Residual Effects of Potash in an Alfalfa-Corn Rotation

By M.A. Schmitt, M.P. Russelle, and C.C. Sheaffer

Observation and data from a recent study in Minnesota point out the tremendous potassium (K) needs of alfalfa. It also reinforces the concept of long-term fertility management that considers the needs of individual crops, but focuses on the entire cropping system using frequent soil testing to monitor soil fertility.

IN THE LATE SUMMER OF 1990, dramatic K deficiency symptoms were present in corn in a "bulk" field of the Rosemount research station in Minnesota. The stark contrast between the best and worst corn was remarkable (see photo at right and next page).

The field displayed a checkerboard pattern—with remnants of previous treatments creating various increments of corn height and overall health. The "good" corn was more than 7 feet tall and had full ear development, while the "worst" corn was no more than than 2 feet tall, including its tassel. The classic marginal necrosis of the corn leaves was present on all but the best looking "squares" of corn—no doubt a previous study had involved K fertilization!

The soil was a Waukegan silt loam with approximately 28 inches of loam over outwash sand and gravel. This hidden, almost forgotten, plot area had been part of an alfalfa study. That study, initiated in the spring of 1985, investigated the interacting effects of K fertilization, alfalfa cutting management schedules, and alfalfa varieties, differing in winterhardiness ratings. The K fertilization rates consisted of 0, 125, 250, and 500 lb of K_2O per acre. This fertilizer was added as a plowdown treatment in 1985 and applied in split, top-dressed applications in 1986 and 1987.

CORN plants in the low-K plot areas showed classic deficiency symptoms . . . note marginal "firing" and necrosis of leaves.

The initial soil K test was 100 parts per million (ppm), rated as "low". The control plot plants exhibited K deficiency symptoms in the establishment year and produced little harvestable forage in 1987. Oats were grown in the plot area in 1989 and corn was then grown in 1990. The field has received no fertilizer since the alfalfa project ended in 1987.

After the discovery of this nutrient-deprived area, a previous plot plan was obtained to link past treatments with current blocks or "checkerboard squares." The alfalfa-fertilization study used a split-split plot design with K fertilizer rates being in the main plots. This is the only factor that provided a significant visible effect on the 1990 corn crop.

M.A. Schmitt is a soil scientist in the Department of Soil Science, M.P. Russelle is a soil scientist with USDA-Agricultural Research Service-U.S. Dairy Forage Research Center, and C.C. Sheaffer is an agronomist in the Department of Agronomy and Plant Genetics, all at the University of Minnesota, St. Paul, MN.

VISIBLE differences in corn growth were the effects of earlier K treatments, when alfalfa was grown in the plot area.

Results

Corn grain yields were measured after physiological maturity. The yield data, ranging from 6 to 180 bu/A, are shown in **Figure 1**. Yields were measured separately for the 3-cut and 4-cut management treatments, but they did not differ. The alfalfa variety sub-sub plots were harvested together.

Available K in the plow layer in 1990 ranged from 53 ppm K for the control plot to 87 ppm for the high K treatment, which had received 1,500 lb of K_2O just a few years earlier (**Figure 1**). Although these data show relative differences in soil test values due to fertilizaton programs, the range of the soil test values is quite narrow when compared to the wide range of yields produced by these plots.

This plot area has led to more questions than answers, and the number of questions grows each year. While the refinement of soil K tests and the resulting K recommendations can be a future goal from this project, a broader issue may be the development of fertilization plans for the entire rotations.

It is important to use a fertilizer management plan that meets current needs **and** that is adaptable for future needs as well. This particular study exhibited greater K treatment differences (excluding the controls) with the subsequent corn crops than it did during the alfalfa crops. ■

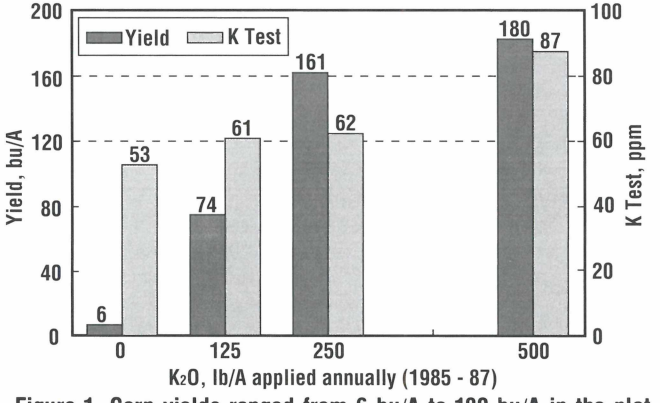

Figure 1. Corn yields ranged from 6 bu/A to 180 bu/A in the plot areas where alfalfa had been grown previously.