

Management of Acid, High Aluminum Soils for Wheat

By R.E. Lamond and D.A. Whitney

Kansas data indicate the importance of phosphorus (P) fertilization in managing acid, high aluminum (Al) soils for wheat when liming is difficult and expensive. Results of recent studies emphasize the importance of P placement with the seed and variety selection.

A **SIGNIFICANT PART** of the highly productive winter wheat area in south-central Kansas and north-central Oklahoma is being affected by acid, high exchangeable Al soil conditions. In 1990-91, 15 percent of the soil samples received at the Kansas State University Soil Testing Lab from the 12 county south-central Kansas area were pH 5.0 or less. Another 26 percent of the samples were between pH 5.1 and 5.5.

Kansas State and Oklahoma State researchers have documented the value of liming these soils. Dramatic wheat yield responses to lime on these soils are common. Recently, Oklahoma State researchers have established that band applications of P with the seed at planting can be an effective management technique on these soils when liming isn't possible. Apparently, the banded P ties up Al, allowing better early growth and development.

Kansas Research

Studies were established in Sedgewick County, KS, on a pH 4.7 soil which had 70 parts per million (ppm) KCl-extractable Al and Bray-1 P at 54 ppm

(high). Three lime rates (0, 3,750, and 7,500 lb ECC/A), P₂O₅ (0, 40 lb/A broadcast, and 40 lb/A banded with seed), and two wheat varieties (Karl and 2163) were evaluated. The 7,500 lb ECC/A lime treatment was the full recommended rate. Karl is fairly sensitive to Al, while 2163 is somewhat tolerant to Al. Lime and broadcast P were applied and incorporated prior to planting.

Results

Shortly after emergence, visual differences began to appear. As the wheat started to break dormancy and begin

Table 1. Lime, P, variety effects on wheat yields.

Lime rate, lb ECC/A	P ₂ O ₅ rate, lb/A	P placement	Wheat variety	Grain yield, bu/A
0	0	—	Karl	44
0	40	Broadcast	Karl	45
0	40	Band	Karl	58
0	0	—	2163	56
0	40	Broadcast	2163	59
0	40	Band	2163	59
3,750	0	—	Karl	51
3,750	40	Broadcast	Karl	50
3,750	40	Band	Karl	58
3,750	0	—	2163	61
3,750	40	Broadcast	2163	61
3,750	40	Band	2163	62

LSD(0.5)

The full lime rate (7,500 lb ECC/A) had no significant effects on yield of either variety.

Dr. Lamond and Dr. Whitney are Professors of Agronomy, Extension Soils Specialist and Agronomy Extension Leader, respectively, at Kansas State University, Manhattan, KS.



PHOSPHORUS banded on acid, high-P soils enhanced wheat tillering and growth, as shown in these plots. Growth differences persisted through heading, advancing maturity.

spring growth, visual growth differences were even more dramatic. Banded P treatments, regardless of variety or lime rate, exhibited more growth, and more tillering than either the control or the broadcast P treatments (see photo above). These growth differences persisted through heading. Visual responses to banded P were much more dramatic than to lime despite the high P soil test.

First year results of this study are summarized in **Table 1**. Yields of the Al-sensitive Karl were increased 14 bu/A by banding 40 lb P_2O_5 /A with the seed at planting without lime. Broadcast P was ineffective. Lime also increased Karl yields, but only 2 to 5 bu/A. Compared to previous work, the lime response was

much smaller. This was likely due to very limited rainfall from the time the lime was applied (early August) through November 1. Soil samples taken in March, 1992 show the lime affected pH and KCl-extractable Al (**Table 2**), but these changes apparently didn't occur quickly enough to produce large yield increases. The Al-tolerant variety 2163 was much less affected by P and lime. This trial will be continued for a few more years.

Conclusions

Based on results of this study and Oklahoma data, it is evident that banded P applied with the seed at planting is a viable management alternative on acid, high

Al soils when liming isn't possible. Both forage and grain yield can be dramatically increased. Liming is the only way, however, to effectively raise soil pH. Results clearly indicate variety selection is also important under these soil conditions. ■

Table 2. Effects of lime on soil pH and Al levels.

Lime	Soil pH		Soil Al, ppm	
	0-3 inches	3-6 inches	0-3 inches	3-6 inches
lb ECC/A				
0	4.9	4.9	72	71
3,750	5.7	4.9	5	66
7,500	6.2	5.0	0	70