Small Grain Response to Potassium and Chloride Additions[1/]

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Studies have been conducted over a three-year period to determine the frequency and the cause of small grain response to KCl additions on high K soils. During the first two years responsiveness of hard red spring wheat, spring barley, and oats were compared at six locations in eastern South Dakota. Broadcast applications of 167 lbs/A of KCl caused grain yield increases significant at the 0.05 probability level at four sites for wheat and two sites for barley while no oat yield increases were measured. Sites giving wheat responses ranged in exchangeable K(NH_4OAc) from 410 to 860 lbs/A. Since spring wheat appeared to be the most responsive crop of the three and due to its importance in South Dakota, further investigations were conducted only on wheat.

K Response or Cl Response? Studies conducted during the second and third years included experiments designed to determine if responses were due to K or due to Cl. These experiments indicated that yield increases were due to Cl, not due to K (Table 1). Similar yields resulted with KCl and $CaCl_2$ while KNO_3 yields were significantly lower (0.05 level).

Broadcast KCl or Drill applied KCl? Since the yield increases were due to Cl, method of KCl placement questions may or may not be answered in the traditional way. Placement comparisons with wheat were made in all three years. Potassium chloride was either broadcast and incorporated with a field cultivator prior to seeding or was applied with the drill in direct seed contact (row spacing of 6"). The rate applied with the drill was 33 lbs/A while various levels of broadcast KCl were applied up to a maximum of 167 lbs/A. Broadcast applications were made with and without the drill treatment.

1/ Papers submitted to Agronomy Journal: 1) Response of Spring Wheat, Barley and Oats to Cl in KCl Fertilizers; 2) Influence of Soil and Applied Chloride on Several Wheat Parameters

On four of the five placement by rate studies that showed a response to KCl, broadcast and drill placements gave the same response when compared at the same rate of KCl. At the remaining site, treatments where some of the KCl was applied with the drill yielded less than where all KCl had been broadcast. No explanation for this response is suggested except for the possibility of a delay in crop development due to the salt concentration in the seed vicinity. Heading notes did not show such an effect.

Six additional experiments were conducted during the third year of the study at six different locations. Various combinations of N, P, K, and Cl were applied with the drill to determine if interactions between these nutrients existed when they were seed placed. Neither K or Cl application resulted in significant yield increases at any site. The KCl rate used was 33 lbs/A which kept total salt applied with the seed within recommended guidelines. Heavy rains following seeding coupled with high yield potentials at these sites likely caused the KCl rate used to result in yield responses that were too small to be detected. Broadcast rate studies over the three-year period predicted that the yield response at this rate should have been below statistical detection limits.

Generally, the placement studies have shown that the major problem with drill application (seed placed) of KCl is that in some cases, sufficient Cl cannot be applied without risking salt problems. On a per unit of Cl basis, responses to broadcast and drilled applied Cl have generally been similar.

How much Cl is required? Too few rate studies have been conducted to answer that question accurately at this time. In the rate studies conducted in South Dakota to date, 60 to 100 lbs/A of KCl generally produced near maximum yield.

Factors influencing Cl response. Subcrown internodes of wheat from all sites were rated for dryland root rot (*Cochliobolus sativus*), however, ratings were generally very low and levels were not correlated with yield response. Suppression of tanspot and leaf rust was very likely the cause of the yield increase due to Cl addition on at least one of the six responsive sites. At the other five responsive sites, no evidence of disease suppression was found.

Response to applied Cl appeared to be related to soil Cl levels and to the chloride concentration of whole plants from non Cl fertilized plots (Table 2, Figures 1 and 2). As soil Cl increased, plant Cl concentrations also increased and response to applied Cl decreased. The potential of using soil Cl levels and plant Cl concentrations as diagnostic tools for predicting responsive areas needs further study.

Investigation of cultivar differences in Cl responsiveness began in 1984. Preliminary results indicate that considerable differences do exist between spring wheat cultivars with responses at a given site ranging from 8 bu/A for the most responsive cultivar to 0 for the least responsive.

Table 1. Salt type influence on wheat grain yield at responsive sites in 1983 and 1984.

Salt type[1]	KCl	KNO_3	$CaCl_2$
Grain yield (bu/A)[2]	49	45	49

[1]Rates varied across sites but within a site K or Cl applied from various sources was equalized.

[2]Average of 4 locations.

Table 2. Relationship between soil Cl, plant Cl, and wheat yield response to applied Cl.

Soil Cl[1]	Plant Cl[2]	Grain Yield Responses[3]
lbs/A	%	bu/A
<100	0.08 (3)[3]	5.8 (4)
100-175	0.15 (2)	3.5 (2)
>175	0.59 (1)	1.0 (1)

[1]Water soluble Cl to a 4' depth.

[2]Whole plant at early heading (Cl check plots).

[3]Number in parenthesis is the number of sites in that range.

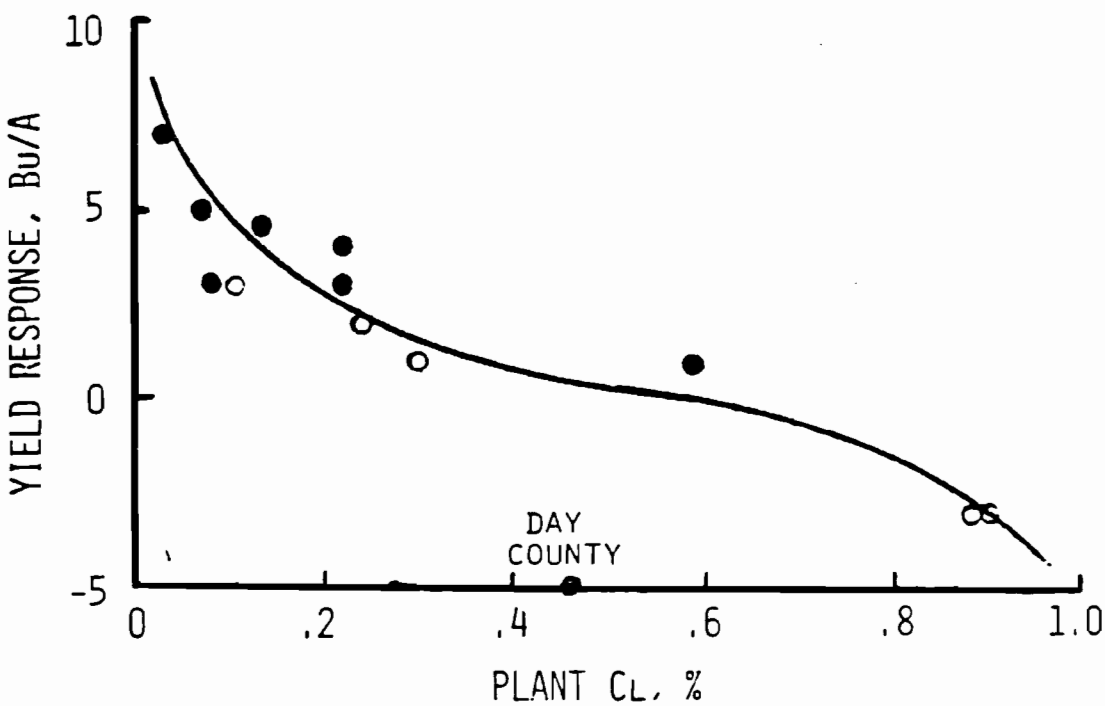

Fig. 1. RELATIONSHIP BETWEEN PLANT CHLORIDE CONCENTRATION AND YIELD RESPONSE TO CHLORIDE FERTILIZATION, 1982-1984.

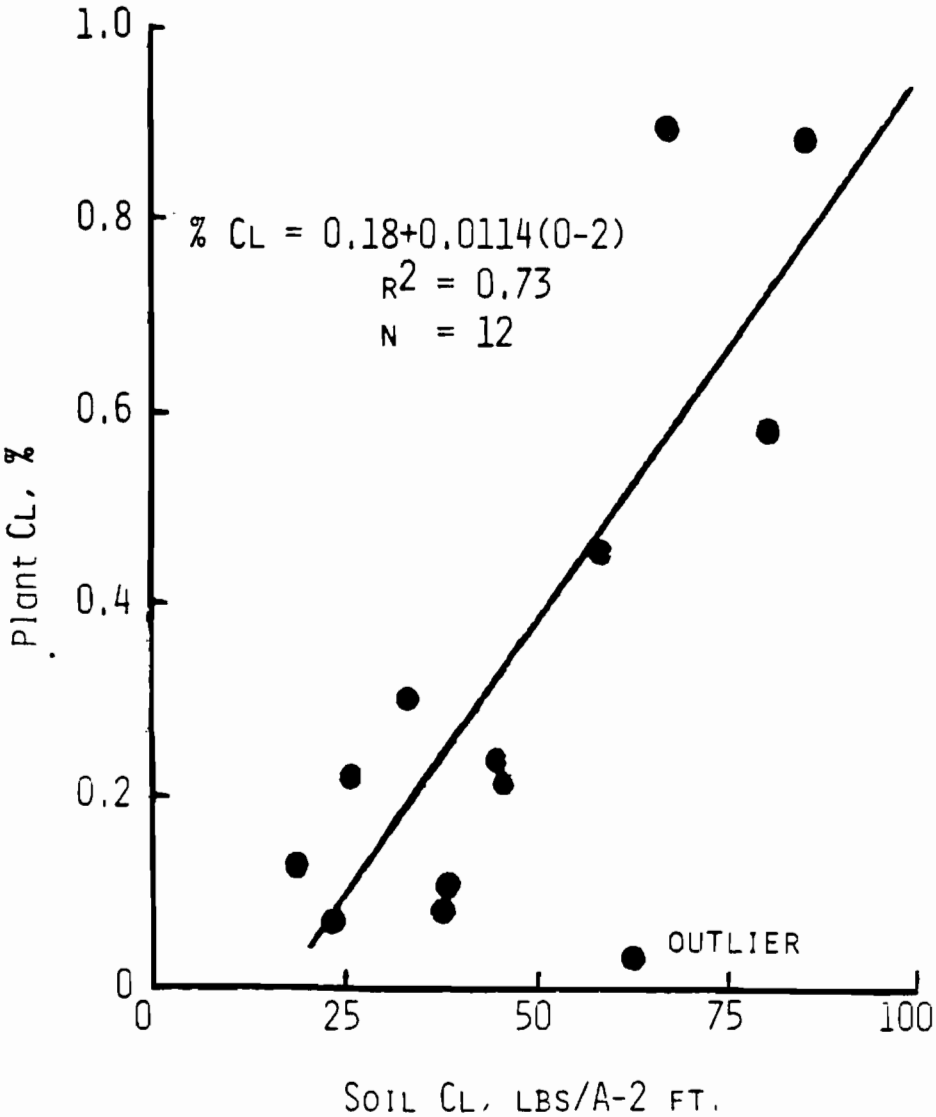

FIG. 2. INFLUENCE OF SOIL CHLORIDE TO A 2 FOOT DEPTH ON PLANT CHLORIDE CONCENTRATION, 1982-1984.

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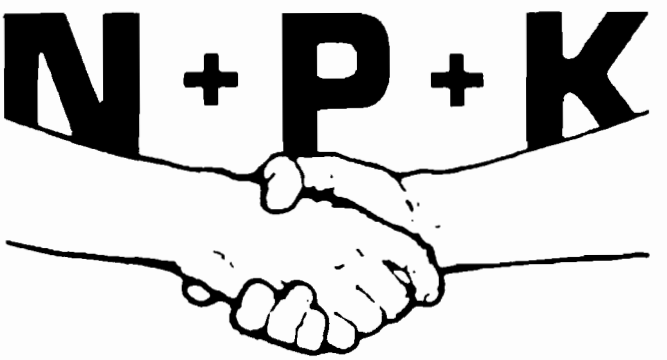

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