POTASH MANAGEMENT FOR CORN/SOYBEAN PRODUCTION IN RIDGE-TILL PLANTING SYSTEMS

T.L. Wagar[1] and G.W. Rehm[2]
Department of Soil, Water, and Climate
University of Minnesota

Crop producers who continuously used ridge-till planting in a corn and soybean rotation were finding potassium (K) deficiency symptoms in corn even though the K soil test levels were high or very high. The unexpected K deficiency in corn was a concern that raised questions about managing potash in the ridge. The same potash management concerns were applicable for strip-till and no-till as well, where plant nutrients become stratified in the soil as a result of reduced tillage.

Potassium deficiency symptoms in corn that was grown in ridges were reported as early as the 1960's in Minnesota. During the drought years of 1988-1989 in the Midwest, deficiency symptoms in corn planted with ridge-till became more common. Field trials in Minnesota showed potash that was deep banded at 40 lb. K_2O/acre in the center of the row, improved yield and K deficiency symptoms disappeared. Other studies reported corn yield response with deep-banded K_2O in ridge-till systems when soil test K levels were in the range of 140 ppm. Research in Iowa (Fig. 1) showed a yield response for corn when potash was banded in the center of the ridge, but not for broadcast K_2O or the check. There was no response for any treatment in soybean.

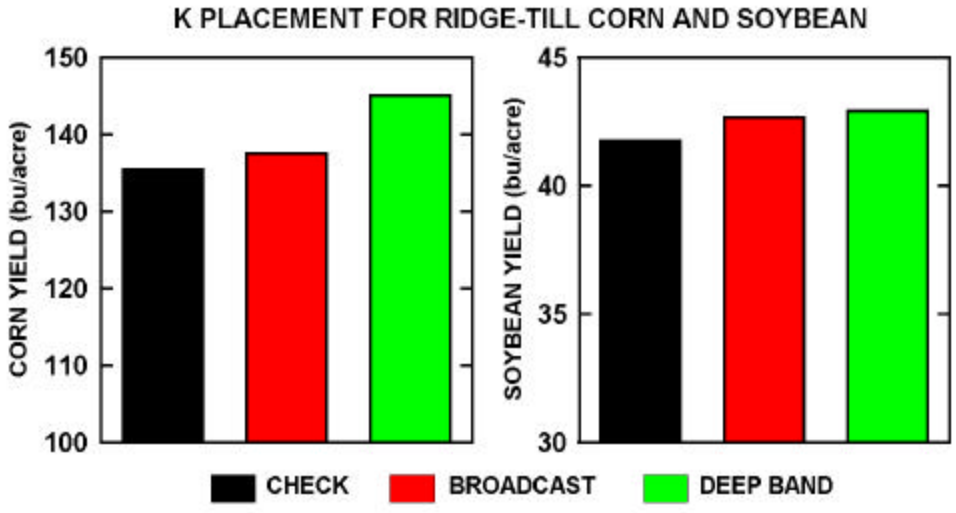

Fig.1. Iowa State University, K placement for corn and soybean planted in ridge-till.

[1] Tim Wagar, Area Extension Educator, 863 30th Ave. SE, Rochester, MN, 55904

[2] George Rehm, Extension Soil Scientist, 439 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN, 55108

Ridge-till, strip-till (zone tillage), and no-till are conservation tillage systems that use various levels of reduced tillage. Broadcast applied potash becomes stratified in soil where less tillage is used. For this reason, research has focused on the question, is banded K_2O essential for optimum corn/soybean production in conservation tillage systems for all soil test levels of K?

Study Objectives

1) Measure the effect of banded potash for corn grown in a ridge-till system when soil test levels are greater than 140 ppm.
2) Evaluate the effect annual and biennial applications of K_2O on the yield of soybean grown in a ridge-till planting system.

Study Details

Three on farm sites were selected that typified ridge-till production in west central and southern Minnesota. Annual rates of potash (0-0-60) were applied in soybean stubble prior to the corn crop and corn stubble prior to soybean at 20, 40, 60, and 80 lb. K_2O/acre. A control (0 K_2O) was also included. The annual rate was doubled and applied once (biennial treatment) prior to corn. Potash was band applied in the center of the existing ridges at a 4-6 inch depth. A split plot design was used with time of application as the main plot in four replications.

Initial Soil Test K Measurements

At all sites the initial K soil test levels at 0-6 in. averaged greater than 140 ppm (Table 1).

Table 1. Initial soil test K measurements.

	Location		
Depth	Blue Earth	Dodge	Pope
in.	soil test K (pmm)		
0 – 3	184	179	279
3 – 6	135	104	158
6 – 9	124	93	130
0 – 6 ave.	160	142	219

Results - Corn

Blue Earth and Dodge Counties sites were harvested for grain yields. The Pope County site was not harvested due to crop damage in the plot area. Blue Earth Co. site had an average corn yield of 178 bu./acre and the Dodge Co. site averaged 160 bu./acre with no statistical difference in yield at either site. The percent concentration of K in the ear-leaf of the corn plant increased at the Blue Earth and Pope Co. plots, but was not affected at the Dodge Co. plots. (Yield and K uptake by the corn plant were not shown in this proceedings).

Conclusions (Corn Phase)

- Banded K_2O had no effect on corn yield when soil test K (0-6 inches) exceeded 140 ppm.
- Banded K_2O increased K uptake by young plants, but enhanced K uptake was not reflected in additional yield.

Biennial and Annual Applications of K_2O

Corn/soybean producers have adopted a biennial application of potash where two annual applications are combined and applied prior to the corn crop to supply K for both growing seasons. In this study, with soil test K levels greater than 140 ppm, there was no yield response in soybean to either the biennial (Table 2) or annual (Table 3) potash treatments.

Table 2. Soybean yield results from a biennial application of K_2O.

K_2O Rate	Location		
	Blue Earth	Dodge	Pope
lb./acre	----------bu./acre----------		
0	37.8	39.2	39.3
40	36.2	39.1	40.1
80	35.8	39.1	41.9
120	38.6	39.2	42.0
160	31.8	40.3	40.0

Table 3. Soybean yield results from two annual applications of K_2O.

K_2O Rate	Location	
	Dodge	Pope
lb./acre	----------bu./acre----------	
0	36.9	41.9
20	36.2	42.2
40	33.6	41.5
60	38.6	40.0
80	31.7	40.1

Potassium Concentration in Soybean Trifoliate Plant Tissue

The K concentration in soybean plant tissue at early bloom showed no difference at any of the sites or for any rate of potash applied (Table 4).

Table 4. Potassium concentrations in the most mature trifoliate at early bloom of soybean.

	Location		
K_2O Rate	Blue Earth	Dodge	Pope
lb./acre	----------%K----------		
0	2.07	2.35	2.57
20	2.07	2.35	2.59
40	2.08	2.35	2.63
60	2.07	2.29	2.63
80	2.09	2.35	2.67

Conclusions (Soybean Phase)

- Rate of banded K_2O had no effect on soybean yield when applied either on an annual or biennial basis.
- Potassium concentration in trifoliate plant tissue sampled at early bloom was not affected by rate of banded K_2O applied annually or on a biennial basis.
- The soil was apparently able to supply the amount of K required for optimum yield.

Summary

- Banded K_2O did not increase corn yield when soil test values for K (0-6 inches) in a ridge-till system were greater than 140 ppm.
- Neither annual of biennial banded application of K_2O increase soybean yield following corn in a ridge-till system.
- Repeated annual application of 80 lb. K_2O/acre increased soil test K in the surface soil compared to a biennial application of 160 lb. K_2O/acre.