Dear Editor,

Mulvaney et al. (2009) claim to present evidence that inorganic nitrogen fertilizer leads to a decline in the organic nitrogen (N) content of soil. This follows an earlier paper purporting to show a corresponding decline in soil organic carbon (C) resulting from N fertilizer applications (Khan et al., 2007). Both are based on an analysis of soil N and C data from the Morrow Plots, a long-term field experiment in Illinois, started in 1876. We submit that their conclusion is flawed because the authors did not take full account of past changes in the inputs of fertilizers and manures on the Morrow Plots. We further submit that their citation of data from Rothamsted and other long-term experiments worldwide, claimed to support their conclusion, is selective and misleading. The conclusions drawn by Mulvaney et al. (2009) also appear to be at variance with other accounts of changes in soil N and C in the Morrow Plots (Aref and Wander, 1998; David et al., 2009).

Mulvaney et al. (2009) compare soil N concentration in selected treatments of the Morrow Plots measured in 1955 and 2005, for three soil depths (0–15, 15–30, and 30–46 cm) and three crop rotations: continuous corn, corn–oats (oats replaced by soybean since 1967), and corn–oats–alfalfa hay. Within each crop rotation, three current fertilizer treatments are compared:

1. None: unamended since the start of the experiment in 1876.
2. NPK: unamended until 1955, then NPK applications started.
3. HNPK (high N–P–K): a higher rate of N than in the NPK treatment applied since 1967. From 1904 to 1966, the treatment was manure, together with limestone and rock phosphate; in 1967 manure was replaced by the higher rate of fertilizer N. We consider that the authors’ misinterpretation of the data arises from ignoring this change.

The rates of N differ for each crop and have changed over time. For corn, the N rate in the NPK treatment was 168 kg ha\(^{-1}\) (1955–1966) and increased to 224 kg ha\(^{-1}\) from 1967. In the HNPK treatment, it was 336 kg ha\(^{-1}\) (1967–1997), reduced to 224 kg ha\(^{-1}\) from 1998. Thus, for the last 8 yr of the study period, the rates of N applied in HNPK and NPK were the same. For oats, the N rate is 28 kg ha\(^{-1}\) in both the NPK and the HNPK treatments. More detailed information on the previous treatments in the Morow Plots is given in Aref and Wander (1998).

In all except one of the crop rotation and fertilizer treatment combinations, there was some decrease in soil N concentration during the 51-yr period considered (1955–2005), ranging from a nonsignificant decrease of 0.007 g N kg\(^{-1}\) soil to a maximum of 0.502 g N kg\(^{-1}\) soil (Table 1 of Mulvaney et al., 2009). This is presumably because the entire site was still subject to a gradual decline in soil N following its conversion from natural grassland to arable cropping at the start of the experiment in 1876. Such long-term trends in soil N and C concentrations following a major change in management are commonly observed in long-term studies in temperate climates (e.g., Aref and Wander, 1998; Johnston et al., 2009). Mulvaney et al. (2009) argue that high rates of N fertilizer cause a decline in soil organic N and C based on the evidence that declines in N concentration were greatest in the HNPK treatment. However, this conclusion ignores the important difference in the longer-term history of the NPK and HNPK treatments summarized above. The treatment that became HNPK in 1967 had previously received manure over a period of 62 yr, and this increased soil N as shown in Table 1 of Mulvaney et al. (2009). For example, for continuous corn, N concentrations in 1955 in the NPK treatment (that had never received manure) were 1.376, 1.342, and 1.020 g kg\(^{-1}\) soil in the 0–15-, 15–30-, and 30–46-cm depths, respectively. In the same year, the corresponding concentrations in the HNPK treatment (that previously received manure) were 1.534, 1.568, and 1.476 g kg\(^{-1}\) soil (i.e., 11–45% greater than in the NPK treatment). It is inevitable that after stopping manure applications in 1966, organic N and C would decline as a result of decreased organic inputs. Thus, the observation that soil N and C declines in the HNPK treatment were greater than in the unamended and NPK treatments is entirely understandable on the basis of the cessation of manure applications. Manure applications stopped at the same time as the high fertilizer N rate started, so the effects are confounded. While it is impossible to conclude unequivocally which change of treatment is

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