What drives corn yield stability?

The researchers used long-term nitrogen fertilizer rate trials in continuous corn and corn-soybean rotations crop systems to determine how insufficient, optimum, and excessive nitrogen fertilizer inputs affected the amount of carbon and nitrogen in soil organic matter. Four locations across Iowa were investigated. At one continuous corn system in Ames, Iowa, the soil organic matter situation was explored in much greater detail.

What was done and why?

Crop productivity and soil quality have a positive relationship. In the absence of livestock manure, crop residues are the primary source of soil organic matter while soil organic matter provides most of the necessary crop nutrients – regardless of the amount of fertilizer inputs. Accordingly, high crop productivity and concomitant residue production are essential to maintain soil quality. This project focused on investigations of the feedback between crop production and soil quality as it is affected by nitrogen fertilizer inputs and crop rotation diversity.

What did we learn?

Iowa corn and soybean rotations receiving agronomically insufficient inorganic nitrogen fertilizer applications will experience long-term soil organic matter decline. The corn-soybean rotation in Iowa is currently unsustainable if the only organic matter inputs are crop residues. In addition, these data were collected from experiments with little to no erosion. As a result, the data should be interpreted as showing minimum levels of soil organic carbon and nitrogen loss. Erosion would represent an additional loss mechanism that is not incorporated into the project’s experimental design since the experimental plots had little or no slope.

Although 0-15 cm SOC stability was measured in sufficiently inorganic N tests, results from more detailed investigation of the Ames continuous corn experiment suggest that excessive inorganic nitrogen fertilizer inputs are rapidly lost to air and water resources. This conclusion is supported by the lack of detectable differences in soil organic matter amounts or properties between the agronomic optimum rate and the excessive rate. Thus, the project data complement agronomic assessments of the environmental nitrogen losses that demonstrate nitrous oxide emissions and nitrate leaching exponentially increase when agronomic optimum nitrogen fertilizer input is surpassed.