BANDED POTASSIUM FOR RIDGE-TILL PLANTING SYSTEMS

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INTRODUCTION

The ridge-till planting system is a proven tool for controlling soil erosion and providing maximum efficiency of water use by corn. The use of the ridge-till planting system in the northern Corn Belt has increased substantially in the past several years. Recently, however, potassium (K) deficiency symptoms have been reported in many fields. These observations have occurred even though soil test values for K have been in the high range.

As the number of reports of K deficiencies increased, it was obvious that research studies were needed to provide an answer to the problem. So, trials were initiated in the fall of 1988 in ridge-till fields in both southwestern and north-central Minnesota. These fields had a documented history of K deficiencies when corn was grown in the corn/soybean rotation.

METHODS

For the experimental site in southwest Minnesota, four rates of K_2O (0, 40, 80, 160 lb./acre) and three hybrids (Pioneer 3737, Pioneer 3732, Pioneer 3902) were arranged in a factorial design with four replications. The various rates of K_2O were knifed into the center of an existing ridge in the fall of 1988. The coulter and knife assembly placed the K_2O, supplied as 0-0-60, at a depth of 3.5 to 4 inches below the soil surface. Detailed soil samples were collected prior to fertilizer application and analyzed for K. The results are summarized in Table 1.

Corn was planted in late April, 1989. Management practices conducive to high corn yields were used whenever appropriate. Whole plant samples were collected at approximately 4 and 6 weeks after emergence. Ear leaf samples were collected at silking. Whole plant samples were dried, weighed, ground, and analyzed for K. The ear leaf samples were dried, ground, and analyzed for K. Grain yields were measured in October and corrected to 15.5% moisture.

Table 1. Soil test values for K in an existing ridge in Murray County, Minnesota. Fall, 1988.

	Distance from the Row (in.)					
Depth	0	3	6	9	12	15
in.	ppm K					
0-3	173	157	166	187	194	179
3-6	141	138	146	139	125	118
6-9	138	132	126	113	101	128
9-12	111	107	105	103	105	107

An estimate of treatment effects on root growth was made in late June. To do this, steel boxes, which were 15 in. x 12 in. x 6 in., were placed over a corn plant and pressed into the soil to a depth of 12 in. The box containing the corn plant, roots, and soil was removed and soaked in water over night. Soil was carefully washed from the roots with a fine mist. Roots were dried, weighed and analyzed for K.

A second study was conducted in a ridge-till field in Kandiyohi County in north-central Minnesota. Four treatments were evaluated. These were:

1. Control (N only)
2. Starter K_2O only (110 lb. 7-21-7/acre)
3. Band-applied K_2O and P_2O_5 (5-26-100) in the center of existing ridge
4. Starter (110 lb. 7-21-7/acre) plus band-applied K_2O (5-26-100).

Production practices conducive to high yields were used. Grain yields, corrected to 15.5% moisture, were measured in October.

RESULTS

Potassium uptake by corn grown in southwestern Minnesota was affected by both corn hybrid and the rate of K_2O banded in the ridge. There was no significant interaction between these two

variables. This observation was consistent for plant samples collected at both 4 and 6 weeks after emergence. Potassium uptake data for plants sampled at 6 weeks after emergence are summarized in Table 2.

Table 2. The influence of corn hybrid and rate of K_2O applied in a band in the center of the ridge on K uptake by corn at 6 weeks after emergence. Southwest Minnesota, 1989.

	K_2O applied (lb./acre)				
Hybrid	0	40	80	160	Ave.
	- - - - - - - mg K/10 plants - - - - - - -				
Pioneer 3902	372	619	748	1122	715 a*
Pioneer 3732	199	486	623	788	524 b
Pioneer 3737	393	759	917	941	753 a
Ave:	321	621	763	950	

* Means for the 3 hybrids followed by the same letter are not significantly different at the .05 confidence level.

Potassium uptake increased curvilinearly with rate of applied K_2O. Considering the hybrid influence, K uptake was lower at all rates of applied K_2O when Pioneer 3732 was grown in the ridge-till system. Potassium uptake was equal when Pioneer 3902 and Pioneer 3737 were compared.

Potassium concentration in the ear leaf tissue was also affected by both rate of applied K_2O and hybrid (Table 3). The K concentration increased curvilinearly with rate of K_2O used for each hybrid. When averaged over all rates of K_2O applied, the K concentration was lowest for Pioneer 3732, highest for Pioneer 3737 and Pioneer 3902 was intermediate. In general, K concentrations in the ear leaf tissue were low for all hybrids and rates of applied K_2O. This observation, however, is consistent with other reported observations for corn planted with ridge-till systems.

The influence of rate of K_2O applied on the grain yield of the 3 hybrids is illustrated in Figure 1. The banded application

of K_2O in the center of the existing ridge increased the yield of each hybrid. For Pioneer 3902 and Pioneer 3737, the rate of 40 lb. K_2O/acre was adequate for optimum yield. The use of 80 lb. K_2O/acre, however, was needed for optimum yield of Pioneer 3732.

Table 3. The influence of corn hybrid and rate of K_2O applied in a band in the center of the ridge on the concentration of K in the ear leaf tissue of corn. Southwest Minnesota, 1989.

	K_2O applied (lb./acre)				
Hybrid	0	40	80	160	Ave.
	- - - - - - - - - -		% K	- - - - - - - - - -	
Pioneer 3902	.98	1.11	1.37	1.47	1.23 b*
Pioneer 3732	.78	1.18	1.28	1.37	1.15 c
Pioneer 3737	1.09	1.34	1.46	1.56	1.36 a
Ave:	.95	1.21	1.37	1.47	

* Means for the 3 hybrids followed by the same letter are not significantly different at the .05 confidence level.

Yields from the trial in Kandiyohi County in north-central Minnesota are summarized in Table 4. With Pioneer 3737, grain yield was increased by the banded application of K_2O in the center of the ridge in the previous fall. This trial was not conducted to evaluate the effect of rate of K_2O applied. It was conducted to determine if both banded K_2O and the use of K_2O in a starter band were necessary for optimum yield.

The use of 8 lb. K_2O in the starter at planting only had no significant effect on yield. The use of the 7-21-7 as a starter fertilizer in combination with the banded K_2O did not increase corn yields when compared to the use of the banded K_2O alone. These data indicate that if K_2O is applied in a band in the center of the ridge, it is not necessary to use K_2O as a component of the starter fertilizer.

Table 4. The effect of placement of K_2O on corn yield in a ridge-till system in Kandiyohi County Minnesota, 1989.

Treatment	Yield
	bu./acre
Control	154
Starter K_2O (110 lb. 7-21-7/acre)	154
Band Applied K_2O (5-26-100) in center of Ridge	171
Starter K_2O + Band K_2O	173

Why the Problem?

The specific reason for the K availability problem in the ridge-till planting system is not known, but it is possible to speculate about potential and probable causes. Some soils can become compacted with the use of reduced tillage planting systems. More compaction could reduce root density in the soil by decreasing the rate of root elongation. Locally, elevated bulk densities could also slow the diffusion of K to the root.

There are others who believe that the K deficiencies are caused by the fact that bulk density is reduced in the ridge-till planting systems. This could reduce the contact between root and soil and thus reduce K uptake by the corn plant.

Subtle changes in root hair density induced by the ridge-till planting system could also be involved. The reduced uptake could also be the result of changes in both soil moisture and temperature with the ridge-till planting system. The data collected to date do not identify the cause of the problem. The use of the banded K_2O, however, will provide a short-term solution. Much more remains to be done before this problem is solved.

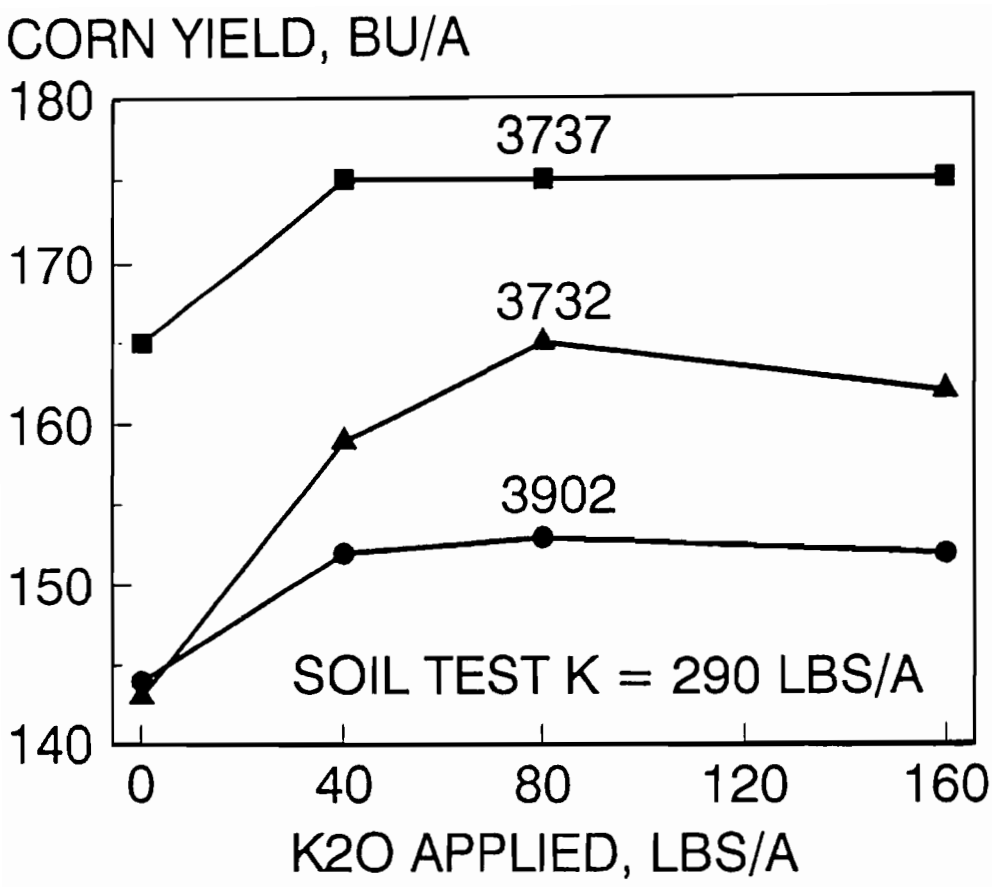

Figure 1. Grain yield of corn as affected by hybrid and rate of K_2O banded in the center of existing ridges. Southwest Minnesota, 1989.

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