Nutri-Facts

Agronomic fact sheets on crop nutrients

Chloride

NO. 11

AUSTRALIA AND NEW ZEALAND GRAINS EDITION

Chloride (Cl^-) is the plant available form of chlorine (Cl), which under standard conditions is an unstable yellow-green gas that rarely occurs in nature. Chloride is essential for plant growth and development but high concentrations of the nutrient in the soil are extremely detrimental to both plant and soil health.

Chloride in Plants

Chloride fulfills many important functions in plants. Some of the roles of Cl^- in plants are:

- **Photosynthesis and enzyme activation.** Some of the enzymes activated are involved in starch utilization which affects germination and energy transfer.
- **Transport of other nutrients.** Chloride aids in the transport of nutrients such as potassium (K^+), calcium (Ca^{2+}) and magnesium (Mg^{2+}) within the plant.
- **Water movement in cells.** Cellular Cl^- helps water move into cells and also aids in water retention in cells, thereby impacting cell hydration and turgor.
- **Stomatal activity.** Both K and Cl^- are involved in the movement of guard cells that control the opening and closing of leaf pores or stomata.
- **Accelerated plant development.** Grain crops that have access to adequate amounts of Cl^- germinate and mature quicker than grain crops that are deficient in Cl^-. In winter wheat production, maturity advances of 5 to 7 days have been observed.
- **Reduced lodging.** Chloride strengthens stems, helping to reduce lodging later in the season.
- **Disease interactions.** Chloride has been reported to play a role in reducing the effects of numerous plant diseases including the suppression of take-all root rot, tan spot, stripe rust, leaf rust, and Septoria in wheat, while in corn and grain sorghum it has been shown to suppress stalk rot.

Table 1. Chloride fertilizer sources and percent of nutrient.

Fertilizer name	Formula	% Cl^-
Potassium chloride	KCl	47
Magnesium chloride	$MgCl_2$	74 (dry) 22 (liq.)
Ammonium chloride	NH_4Cl	52
Calcium chloride	$CaCl_2$	65

Chloride in Soils

Most soils in Australia contain satisfactory concentrations of Cl^- either naturally or because they receive sufficient amounts through rainfall, irrigation water, sea spray, and/or fertilizer applications[1]. Nearly all Cl^- in soils exists in soil solution. Chloride is mobile in soils and moves freely with soil water, therefore, under certain conditions it can be readily leached from the rooting zone. Chloride is the dominant anion in saline soils and comes in the form of common salt (NaCl), calcium chloride ($CaCl_2$), and magnesium chloride ($MgCl_2$).

Chloride Deficiency and Crop Responses

Chloride deficiencies are rare in Australian soils and crop responses from added Cl^- are not likely. However, symptoms have been observed and characterized in several crops overseas[2,3,4,5]. Symptoms can vary greatly between different species, but the two most common symptoms are chlorosis in the younger leaves and an overall wilting. Necrosis of some parts of the plant, leaf bronzing, and reduction in root and leaf growth, as well as an increased susceptibility to infection of various diseases may also occur as a result of Cl^- deficiency. In Australia, the most common crop that expresses Cl^- deficiency symptoms is durum wheat, but this is not widespread.

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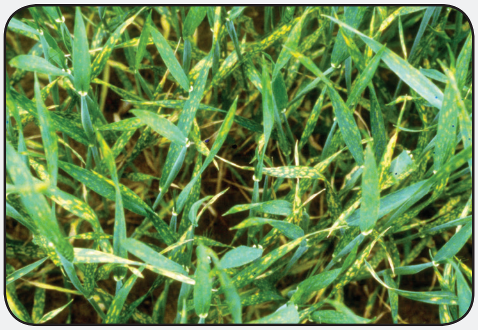
This Nutri-Fact is one of a series of fact sheets written by scientific staff of the International Plant Nutrition Institute (IPNI) that is focused on essential plant nutrients and their use. This series is available as PDF files at www.ipni.net/nutrifacts.



IPNI PHOTOS-LAMOND

Chloride deficiency observed as physiological leaf spot in winter wheat (left). Photo on the right shows wheat that received Cl^- fertilizer application.

Chloride Toxicity

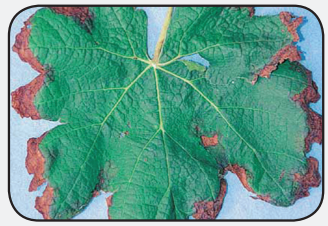
Salinity is a common problem in Australian soils. High concentrations of salt (NaCl) in the soil is detrimental to the growth and development of many crop and pasture species. This is a combination osmotic and sodium toxicity. Sensitivity to higher levels of Cl^- varies between species of plants. On average, sensitive plants such as beans and cotton, will show symptoms of toxicity when Cl^- concentrations on the soil solution are more than 20 millimoles. For tolerant species, such as barley, the concentration can be 4 to 5 times higher before symptoms of toxicity become visible. A crops ability to tolerate Cl^- concentrations is closely linked to the plants salt tolerance mechanisms.

Most cereal crops grown throughout Australia are more susceptible to Cl^- toxicity at the seedling stage but grow more tolerant as the crop develops. Leaf damage can result from excessive Cl^- deposited on foliage if crops are irrigated with water containing high levels of the nutrient. Careful fertilizer and water management is key when it comes to avoiding salinity and Cl^- toxicity. Leaching by flushing the soil with water can be used to reduce the concentration of Cl^- in the soil once it has become toxic to plants, but preventing Cl^- build up in the soil is a much more desirable management strategy than correcting Cl^- toxicity, especially in dryland agriculture.

Soil and tissue tests can be conducted to help diagnose Cl^- deficiency or toxicity. As with all micronutrients, these result need to be used in combination with other information including visual analysis of the crop, soil type, and paddock history.

Fertilizing with Chloride

There are several fertilizer sources of Cl^-, but the most common and readily available is potassium chloride (KCl), also known as muriate of potash. No one source is superior to another when strictly considering Cl^-. Since Cl^- is soluble and moves readily with soil water, placement is not as great an issue as with other, more immobile nutrients.



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Some plants are sensitive to high Cl^- concentrations. Symptoms of excessive Cl^- (clock-wise starting top-left: grape, almond, walnut, strawberry) usually appear first at the tips and edges of older leaves.

References

1. Price, G. (ed.). 2006. Australian Soil Fertility Manual, 3rd Ed.
2. Leikam, D.F., R.E. Lamond and D.B. Mengel. 2003. Kansas State Univ. Ag. Exp. Station. MF-2586.
3. Ruiz Diaz, D.A. et al. 2012. Comm. Soil Sci. Plant Anal. 43:2437-2447.
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Further Reading

Engel, R.E. and P.E. Fixen. 1994. Better Crops 78:20-23.

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