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# Soluble chloride

Chloride (Cl) is the most commonly occurring water-soluble anion in seasonally dry Australian soils. Although essential for plant growth, the importance of this anion in land use assessment is due to its possible accumulation in soil profiles and waters to levels detrimental to plant growth and ecosystem health. Typical concentrations in Australian soils, where $Cl^-$ has been studied extensively, range from almost zero to well in excess of 1000 mg Cl/kg. Soil solution concentrations are known to vary widely (e.g. zero to 32.3 mM; Adams 1974), while the median total concentration for soils worldwide is ≈100 mg Cl/kg (Ure and Berrow 1982).

Chlorides in soils originated from salts trapped in parent materials, from volcanic emissions, from marine encroachment and aerosols, as a component of commercial fertilisers such as muriate of potash, and as a soluble anion in irrigation and effluent waters. The $Cl^-$ concentration in soil solution likely to cause crop damage is dependent upon environmental conditions, the particular crop, and on irrigation management practices. Symptoms of $Cl^-$ toxicity in plants include burning of leaf tips or margins, bronzing and premature yellowing of leaves, and leaf drop (Chapman 1966). Chloride is actively absorbed into plant cells and, if the concentration is high enough, it may interfere with the uptake and transport of essential nutrients within and between cells.

Elevated $Cl^-$ concentrations (≈600–1500 mg/kg of water-soluble $Cl^-$) in surface soils (0–150 mm) correlate with progressively higher concentrations of Cd in potato tubers (McLaughlin *et al.* 1993). Similar findings were earlier reported (Bingham *et al.* 1983) for Swiss chard, namely that plant concentrations of Cd increased with increasing concentrations of sodium chloride salinity. Relatively stable Cd–Cl complexes are expected because $Cd^{2+}$ is a soft Lewis acid and $Cl^-$ exhibits some characteristics of a softish Lewis base (Lund *et al.* 1985).

There is little call for information on total soil Cl levels. Particularly in the ancient landscapes of sub-humid to semi-arid Australia, $Cl^-$ derived from marine sediments, rocks and rainfall migrated with water movement to eventually accumulate in many subsoils, sometimes to high levels. Hydrological changes associated with land clearing, cultivation, drainage and irrigation, subsequently mobilised significant amounts of the salt, sometimes into waterways, to the soil surface or to deeper layers of the soil profile. The measurement of water-soluble soil $Cl^-$ at a range of depths helps quantify these changes and the effects of different land and crop management options. Harris and Bond (1960) have reported on the problems of soil salinity in turf wicket management. Dryland salinity currently affects more than 5 million hectares of land in Australia (Anon 2004).

Values of water-soluble $Cl^-$ useful for the general interpretation of soil chemical analyses, irrespective of sampling depth, are: <100, 100–300, 300–600, 600–2000 and >2000 mg Cl/kg dry wt for ratings of very low, low, medium, high and very high, respectively (Rayment and Bruce 1984).