First Year Summary
Spatial Variability of Chloride
Dr. Dave Franzen
North Dakota State University
Fargo, ND

For the Potash and Phosphate Institute
and
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Introduction

Little has been recorded regarding field chloride variability. The objectives of this study are to study the variability of chloride in fields and investigate methods of identifying chloride management zones within fields in order to express field chloride levels with the least amount of sampling and analysis.

Summary of activities

Four fields were sampled in a grid pattern. A summary of the sampling patterns used at each site is given in Table 1.

Table 1. Fields and sampling grid used, 1996.

Field site	Acres	Grid size
Gardner	40	110 ft.
Colfax	40	110 ft.
Valley City	40	110 ft.
Mandan	80	East 30 acres, 110 ft., West and Center field, 150 ft.

Samples consisted of at least 5 sample cores per sample taken within a 15 ft. radius of center from 0-2 ft. in depth. Field maps of chloride levels were constructed from the original sampling grid (Figure 1-4). Chloride variability appeared to conform to landscape differences within all fields.

At Gardner (Figure 1), alfalfa has been grown in the north 15 acres of the site from 1993 to after sampling in 1996. The south 25 acres was in annual crop (corn, wheat, barley) in 1993-95, before being seeded to alfalfa in 1996. The north 15 acres of alfalfa began to die out rapidly in 1996, and chloride levels follow the line of surface drainage from west to east along the south line of that subfield area. Chloride areas shown in the south and reported in Better Crops earlier this year from 1995 data are much lower in 1996 following alfalfa seeding. We do not know if this is because of alfalfa uptake, or because local water table has been lowered because of the alfalfa water transpiration removal and decrease in related surface salt levels.

At Colfax (Figure 2), chloride levels ranged from 115 lb/acre 2 ft. to 1119 lb/acre 2 ft. Although the levels were all in the high range, the distribution was based on topography. The very high levels of chloride were located in the low depressional areas, while the lowest chloride levels were located on the subtle hilltops in this field which ranged in elevation to about 2.5 feet from low to high. High water tables containing chloride may have contributed to high levels of chloride. Sugarbeet has also been observed to accumulate high levels of chloride in the leaf tops,

which results in a cycling of chloride from deeper depths to surface levels in a sugarbeet rotation (Moraghan, 1996 Sugarbeet Research and Extension Reports). This field is in a sugarbeet rotation.

At Valley City (Figure 3), chloride levels also relate to topography, and patterns, as at Colfax, are similar to nitrate-N levels within the field. The horsehead pattern at Valley City is also observed in nitrate-N, K, Zn and organic matter. The very high chloride level in the northwest is also very high in nitrate-N and P.

At Mandan (Figure 4), chloride levels from the 110-150 ft. grid are lowest in the center field, and highest in the east. The general slope of the field in from northwest to southeast. Some of the higher chloride levels are in the northeast, where a periodic waterway carries spring runoff from a livestock pasture containing piles of manure occasionally. The lowest chloride levels follow sunflower in 1995, which were also the lowest nitrate-N levels in 1995. However, after fertilizing both the center and east fields for wheat in 1996, the center field in 1996 contained higher levels of nitrate-N than expected compared to the east field. Chloride levels in the center field remain low in 1996.

Correlations were made between the original sample values and 220 ft., 330 ft., 4.5 acre grids and point and area based topography sampling (Table 2). Figure 4 shows the original chloride levels at Mandan compared to the results of expressing chloride levels in this field with other less intensive sampling strategies, including topography using 14 sample locations.

Table 2. Correlation of chloride levels in theoriginal sampling grid with selected grid sizes and topography sampling methods.

Site	220 ft.	330 ft.	4.5 acre	Topography	
				point	area
Gardner	0.410	0.300	0.010	0.384	0.474
Colfax	0.240	0.059	0.015	0.056	0.195
Valley City	0.489	0.334	0.126	0.533	0.623
Mandan	0.168	0.149	0.148	0.386	0.340

Year one observations

Chloride is extremely variable. Results from the fields investigated this first year suggest that low composite soil test levels are probably relatively predictive of general soil levels. However, medium and high composite soil test levels may or may not reflect within field values. Landscape sampling may be a cost-effective way to depict within field levels. Using several composited sampling points taken from an area within a landscape zone was more correlated to the dense grid chloride values in the analyzed fields to date than point sampling within the landscape zones.

Contrary to investigations of nitrate-N levels in North Dakota, chloride levels appear more clustered. Nitrate-N levels within a landscape management zone are less variable than chloride levels. This observation may be responsible for area landscape sampling to better represent a field than a point method.

Outreach activities during 1996-1997

In addition to the Better Crops article in 1996 which showed chloride variability at Gardner, chloride variability was also displayed in the 1996 Great Plains Soil Fertility Conference Proceedings, the 1996 North Central Extension-Industry Proceedings, at the American Society of Agronomy meetings as a poster paper and in the Agronomy abstracts. Variability of chloride was also discussed at the numerous speaking engagements around the state of North Dakota , including 8 summer field days and talks at Minot, Grand Forks, Mohall, Devils Lake, Fargo, and other locations during the winter of 1996-97. Three Precision Farming

Workshops were organized and held during February, 1997 at Minot, Grand Forks and Fargo (Feb 27). Newsreleases, TV and radio presentation also discussed variability of plant nutrients including chloride to area growers. The Manitoba-North Dakota Zero-Till Conference was held in Brandon, MB this year. The 1,200 producers attending heard my presentation of precision farming including chloride variability.

Plans for 1997

The cooperator at the Gardner location decided to put the remaining field into alfalfa this year. Continuation of the study at this location would reduce the annual crop to about 15 acres because the 15 acres that was alfalfa was plowed up this fall. However, I do not think this is enough annual crop to warrant using this site again. Gardner has three years of sampling history and analysis already including chloride analysis in 1995. Another site will be selected, hopefully, on a Bearden soil in the Casselton area, with sampling to begin this fall.

Funding for the chloride analysis in this study is appreciated, since chloride is one of the more expensive tests to run. Wheat, barley and corn growers in North Dakota and from the region should benefit from the research.

Figure 1. Gardner 0-2 ft. chloride levels, 1996.

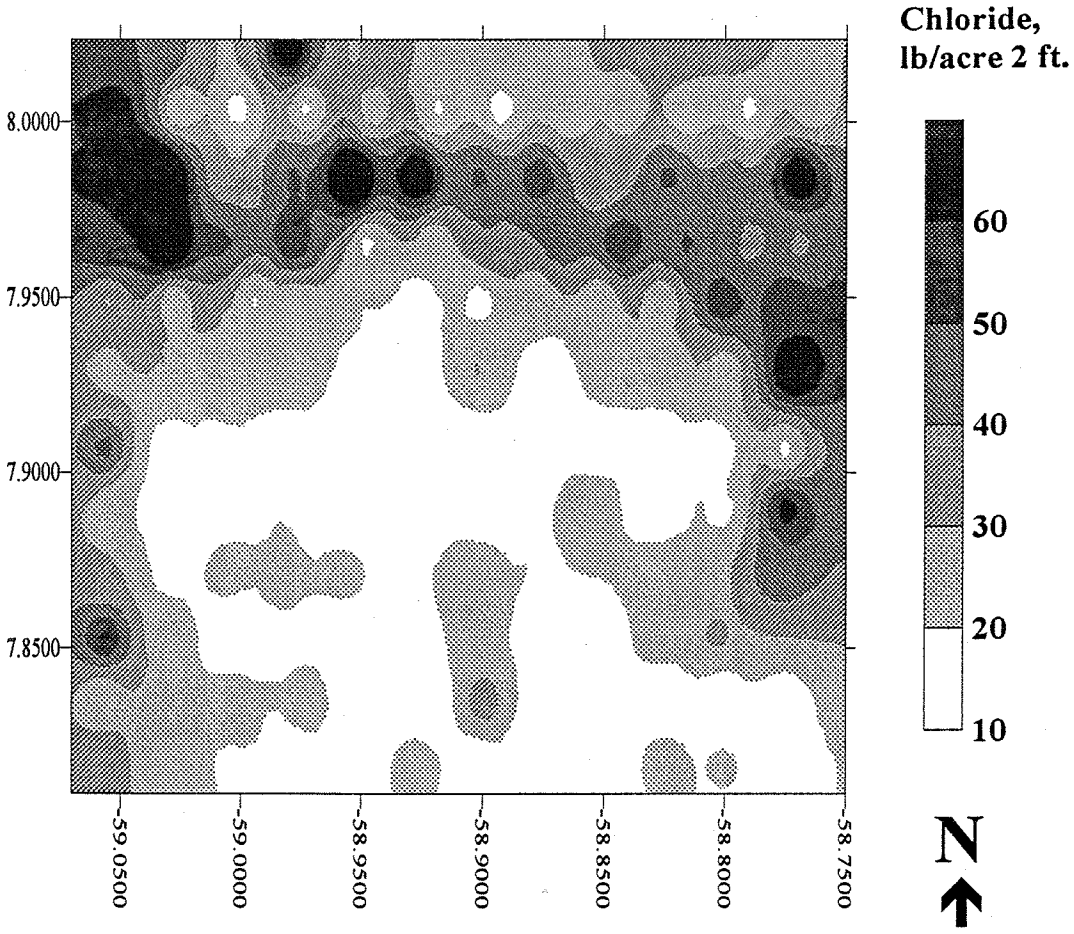

Figure 2. Colfax 0-2 ft. chloride levels, 1996.

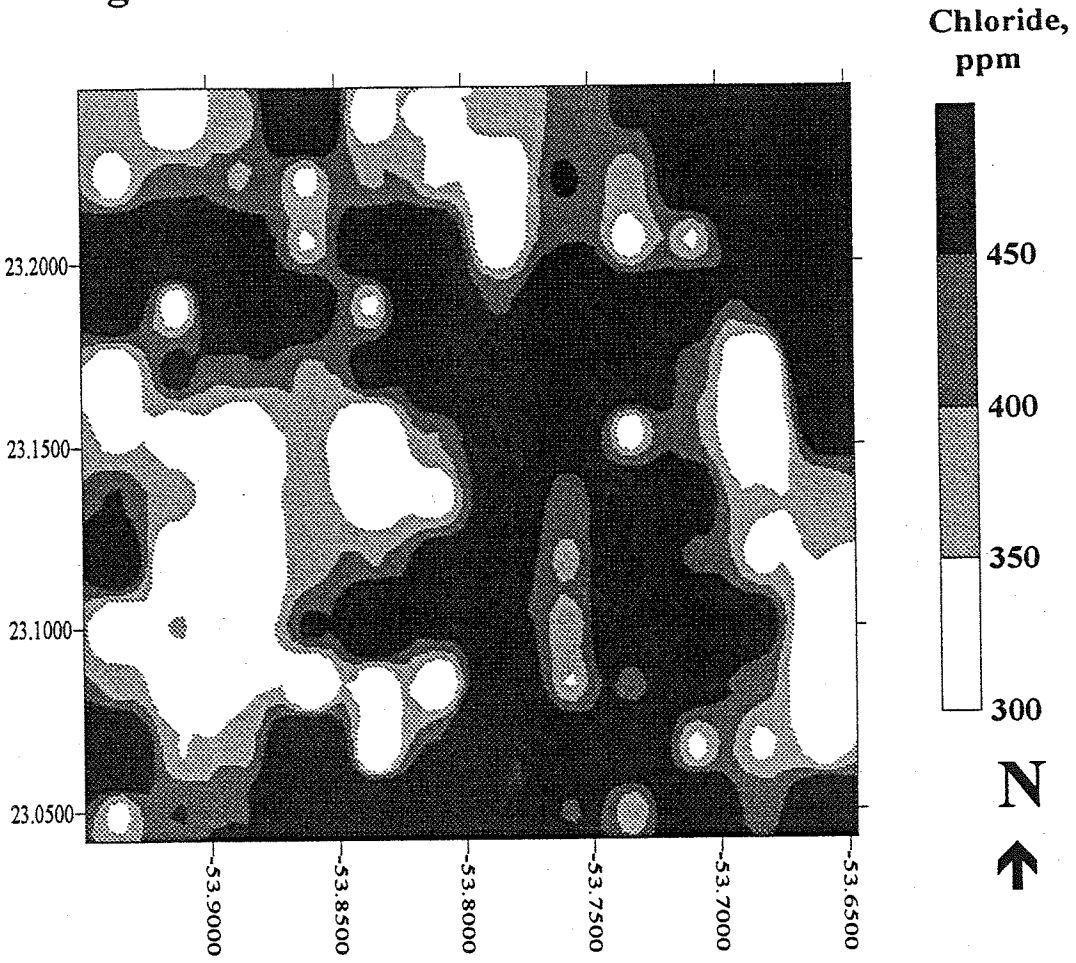

Figure 3. Valley City chloride levels, 1996.

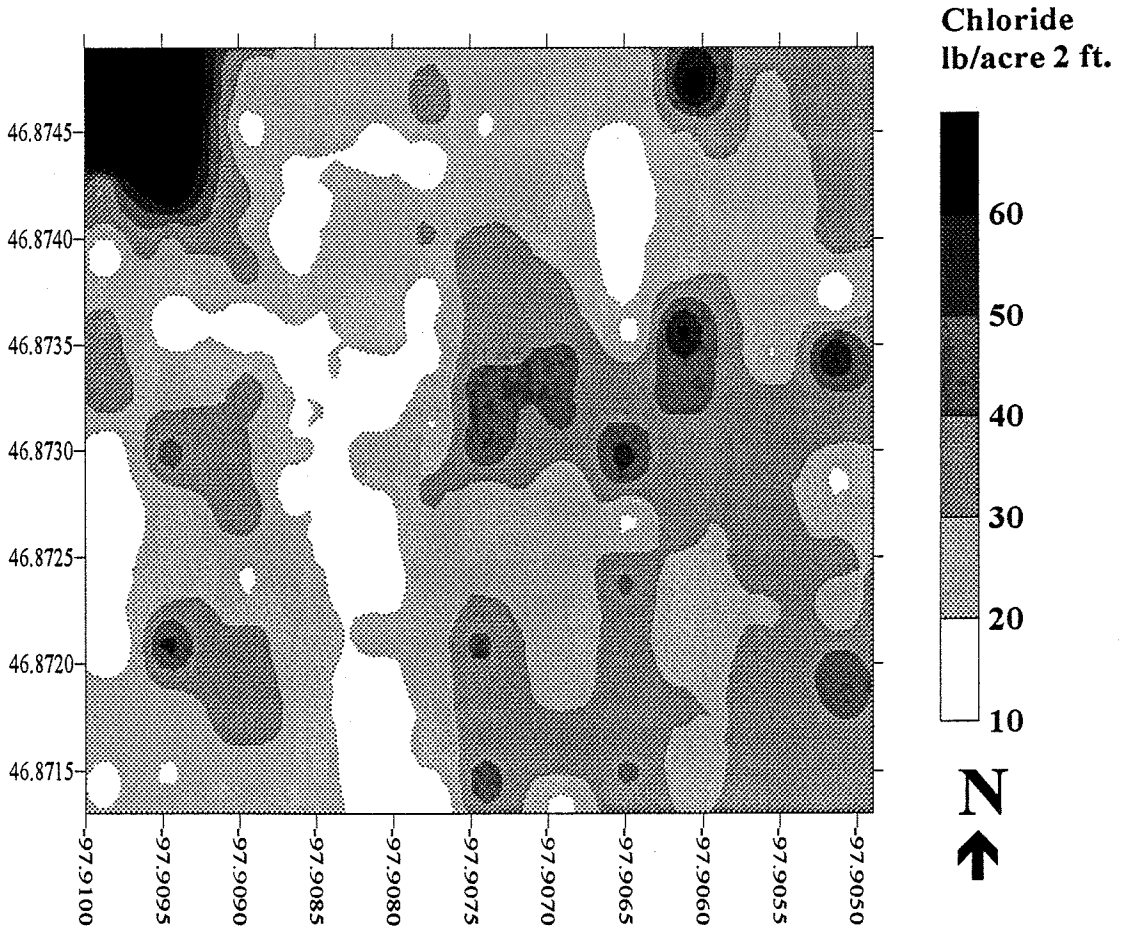

Figure 4. Mandan chloride levels at selected grid densities and topography sampling, 1996.