Queensland Government

Soil fertility

To be healthy, plants need a steady supply of nutrients from the soil.

Required in relatively large quantities are macronutrients:

- nitrogen (N)
- phosphorus (P)
- potassium (K)
- sulphur (S)
- calcium (Ca)
- magnesium (Mg).

Other nutrients are required in small quantities. They are known as micronutrients or trace elements and include:

- copper (Cu)
- zinc (Zn)
- iron (Fe)
- manganese (Mn)
- boron (B)
- molybdenum (Mo).

A shortage or absence of any one of these essential nutrients can severely affect plant growth. Too much of any nutrient can also be as bad as too little.

Contributing factors

The availability of nutrients is affected by the pH (https://www.qld.gov.au/environment/land/management/soil/soil-properties/ph-levels) of the soil. For example in very acid soils, manganese and aluminium may be present in toxic concentrations.

The nutrient status of a soil can be determined by a laboratory analysis of the soil or by tissue analysis of the plants that grow in it.

A soil's natural fertility depends largely on the parent materials from which the soil has developed and the original vegetation. Nutrients are held in the soil as electrically charged ions (https://www.qld.gov.au/environment/land/management/soil/soil-testing/soil-terms) that can be positive (cations (https://www.qld.gov.au/environment/land/management/soil/soil-testing/soil-terms)) or negative (anions (https://www.qld.gov.au/environment/land/management/soil/soil-testing/soil-terms)).

As roots grow through the soil, they come into contact with cations and anions (held on the soil or dissolved in water) and the nutrients are actively taken up by the plant.

The amounts of nutrients available in soils depend on interactions between:

- soil properties—pH (https://www.qld.gov.au/environment/land/management/soil/soil-properties/ph-levels), texture (https://www.qld.gov.au/environment/land/management/soil/soil-properties/texture) and different clay minerals can have an influence on soil fertility
- soil biology—organisms living in the soil break down animal and plant matter into nutrient forms that can be used by plants
- soil organic matter (https://www.qld.gov.au/environment/land/management/soil/soil-testing/soil-terms)—important for holding nutrients until they can be taken up by plants
- soil water (https://www.qld.gov.au/environment/land/management/soil/soil-properties/water)—water in soil pores carries the nutrients to plant roots
- fertilisers—an excess of a particular nutrient can impede the uptake of others.

Trial demonstrating the importance of phosphorus to plant growth. Note the difference in plant growth between the pot on the left, which has had phosphorus added, to the pot on the right, which has phosphorus-deficient soil. All other nutrients were added to ensure only phosphorus was limiting plant growth.

Importance of soil fertility