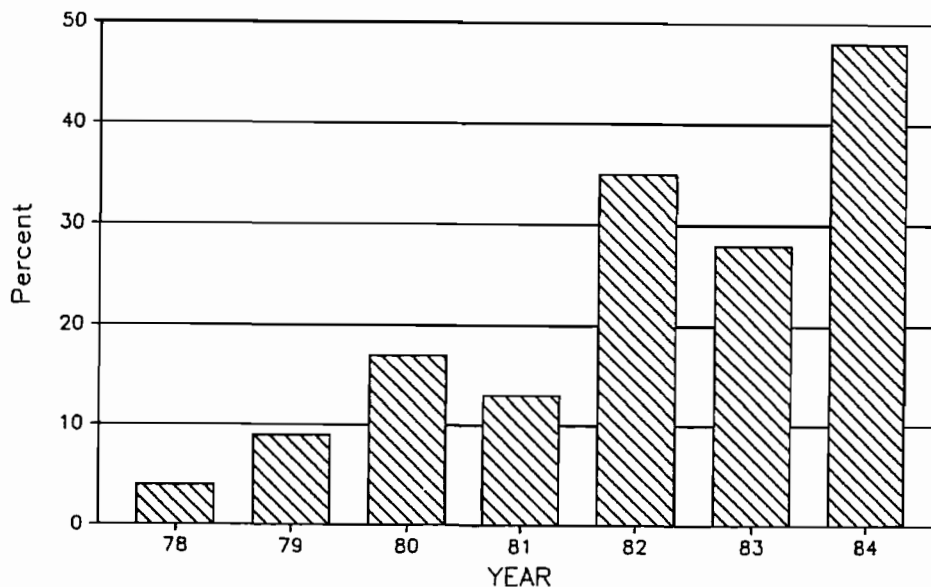


TOLERANCE TO LOW pH - SOLUBLE ALUMINUM
BY WINTER WHEAT GROWN IN KANSAS

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The majority of Kansas soils are relatively young in terms of geologic development. Low pHs and the need for liming are not common in other than the eastern third of Kansas. In South Central Kansas, isolated very low pH's have been reported in fields predominantly cropped to continuous wheat since the late 1970s. However, in the past three to four years, an increasing number of low pH soils have been reported. A summary of the soil test results from the KSU Soil Testing Lab by year shows a dramatic increase in the percentage of samples testing below pH 5.6 for two counties (Sumner and Harper) in the southcentral area. The marked increase starting in 1982 over prior years probably reflects in part an increased awareness of the low pH problem and soil sampling by farmers not previously sampling.

PERCENT OF SOIL SAMPLES BELOW pH 5.6
RECEIVED FROM SUMNER-HARPER COUNTIES



Several simple lime rate experiments were established in the fall of 1982 for the 1983 wheat crop on sandy soils location in Reno and Stafford counties. Two of the five locations harvested gave very substantial increases to lime as can be seen in the table below. The five locations were all quite similar for initial soil water pHs but did vary in KCl extractable Al. Two of the three sites with greater than 40 ppm KCl extractable Al did respond to lime. The location with greater than 40 ppm Al that did not respond was heavily grazed and was planted to a different wheat variety. This observation plus other field observations raised a question as to whether there might be genetic differences in wheat varieties in tolerance to low pH-aluminum.

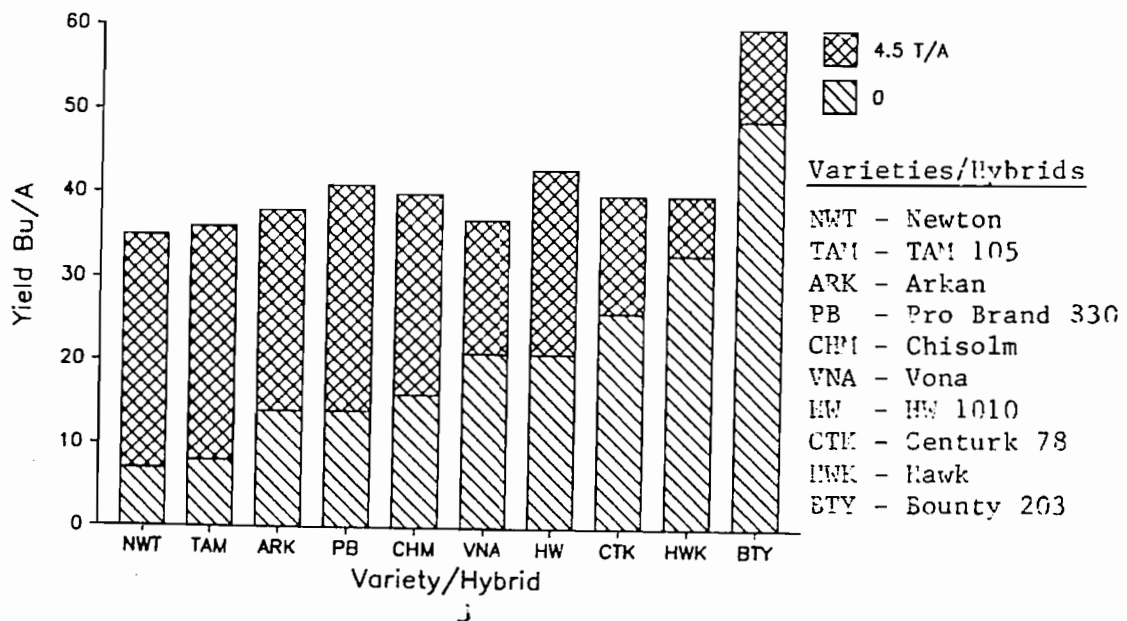
EFFECT OF LIME ON WHEAT IN SOUTH CENTRAL KANSAS

Lime Rate	Hurst-S	Hurst-N	Location Hildebrand	Miller	St. John
Lbs ECC/A	-----		Bu/A	-----	
0	30	24	27	43	48
2000	48*	42*	28	43	51
FLSD (0.05)	10	14	NS	NS	NS
Initial pH	5.1	4.9	5.1	5.2	5.1
KCL Al, PPM	44	66	53	19	14
Variety	Newton	Newton	Buckskin	Newton	Newton

1) whether wheat varieties differ in their tolerance to low pH-aluminum and 2) how this tolerance would affect the response to agricultural lime. The experiment was established on a sandy loam soil (water pH 4.7, KCl Al of 65 ppm) near Udall, Kansas which had been under intensive production. A split plot design with four replications was used. The main plots consisted of four rates of lime (0, 2250, 4500, and 9000 ECC/A) arranged in a latin square configuration. Subplots consisted of two hybrids and eight varieties of wheat. The 9000 lb/A of effective calcium carbonate (ECC) was the recommended lime rate by the KSU Soil Testing Lab. The lime was applied on September 2, 1983. Wheat planting was delayed due to wet weather until November 17, 1983 and November 10 in 1984.

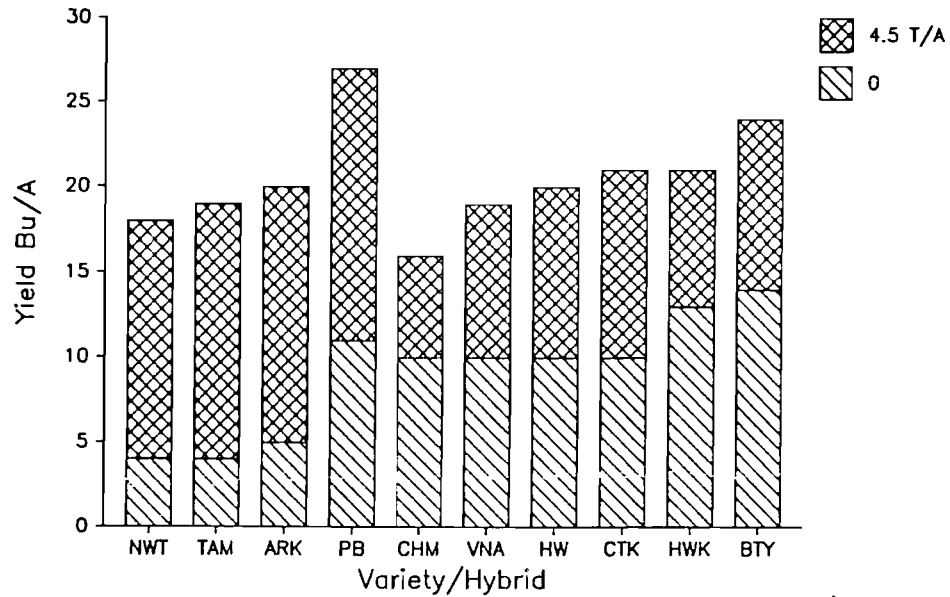
The lime was only lightly incorporated before wheat planting in the fall of 1983. Soil samples taken from the 0" to 3" and 3" to 6" depth in April of 1984 showed no pH change for the 3 to 6" layer for the limed plots. The field was plowed after the 1984 planting to help mix the lime.

ALUMINUM TOLERANCE IN WHEAT Cowley County 1984



ALUMINUM TOLERANCE IN WHEAT

Cowley County 1985



The grain yield results for both years showed a marked variety/hybrid by lime rate interaction. The data for 1984 and 1985 for the 0 and 9000 lb/A ECC (4.5 T/A) treatments are shown in the two figures below. Two of the most popular varieties in Kansas (Newton and Tam 105) seem to be extremely sensitive to low pH-aluminum soils, whereas Hawk and Bounty 203 showed excellent tolerance to the low pH especially in 1984. However, the data clearly shows that all varieties/hybrids responded to lime application. Although data for the lower lime rates is not shown in the figures, response to the 1/4 recommended lime rate (2250 lb/A ECC) was quite good suggesting that raising the pH slightly to reduce soluble Al is all that is necessary. With no lime quarries in the area and lime cost relatively expensive, farmers with low pH fields are looking at putting on less than the recommended rate in this time of low crop prices. There is also some variety selection for tolerance by

farmers on relatively low pH soils where liming is not possible at this time.

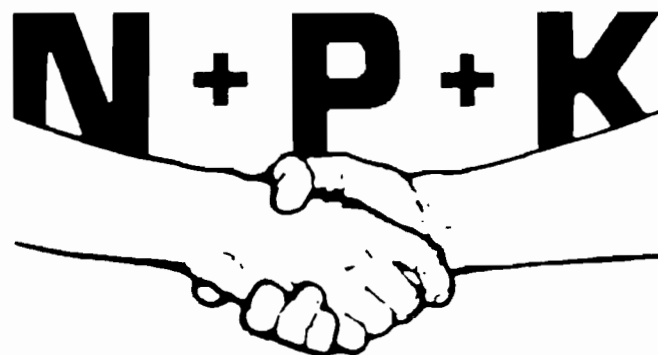
A laboratory staining technique developed by Polle, Konzak, and Kittrick (Crop Sci. 18:823-827) was used to confirm field results. Two day old wheat seedlings were grown over night in nutrient solution containing varying amounts of Al. The roots were stained with hematoxylin. Stained root caps indicated aluminum injury. This technique correlated extremely well with the field results in separating varieties according the Al tolerance. The varieties in the 1985 Kansas Wheat Performance Test were also tested. A tremendous range of Al tolerance was seen, and the majority of the varieties grown in the Southern Great Plains seem to be extremely sensitive to Al.

Research is continuing in 1986 looking at various lime sources and for further screening of wheat varieties.

CONCENTRATION OF ALUMINUM WHERE HEMATOXYLIN STAINS THE ROOT CAP

8	Al ug/ml					
	12	16	20	24	28	32+
Arkan	AGC 102	AGC 101	BTY 301	Garst HR48	BTY 205	AGC 105
Eagle	BTY 310	Centura	Jesse	Hawk	Garst HR64	BTY 202
Larned	Brule	Centurk	Ram	Mustang	Parker 76	BTY 203
Newton	Chisolm	HW 1010		Sandy	Wrangler	Atlas66
PE 830	Colt	Rodeo				
Pony	Payne	O 555				
O XH182	O XH405	O 568				
Scout 66	Tam 108	O 576				
Siouxland	Wings	O XH196				
Stallion		Vona				
Tam 105						
Tam 107						
Thunderbird						
Triumph 64						
Victory						

PROCEEDINGS
OF THE FIFTEENTH
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