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Impact of long-term effects of wheat production management practices on soil acidity, P and some micronutrients in a semi-arid Plinthosol

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Farmers continuously remove crop residues for use as building materials, fuel and animal feed or bedding as well as to avoid difficulties during tillage operations. Therefore, demonstrations of the benefits of recycling crop residues are necessary. The aim with this study was to evaluate the influence of different wheat production management practices on acidity and some essential nutrients from a long-term trial on a Plinthosol in semi-arid South Africa. The trial was set up in 1979, and since then two methods of straw management (unburned and burned), three methods of tillage (no-tillage, stubble mulch, and plough), two methods of weed control (chemical and mechanical), and three levels of nitrogen (N) fertilizer (20, 40 and 60 kg ha−1) have been applied. Soil samples were collected in June 2010 at depths of 0–50, 50–100, 100–150, 150–250, 250–350 and 350–450mm from plots that received 40 kg N ha-1 and were analyzed for pH, phosphorus (P), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn). Results obtained showed that straw burning resulted in higher P and Mn but lower Cu than no-burning. No-tillage, and to some extent stubble mulch, suppressed soil acidification and increased P and Zn compared with ploughing, especially in the surface layers where crop residues accumulate. In contrast, mouldboard ploughing and stubble mulch increased Cu more than no-tillage, possibly due to the strong affinity of organic matter for Cu. Tillage effects on Mn were inconsistent and difficult to explain. Chemical weeding also improved P, probably because of the pesticide application, but resulted in lower pH and Cu values compared with mechanical weeding. Treatment combinations also had an influence on P and, to a lesser extent, on soil pH and Cu, which might be due to the higher organic matter present in no-tilled soils. Irrespective of straw management or weed-control methods, no-tillage resulted in higher P than did ploughing and stubble mulch. Nutrient concentrations and pH values were sufficient for wheat growth under all treatments. However, although the nutrients were highest under straw burning, no-tillage and, to some extent, stubble mulch, wheat yield was higher with unburned straw and mouldboard ploughing. Therefore, an integrated approach from various disciplines is recommended to identify and rectify yield-limiting factors under conservation tillage systems.

KEYWORDS: nutrients, soil pH, straw management, tillage, weed control

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