

Chloride Requirements in Onion: Clarifying a Widespread Misunderstanding

By William M. Randle

Chloride (Cl) is a misunderstood nutrient. Recent studies in Georgia have found that onions require higher levels of Cl than previously thought. The reason is related to stomates, which regulate movement of gases in and out of plant leaves.

In most plants, Cl is an essential minor element which is thought to be toxic at high concentrations. There has been extensive research on Cl requirements by wheat, barley, corn, and sorghum, showing sufficiency levels in the 0.15 to 0.40% range. Talk with tobacco farmers in south Georgia about applying high rates of Cl to fields and you just might find that Southern hospitality has a limit, and it stops at Cl. Tobacco burning quality is affected by Cl...the crop is extremely sensitive to even moderate levels, as growers know.

However, in southeastern Georgia, tobacco is not king. The onion is. This is the home of the well-known “Vidalia®” onion. Grown in the sandy soils of the Coastal Plain, these onions are internationally known for their sweet and mild flavor. We have observed that higher plant potassium (K) levels are often associated with higher sugar levels in onion and the percentage of good bulbs is associated with higher phosphorus (P) nutrition.

Onions also have a high requirement for Cl, which is not well known. The problem arises because many onion producers also grow tobacco, and they are concerned about elevated soil Cl.

Preliminary research at the University of Georgia has shown that onions not only tolerate high Cl levels, but may actually require these higher levels for optimum

growth and production. When Cl was supplied at high levels...up to 500 parts per million (ppm) in nutrient solutions...several studies by our group have shown that Cl, on average, is the fourth most utilized essential element, superseded only by nitrogen (N), K, and P. **Figure 1** illustrates the relative uptake of nutrients. This result is amazing considering Cl is thought to be required by plants in only small amounts.

The reason for the high Cl requirement of onions may reside in the plants’ stomates. The stomates are structures on the leaf surface which regulate the movement of gases in and out of the leaf. Specialized cells, called guard cells, either swell or deflate, which opens or closes a leaf pore, thereby regulating movement of gases

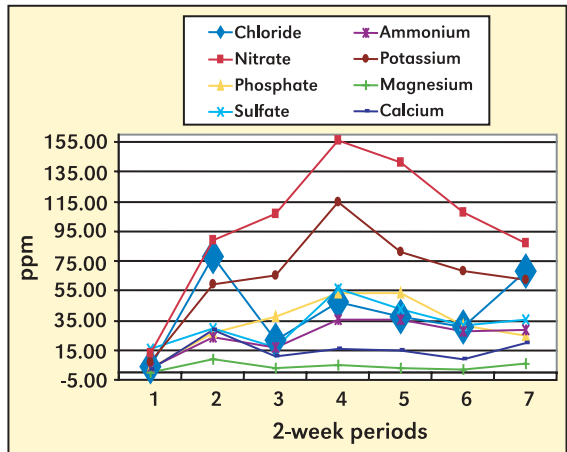


Figure 1. Usage patterns for selected nutrients in onion during growth, development, and maturation. Chloride nutrient usage is highlighted.

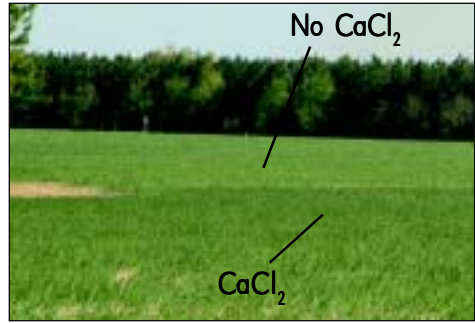


Plant stomates on the leaf have kidney-shaped guard cells surrounding the circular pore. In onion plants, K^+ and Cl^- ions control the opening and closing of the pore.

in and out of the plant. In most plants, K^+ ions (+ charged) move in and out of guard cells, and cause stomates to open or close (see above).

The positively charged K^+ ions need to be balanced by a negatively charged ion, usually malate, formed from the decomposition of starch. Onions do not have starch, so they have evolved a different mechanism to counter the influx of positively charged K^+ ions by utilizing the negatively charged Cl^- ion. Knowing this, it stands to reason that Cl^- is needed in high amounts to produce an onion crop. Unfortunately, the Cl^- requirement is not widely known among the onion community. Some claim that onions are sensitive to Cl^- . Based on our preliminary work, this is not the case.

Chloride fertilization in onion is also overlooked and avoided because of an often misinterpreted association with sodium. Current recommendations for onion production in Oregon, Michigan, New York, Georgia, Texas, and California call for no additional Cl^- to be added to fertilization programs. If Cl^- status in the plant is compromised, poorly functioning guard cells can lead to a number of abnormalities, including reduced photosynthesis (which may lower yields) and reduced transpiration. This can lead to water “congestion” and increased foliar disease. Recent observations and analyses in commercial onion fields suggest that a low Cl^- status may have an association with a higher disease incidence. Elevated Cl^- levels have reduced disease severity in several grasses and potato. Most recently, it has reduced



The effects of adding 20 lb Cl^-/A to onion fields in south Georgia. Plants which received Cl^- application through irrigation water have healthier, darker green foliage.

Stemphylium vesicarium disease in pears.

Soils in Georgia were recently tested for Cl^- levels prior to planting onions. Most results indicated that extractable Cl^- was present at less than 6 lb/A, which is the lower limit of detection. In an effort to evaluate the effects of adding Cl^- to the fertility program, several test areas were established. The effects of adding 20 lb Cl^-/A can be seen in the field photo above. The onion plants in the foreground received Cl^- through the irrigation water and are darker green than the onions in the background. The effects of Cl^- fertilization on onion production and quality in these two areas are still being investigated. As we learn more about Cl^- , the recommended rate for Cl^- fertilization will likely increase.

In summary, research into effects of Cl^- on onion production is just beginning. Preliminary trials indicate that onions would benefit from increased Cl^- fertility in Georgia. Our current research is exploring Vidalia® onion yield and pungency response to Cl^- , Cl^- effects on disease reduction, and effects of late K application on sugar content, onion quality and calcium uptake and utilization. Other onion-producing areas should consider testing to determine Cl^- levels in their soils and fertilize accordingly. [BC](#)

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