by Dr. George Rehm

Change a Necessity When Switching to Reduced Tillage

Fertilizer Managment studies in reduced tillage focus on NPK.

Summary: Some changes in fertilizer management are needed when growers switch from more conventional to ridge-till and no-till systems. There's no need to change N rate for ridge-till but higher rates may be needed for continuous no-till corn. No change in selection of sources is needed for N and all sources should be placed below the soil surface. For P, no need to change rate, banding is more effective than broadcasting and there are several possible locations for the band. Added K may be needed even though soil test values are high and banding again is more effective than broadcasting. When soil testing in ridge-till, collect sample six inches to the side of the row. For pH, organic matter content, P, K, and Zn analyses, collect samples to a minimum depth of six inches.

There is considerable interest in using ridge-till and no-till planting systems for corn and soybean production throughout Minnesota. This interest is sparked by concerns for environmental quality, farm profitability and conservation compliance. There are also several questions that need answers as farmers consider switching to conservation tillage production systems. Many of those questions involve fertilizer use.

There's general agreement that some changes in fertilizer management practices are needed as growers switch to ridge-till and no-till planting systems. Some of these changes have been documented by research projects. There are also needed changes that have not been identified. The needed changes will also vary with nutrient. Therefore, this article will discuss the changes needed for nitrogen management contrasted with those needed for the management of phosphate and potash.

Managing nitrogen

In recent years, a number of research projects have focused on developing nitrogen management practices that are appropriate for corn production in ridge-till and no-till planting systems. There is general agreement in most of these studies that were conducted throughout the United States. Some important points about nitrogen fertilizer management can be summarized as follows.

• There is no need to change the rate of nitrogen fertilizer needed when switching to ridge-till and no-till planting systems. In western Minnesota, suggestions for nitrogen rates should be based on the results of the soil nitrate test. For the remainder of the state, recommendations should be based on yield goal, the previous crop in the rotation and the soil organic matter content.

• There is no need to change time of applications. In Minnesota, suggestions for timing vary with soils and climate.

• Placement is a major consideration. All nitrogen, regardless of the source used, should be placed below the soil surface in ridge-till and no-till planting systems. Nitrogen is lost or immobilized if nitrogen fertilizers (primarily 28-0-0) are placed in contact with crop residue. Some incorporation eliminates this possibility for loss.

• If incorporated, all nitrogen sources have an equal effect on yield.

P & K use

In contrast to nitrogen, there has been a limited amount of research devoted to developing management practices that will provide for the most efficient use of these two nutrients. These nutrients are not mobile in soils. Therefore, special consideration should be given to the most appropriate placement that will lead to effective and efficient use.

In addition, there have been reports for several years of the appearance of K deficiencies in corn grown in ridge-till planting systems. These symptoms were noted even though soil test values for K were considered to be in the high category. The severity of the problem appeared to be related to hybrid.

In the northern Corn Belt, the problem did not appear to be confined to specific soils or environments. Reports of the problem have come from a diversity of corn production situations in Minnesota and neighboring states.

Emphasis on banding

As more research information is accumulated, there are strong indications that banding phosphate and potash fertilizers will be superior to broadcast applications. Yields from a study conducted at the West-Central

Experiment Station show the importance of banding potash (Table 1).

Table 1. Impact of K_2O placement and corn hybrid on yield of corn. Morris, 1992.

Hybrid	Placement	Yield bu/acre
Pioneer 3732	None	54
Pioneer 3732	Band	99
Pioneer 3732	Broadcast	58
Pioneer 3737	None	58
Pioneer 3737	Band	102
Pioneer 3737	Broadcast	69

The rate of applied K_2O was 40 lb/acre for both band and broadcast placements. Yields were substantially higher for both hybrids when the banded placement was used. This would indicate more efficient use of banded K_2O. Potassium is not considered to be mobile in soils and, although yields were improved slightly with the use of a broadcast application, highest yields were produced by banding. The soil test value for K was 161 ppm at this site.

Research trials on banded potash were also conducted in Murray County in 1989. In these studies, three rates of K_20 (40, 80, 160 lb/acre) were banded in the center of the ridge at a depth of 3 to 4 inches in the fall of 1989. Three hydrids (Pioneer 3902, Pioneer 3732, Pioneer 3737) were also used. A control was used for each hybrid. Plant samples were collected during the growing season and analyzed for K to monitor K uptake. The effect of rate of potash applied on K uptake is summarized in Table 2.

The V4 stage samples are whole plants collected at approximately four weeks after emergence. The V8 stage samples were collected at approximately six weeks after emergence. The ear leaf (EL) samples were collected at silking. As might be expected, the K concentration in the tissue increased as the rate of K_2O increased. This is rather clear evidence that roots of the corn plants are using the banded K_2O throughout the growing season.

Table 2. The effect of rate of applied K_2O on K concentration in corn tissue in 1989.

K_2O Applied lb/acre	Stage of Development V4	V8 % K*	Ear Leaf
0	0.91	1.08	0.95
40	2.18	1.49	1.21
80	2.57	1.75	1.37
160	3.06	2.08	1.46

*Values reported are the averages for 3 hybrids.

Table 3. The effect of corn hybrid on K concentration in corn tissue.

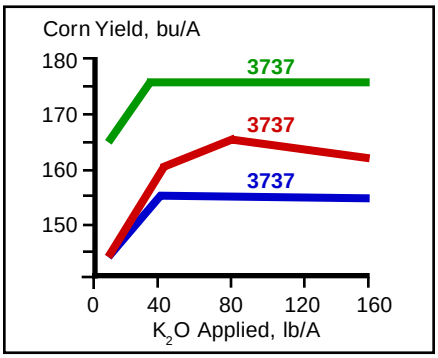
Hybrid	State of Development V4	V8 % K*	EL
Pioneer 3902	2.23	1.71	1.23
Pioneer 3732	1.90	1.28	1.15
Pioneer 3737	2.40	1.80	1.36

*The values shown are averages for all rates of K_2O applied.

Uptake of banded K was also affected by the variety planted (Table 3). Throughout the growing season, K concentration was lowest for the Pioneer 3732 variety. Concentrations were nearly equal when the two varieties were compared. These observed differences in uptake among varieties indicate that there are some genetic deferences in root structure, root hairs, root distribution in soils, etc. These deferences, if they exist, are not known at this time.

The differences in K uptake carried through to grain yield (Figure 1). Even though the soil test for K was considered to be in the high range (145 ppm or 290 lb/acre), there was a substantial yield increase when K was banded. For the 3737, and 3902 hybrids, optimum yield resulted from the use of 40 lb K_2O per acre. The application of 80 lb K_2O per acre was needed to produce the optimum yield, when using the 3732 hybrid.

Figure 1. Effect of rate of banded K2O on



Soybean response

Soybeans were planted at the Murray County site plots in 1990 and frequency of application of K_2O was evaluated. The rates of applied K_2O remained the same. The effect of a single application in the fall of 1988 was compared to the results from two annual applications in the fall of 1988 and fall of 1989 (Table 4).

Table 4. The effect of frequency and rate of K_2O on yield of soybeans planted in ridges (Murray County, 1990).

K_2O Application lb/acre	Rate Applied Each Year bu/acre	Yield
1988	0	49.6
	40	49.6
	80	49.7
	160	52.5
1988,1989	0	49.5
	40	51.0
	80	51.5
	160	54.3

Highest yield was produced by the annual application of 160 lb K_2O per acre. Applying either 40 or 80 lb K_2O per acre on an annual basis produced yields that were equivalent to the yield produced by applying 160 lb K_2O per acre in 1988 only. These limited data indicate that an application of K_2O once every two years in a corn-soybean rotation should be adequate for

optimum yield of both crops.

Placement of the band

Results of research in the past few years have emphasized the importance of banding both phosphate and potash in ridge-till and no-till planting systems. Some, however, question if there is an ideal location for the band with respect to the seed.

Placement of banded phosphate fertilizers in a ridge-till planting system has been evaluated in trials at the West-Central Experiment Station at Morris and the Southwest Experiment Station at Lamberton. The phosphate fertilizer was applied in a band at various positions from the row. The yields are summarized in Table 5.

Table 5. The influence of location of the band of phosphate fertilizer on corn yield at Morris and Lamberton in 1989.

Band Placement	P_2O Applied lb/acre	Location Morris bu/acre	Lamberton bu/acre
Starter	23	148	113
Ridge Center	23	151	112
Ridge Shoulder	23	154	117
Soil Test P (Bray), ppm		5.5	5.1

Position of the band had no major effect on yields at both locations. These results are consistent with grower experiences. Some choose the use of a starter fertilizer for placement of phosphate and potash and are satisfied with the results. Others, who use a ridge-till planting system, prefer banding during the previous fall.

Suggested rates of phosphate and potash are, at this time, the same for all band placements. For phosphate, suggestions are to use the rates recommended for a starter application. For potash, an annual rate of 40-50 lb / K_2O per acre is suggested. This can be doubled and applied once every two years for the corn-soybean rotation.

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