# 27 Chloride

## 27.1 Chloride in plant nutrition

The main source of chloride ($Cl^-$) in North Dakota soils is in the underlying shale that was produced over time under saline seas millions of years ago. The formation of this Cl-rich shale was a result of the chloride saturated clay and other sediments filtering down and collecting on the shallow ocean bottom (See Chapter 1). Pressure from the build-up of overlying sediments transformed the clays into shale rock. The shale was uplifted to its past and present positions by internal geologic forces. Glacial activity incorporated some of the shale into the ice, and some of it into the till and other glacial materials left after they melted. High water tables, which are common across much of North Dakota, can result in the soluble salts, including chlorides, moving closer to the soil surface through capillary water movement, concentrating them near the soil surface.

Chloride is a mineral that can be easily leached, making low soil chloride concentrations more common in deep, sandy soils. Low chloride levels are also more common west of the Missouri River, where the glacial deposits from past glaciations have long been eroded away, and crops are currently grown in the underlying sediments that are generally over 65 million years in age.

In plants, chloride is an important cofactor in the release of oxygen from the chloroplasts as part of photosystem II, the water-splitting reaction of photosynthesis, termed the Hill reaction. Chloride also helps to regulate the activities of asparagine synthetase, and ATPase.

In North Dakota, crops grown that are sensitive to low $Cl^-$soil test levels are spring wheat, durum and barley (Fixen et al., 1986; Goos et al., 1987; Engel et al., 2001; Graham et al., 2017). Yield increases from a $Cl^-$ application are due to an increase in kernel size (Engel et al., 1994) and in reducing common root rot disease (Goos et al., 1987). Increase in kernel size in barley not only results in increased yield, but increased 'plump', which is a factor considered positive for the malting process (Goos et al., 1987). Increases in the yields of spring wheat due to chloride application can be inconsistent between years, even for the same variety (Grant et al., 2001). Yield increases in a Manitoba study were reported only about half of the time, with yield increases only being about 3-5 bushels per acre.

## 27.2 References of chloride nutrition in crops


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