Deep-band placement of fertilizer increases corn grain yield in eroded soils

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Nitrogen and P fertilizer placement options have the potential to affect corn yield. Tillage practices often are associated with common fertilizer placement options. Strip tillage (ST) is one tillage practice being investigated in the Pacific Northwest to conserve soil and soil water through residue management and reduce tillage costs in many areas of the Corn Belt. While ST and other conservation tillage practices are less common in this region overall, ST is becoming more common in the sugar beet industry in southern Idaho, and due to the high dairy cow populations, corn production is increasing. The dual use of ST for sugar beet and corn production will likely continue to develop, increasing the need for ST best management practices in this region.

In 2007 and 2009, fertilizer placement options under ST were compared with commonly used fertilizer placement options under conventional tillage (CT) in southern Idaho.

Methods

The field study was conducted at four locations during 2007 and 2009 at the USDA-ARS Northwest Irrigation and Soils Research Lab in Kimberly, ID on a Portneuf silt loam soil. The fields have been furrow-irrigated for 80 to 100 years and have a 1 to 2% slope. As a result, most topsoil has eroded from the top areas of the fields and some has been deposited on the bottom areas of the fields. This erosion process has decreased yields on at least 800,000 ha in the Pacific Northwest (Carter et al., 1985). During each year of the study, two locations were utilized, one at the top of a field (eroded) and one at the bottom of a field (not eroded). Prior to field operations, soil samples were collected and analyzed for organic matter (OM), free lime, bicarbonate extractable P and K, and NO₃-N and NH₄-N. Results are listed in Table 1.

Treatments were a combination of ST and CT with N and P fertilizer applied either broadcast prior to the final tillage operation (broadcast), placed 5 cm to the side and 5 cm below the seed at planting (5×5) or placed 15 to 20 cm below the soil surface directly below the seed during ST (band). The specific treatment combinations were: (1) ST with band placement of P and broadcast N; (2) ST with 5×5 placement of N and broadcast P; (3) ST with band placement of N and P; (4) CT with 5×5 placement of N and broadcast P; and (5) CT with broadcast N and P. Total N and P rates of 105 lb N/ac and 58 lb P₂O₅/ac were applied to all treatments as urea (46–0–0) and monoammonium phosphate (11–52–0).

All treatments were replicated four times.

Conventional tillage treatments consisted of chisel plow, tandem disk, fertilizer application (on broadcast treatments), and roller harrow in the spring. Strip tillage was conducted using a Strip Cat implement developed by Twin Diamond Industries, LLC in Minden, NE. The study locations were irrigated with furrow irrigation in 2007 and sprinkler irrigation in 2009.

Results

Soil analysis

In both years, soil at the top of each field had free lime two times greater and OM that was approximately 20% less than the bottom. These differences resulted from the erosion of topsoil on the top end, exposing the calcareous subsoils associated with many soils in this region. The soil test P concentrations at three of the sites (2007 top, 2009 top, and 2009 bottom) were considered low to marginal according to the University of Idaho fertilizer recommendations for field corn. The recommendations suggested application of 40 to 140 lb P₂O₅/ac depending on the soil lime content. The soil test K at all sites was considered sufficient.