NEWS & VIEWS

A regional newsletter published by the Potash & Phosphate Institute (PPI) and the Potash & Phosphate Institute of Canada (PPIC)

Dr. W.M. Stewart, Great Plains Director
March 2000

Chloride Fertility: What about Corn and Grain Sorghum?

Chloride (Cl) is an essential plant nutrient first recognized as necessary for proper plant growth and function in the 1950s. It is needed in relatively small quantities and is therefore classified as a micronutrient. Nonetheless, it's a critical component in a complete and balanced fertility program. **Chloride plays several important roles in plants, including:**

- **Photosynthesis and enzyme activation.** Some of the enzymes activated are involved in starch utilization that affects germination and energy transfer.
- **Nutrient transport.** Chloride aids in the transport of nutrients such as potassium (K), calcium (Ca), and magnesium (Mg) by maintaining electrical charge balance.
- **Water movement in cells.** Cellular Cl helps water retention and movement into cells.
- **Stomatal activity.** Both K and Cl are involved in the control of guard cells that are responsible for the opening and closing of stomata. Efficient operation of stomata is necessary for absorption of carbon dioxide (CO_2) for photosynthesis and avoidance of drought stress by minimizing water loss from the plant.
- **Accelerated plant development.** Winter wheat grown with adequate Cl has been shown to mature as much as seven days faster than Cl deficient wheat.
- **Reduced lodging.** Chloride strengthens stems and reduces late season lodging.
- **Disease suppression and tolerance.** Chloride suppresses several diseases in various crops. Examples include stalk rot in corn and wheat diseases such as take-all root rot, leaf rust, and stripe rust.

Chloride is susceptible to leaching in soils. It is an anion and therefore moves freely with soil water. Deficiencies are most common in sandy, well-drained soils, although they may occur in clay soils in high rainfall regions. In most well-drained and productive soils, Cl is replenished through the use of Cl-bearing fertilizers such as muriate of potash (KCl) or from atmospheric deposition. Hence, Cl deficiency is most likely where there is no history of KCl fertilization and atmospheric deposition of Cl is low. Sea water is relatively high in Cl, so atmospheric deposition tends to be higher near the coasts and decreases inland. Atmospheric deposition of Cl is rather low in the Great Plains states…and KCl use in much of this region is not as common as in other areas of the U.S. These are conditions where response to Cl fertilizer might be expected.

A detailed map showing estimated Cl deposition in the U.S. is available from the National Atmospheric Deposition Program/National Trends Network at http://nadp.sws.uiuc.edu.

Chloride can be an important element in wheat production. Research conducted across the Great Plains and Canadian prairies has established that wheat yield increase from Cl fertilization is usually classical nutrient response and/or suppression of fungal diseases. Some wheat varieties will exhibit Cl deficiency symptoms, also referred to as physiological leaf spot syndrome, under low soil Cl conditions. Chloride has been shown to suppress septoria, leaf rust, stripe rust, tanspot, and common and take-all root rots in wheat. Considering wheat response data, it's reasonable to question whether other crops are responsive to Cl fertilization.

Co-author:
Dr. W.M. (Mike) Stewart, Great Plains Director
Potash & Phosphate Institute (PPI)
P.O. Box 6827, Lubbock, TX 79493
Phone: (806) 795-3252 Fax: (806) 795-5997
Email: mstewart@ppi-far.org

Co-author:
Dr. Ray E. Lamond
Kansas State Univ., Dept. of Agronomy
2014 Throckmorton Hall
Manhattan, KS 66506-5504
Phone: (785) 532-5776
E-mail: rlamond@bear.agron.ksu.edu

Kansas State University has evaluated corn and grain sorghum response to Cl fertilizer since 1995 (**Tables 1 and 2**). The studies have been conducted at several sites, using different Cl sources and rates. **Corn yield response as high as 24 bu/A was observed with application of 20 lb Cl/A. When averaged across all rates and sources, Cl fertilization resulted in a corn yield increase of about 6.5 bu/A over 9 site years.** Maximum grain sorghum yield response was 25 bu/A to 20 lb Cl/A. **The average sorghum response to Cl across all sources and rates was 10 bu/A over 15 site years.** All Cl sources used in these studies performed similarly.

Table 1. Corn response to chloride fertilization (Kansas).

Year	Site, county	Cl rate[1], lb/A 0	20	40	Average response
		- - - - - Corn yield, bu/A - - - - -			
1995	Riley	70	89	86	18
1996	Riley	127	129	137	6
	Brown	108	121	122	13
1997	Riley	64	67	71	5
	Brown	188	188	186	-1
1998	[2]Riley	107	111	114	6
	[2]Osage	133	133	135	1
1999	Brown	123	121	130	3
	Marion	94	104	104	10

[1] Averaged over several Cl sources.
[2] Sites testing over 20 lb Cl/A-2 ft of soil

Soil Cl level can be a good predictor of response to Cl fertilization. Wheat studies have shown that response is likely when soil Cl level is less than about 30 lb/A-2 ft and that an optimum level is at least 60 lb Cl/A-2 ft. Similar observations have been made in the corn and grain sorghum research. The average corn response was 7 bu/A where soil Cl was less than 20 lb/A-2 ft. Where it was over 20 lb Cl/A-2 ft the response was only 3 bu/A. The average sorghum response was 11 bu/A where soil Cl was less than 20 lb/A-2 ft. Where it was over 20 lb Cl/A-2 ft, the response was 5 bu/A.

Table 2. Grain sorghum response to chloride fertilization (Kansas).

Year	Site, county	Cl rate[1], lb/A 0	20	40	Average response
		- - - - Sorghum yield, bu/A - - - -			
1995	Marion	87	96	99	10
1996	Powhattan	119	125	126	6
	Marion	106	120	103	6
1997	Powhattan	102	106	110	6
	Marion 1	60	70	73	12
	Marion 2	117	135	139	20
1998	Riley	101	110	115	12
	Marion 1	62	70	76	11
	Marion 2	63	72	71	8
	Marion 3	87	110	106	21
	[2]Osage	125	125	126	1
1999	Brown	93	99	102	8
	Marion	98	108	108	10
	Stafford	132	144	141	11
	[2]Osage	96	101	108	9

[1] Averaged over several Cl sources.
[2] Sites testing over 20 lb Cl/A-2 ft of soil

Chloride fertilization can be an important part of profitable corn and grain sorghum production. In determining the need for Cl, use soil testing and consider other factors such as soil type and drainage, historical and planned KCl use, and atmospheric deposition of Cl. To learn more about the history and role of Cl in crop production, visit the Chloride Crop Nutrition Homepage at http://www.ppi-far.org/chloride/index.html. ■

Contact PPI/PPIC/FAR on the Internet

You can reach the Potash & Phosphate Institute (PPI), Potash & Phosphate Institute of Canada (PPIC), and Foundation for Agronomic Research (FAR) on-line. Use one of the following as a URL to reach the web site: www.ppi-far.org or www.ppi-ppic.org.

For futher information, contact PPI headquarters by phone at (770) 447-0335 or fax (770) 448-0439.

RN 20067

NEWS & VIEWS

Great Plains
March 2000

Potash & Phosphate Institute (PPI)
655 Engineering Drive, Suite 110
Norcross, GA 30092-2837