SOIL pH AND CORN-SOYBEAN ROTATION YIELD RESPONSES TO LIMESTONE APPLICATION AND TILLAGE[1]

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Abstract

Farmers growing corn and soybean in northwest Iowa must carefully consider liming needs and economics. This is because of high limestone material cost and the fact that soils in northwest Iowa have high pH subsoil, which can moderate negative effects of acid surface soils. Another factor that must be considered is the variable effect from limestone mixing depth associated with different tillage systems. An experiment designed to evaluate six rates of aglime (0 to 6,000 lb/acre of effective calcium carbonate equivalent, ECCE) with three tillage systems (no-till, ridge-till, and chisel plow) in a corn-soybean rotation was established in 1994 at the ISU Northwest Iowa Research Farm, Sutherland Iowa. The tillage systems and crop rotation started in 1992. Lime was applied in December, 1993 and incorporated accordingly by tillage for each system – the ridge system was row cultivated twice each year, the no-till system included a shallow row cultivation once each year from 1994 to 1997, and the chisel plow system included fall chiseling, spring soil preparation with a disk/field cultivator, and one row cultivation. Corn and soybean were planted in 30-inch rows with row cleaning planter attachments. The soils in the experimental area consist of Galva, Primghar, and Marcus soils that are typical of the predominant upland soils in northwest Iowa. The initial soil pH in 1993 of the surface six inches in the experimental area was 5.6. Nitrogen fertilizer was surface applied each spring to corn at 120 to 130 lb N/acre as ammonium nitrate before planting. Grain yields were measured each year and soil was sampled (0-2 and 2-6 inch depths) every other year.

Soil pH increased with increasing aglime rates. Lime application with the no-till and ridge till systems increased pH in the top two inches of soil but had little to no effect on pH at the two- to six-inch depth. With the chisel plow system, the higher rates of aglime increased soil pH in the top two inches of soil as well as in the two- to six-inch depth. Surface application of the nitrogen fertilizer depressed pH in the surface two-inch depth and reduced the effective period of the applied lime in that soil zone. Lime application significantly increased soybean yield similarly each year in all tillage systems indicating the lime was effective in moderating low soil pH effects even when incorporation was minimal in no-till and ridge-till. Higher rates resulted in higher soybean yields. Lime application, however, did not affect corn yield in any year of the study despite the surface two-inch soil pH falling to 5.1 and the two- to six-inch pH being 5.5 (with no applied lime). The chisel plow system tended to have the highest corn yield most years and the average corn yield across years was higher with the chisel plow system than either the no-till or ridge-till system. Tillage system generally had little and no consistent effect on soybean yield, with no significant difference when averaged across years. Based on soybeans

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selling at $6.00/bu and lime costs at $25/ton of ECCE (not including application cost), it would take yield increases from approximately two soybean crops to pay for the aglime. Interestingly, the relatively low rates of 1,000 and 2,000 lb ECCE/acre increased soybean yield with correspondingly only small long-term effects on soil pH. The highest soybean yields occurred with the highest lime rate – the rate that also maintained the soil pH above 6.0.