Chlorine vs. Chloride

FACT SHEET

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Chlorine vs. Chloride ……a Brief Discussion

There have been claims in the press and elsewhere that the addition of chloride in muriate of potash is harmful in a number of ways. This article provides a factual review of this element.

Forms of Chloride

Chloride (Cl^-) is an essential element for humans, animals and all plants. It is a component of common salt and found in seawater. This must not be confused with other forms of the element such as chlorine gas (highly toxic and unstable), chlorine in swimming pools, hypochlorite (a sterilant and bactericide), hydrochloric acid (corrosive and dangerous liquid), etc. It is important to recognize that none of these forms can occur in soils as the result of the additions of chloride in fertilizers, manures, or rainfall.

For the purpose of this discussion it must be understood that chlorine gas does not occur in nature and is only slightly soluble in water. It is very unstable, volatile and can easily be broken down by light. Chloride however is stable, highly soluble and is easily taken up by plants.

Chlorine (Cl_2) is a poisonous, toxic, corrosive gas that is used in the manufacture of bleaching agents and disinfectants. It is commonly associated with the disinfections of water. It may be added to water as a solid such as calcium hypochlorite or liquid chlorine (compressed chlorine gas). When placed in water it is quickly transformed into other chemicals such as hypochlorous acid and hypochlorite ion, which kill bacteria and disinfect water. Since chlorine is highly reactive, combining with water pollutants to form other toxic chemicals such as chloroamines complicates its benefits of water purification.

Chloride (Cl^-) is the ionic form and commonly found in nature and is associated with salts and other positively charged ions such as potassium. It is non-toxic and readily adsorbed by plants. Abundant levels of chloride come form geologic forces and sea salt. Hydrogen chloride is an important constituent of volcanoes, which dominated in earth's early existence. Large quantities of hydrogen chloride was released into the atmosphere and dissolved in the oceans.

Benefits of Chloride...

Osmosis, diffusion and passive transport are important factors that regulate membrane and cellular structure. Osmosis will occur if a gradient is present. Plant cells in a soil hypertonic solution will lose water across its membranes and cause the plant cells to shrink. However all cells have salt which is critical in regulation and balance. It is important to have that critical level so equilibrium and an isotonic balance between plants and soil exists. Low levels of soil salts or a hypotonic solution will cause the reverse condition and be as just as severe.

If soils were chloride deficient it would actually be beneficial to add chloride since plant roots adsorb chloride, which is important in photosynthesis. Also, chloride is beneficial in controlling plant disease, inhibiting conversion of N to NH4 and helping with magnesium uptake. The physical regulation of osmosis and diffusion, which include the transport nutrients, sugars, amino acids and organic acids are important factors dependent on salts such as chloride. All of these factors will indirectly influence effects on the plant either positively or negatively, which will directly reflect on the plants ability to withstand external stress and resist disease and physical damage from insects.

Chlorides in soil

Soils in some parts of the world are deficient in chloride and additions of this element are associated with yield responses and improved growth as for any other limiting nutrient. Most of the soils in Canada are between 6 to 15 ppm of chloride with 8 to 10 ppm being the norm. Chlorides less than 15 are considered low and crops will respond to additional chloride. Cereal crops will respond to up to 30 ppm of chloride.

Soils under covered crops can suffer chloride (and other salts) build up because they are not subject to through drainage and the normal natural regulation of Chloride because it is very leachable. Similarly soils in arid climate with little rainfall are vulnerable to salt build up or areas where crops are irrigated with water containing high levels of salts.

Chlorides in Plants

Chloride is an essential element for all plants but is only required in small quantities similar to other trace elements. Actual concentrations of chloride content of plants can vary greatly with species and stage of growth. Like many other substances (including innocuous materials such as water), chloride is not harmful to plant, animal or microbiological life in normal quantities but is undesirable in excess.

Wilting is a common symptom of chloride deficiency and transpiration is also affected and the plant is often chlorotic. Chloride toxicity symptoms include burning of leaf tips and margins, bronzing, premature yellowing and abscission of leaves. Seedlings and tuber will exhibit root and shoot scorch. Damage from excess chloride normally results from osmotic effects (moving water across nutrient concentrations) which are associated with the above toxicity symptoms. Other physiological effects are not well defined but can involve reduced carbon dioxide assimilation and reduced protein synthesis. Chloride is easily absorbed by leaves and scorch can result in coastal districts from sea spray and saline drift.

Plant species differ considerably in their sensitivity to chloride excess with sugar beet, barley and rape, being highly tolerant, wheat, grasses and potatoes intermediate, peas, beans, clover and other legumes are sensitive. Because the effect is one of osmotic pressure, the sensitivity also varies with the moisture holding capacity of the soil and soil moisture content.

Chloride and Biological Activity in Soil

It has been suggested that biological activity of soil is adversely affected by chloride additions in fertilizers. Soil biology is immensely complex and its measurement at present is very imperfect but there is no reliable scientific evidence to support this contention. The successful use of muriate as a potash source for 150 years to produced flourishing and increasingly productive crops appears to be clear practical evidence refuting such claims. The existence of healthy ecosystems in coastal regions of the world, which receive enormous quantities of chloride from rain, is further evidence that chloride addition is not a problem. Antagonist of muriate of potash suggests the use of sulphate of potash (SOP) as an alternative. SOP is of course a very important and satisfactory fertilizer, which provides both potash and readily available sulphur.

Where there is a requirement for sulphur, SOP may be the best choice of fertilizer, but not because it does not contain chloride. It has also been emphasized that muriate is prohibited in organic production and some claim this is because of its chloride content. However this is totally contradicted by the allowable use of cured salts such as Sylvinite and Kainit within the organic rules, as these materials respectively contain 2.8 and 4.8 times as much chloride as muriate per unit of potash.

Chloride Levels in Soils in ppm	
Very Low	**0-7 ppm**
Low	**8-15 ppm**
Medium	**16-22 ppm**
High	**22 - 30 ppm**
Very High	**30+ ppm**