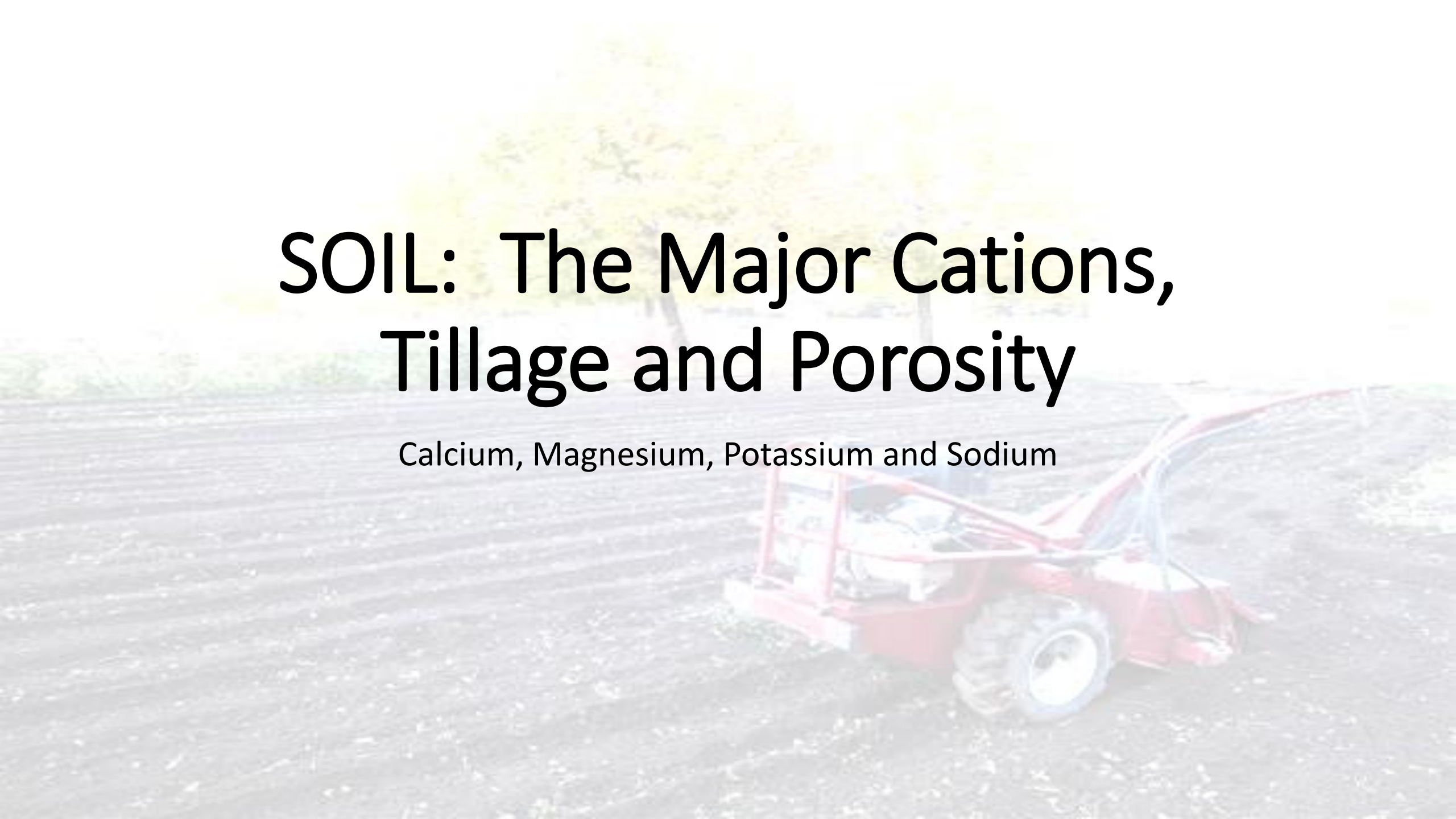
SOIL: The Major Cations, Tillage and Porosity

Calcium, Magnesium, Potassium and Sodium



Calcium – Ca++

Roles

- Cell wall construction
- Cell division
- Cell membrane function and material transfer in and out of cells
- Soil structure
- Immobile

Calcium – Ca++

Deficiency

- Terminal buds die
- Young leaves hooked
- Blossom end rot on fruit

Excess

- Tie up off other nutrients
- Symptoms of other nutrient deficiencies

Calcium – Ca++

Sources

- High Calcium lime – ~30-38% Ca, minimal Mg
- Dolomite lime – ~20-24% Ca, ~10-12% Mg
- Gypsum - ~22-24% Ca, ~15-18% Sulfur
- Marl - ~30-38% Ca + clay impurities
- Oyster shell lime – ~30-38% Ca
- Rock Phosphates - ~ 20 Ca, ~20% P
- Layer manure - Variable
- Industrial byproducts – Variable (i.e. kiln dust, sugar beet waste)

Magnesium – Mg++

Roles

- Part of the chlorophyll molecule
- Actively involved in photosynthesis
- Aids in Phosphate metabolism
- Activates several enzyme systems
- Soil Structure
- mobile

Magnesium – Mg++

Deficiency

- Yellowing/mottling of older leaves

Excess

- Can be similar to deficiency symptoms

Magnesium – Mg++

Sources

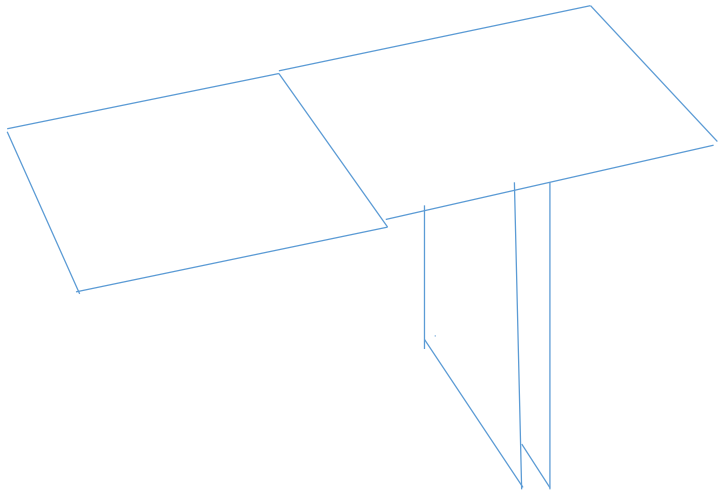
- Dolomite lime - ~20-24% Ca, ~10-12% Mg
- Sul-Po-Mag/K-Mag – 22% K_2O, 11% Mg, 20-22% S
- Magnesium Sulfate – ~9-11% Mg, 11-14% S

The 1:1 Relationship of Ca & Mg

Soil Structure

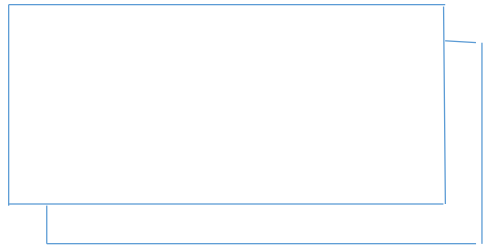
Calcium

- Flocculates the soil colloids
- Increases pore space



Magnesium

- Aggregates the soil colloids
- Decreases pore space



Potassium – K+

Roles

- Processes that produce stalk strength
- Regulation of leaf transpiration and gas exchange
- Water use efficiency
- Winter hardiness
- mobile

Potassium – K+

Deficiency

- Scorched/yellow leaf margins usually on older leaves

Excess

- Luxury consumption can lead to other cation deficiencies

Potassium – K+

Sources

- Potassium Sulfate - 50-52% K_2O, 17-18% S
- Sul-Po-Mag/K-Mag – 22% K_2O, 11% Mg, 20-22% S
- Greensand – ~6-9% K_2O
- Granite dust – ~4-6% K_2O
- Animal manures – ~0.5-3% K_2O
- Kelp (seaweed) – ~5-16% K_2O
- Wood ashes - ~7-9% K_2O

Sodium – Na+

Role

- Required for proper growth of Barley and crops in the Goosefoot family (i.e. Beets, Spinach, Swiss Chard)

Sodium – Na+

Deficiency

- Poor growth/yield of Na requiring crops

Excess

- Substitution for K potentially resulting in tissue rupture/damage

Sodium – Na+

Sources

- Sodium Nitrate – 16% N, 26% Na
- Sea minerals – Variable
- Kelp - Variable

Soil Structure

Potassium

- Seals off edge of clay plates
- Plugs up pore space

Sodium

- Disperses clay plates
- Plugs up pore space