NEW ITEMS IN THE NBMA RESOURCE LIBRARY

Carbon reserves July 2016

TITLE: The effects of long-term application of organic amendments on soil organic carbon accumulation

Author: Li, J. and G.K. Evanylo

Source: Soil Sci. Soc. Am. J. 2013 77:964-973

Abstract: Application of organic amendments (e.g., biosolids [BS], composts) to soil may provide an effective method for accumulating considerable amounts of C, but the long term stability of such C is not well known. We investigated study sites in Virginia to determine the amounts of C remaining in soils 7 to 27 yr following amending with biosolids and composts. The first study employed a Fauquier silty clay loam (fine, mixed, active, mesic Ultic Hapludalf) to which four treatments (control, poultry litter-yard waste compost, biosolids compost, and poultry litter) were continuously applied during 2000–2004. The second study was conducted on a Davidson clay loam (fine, kaolinitic, thermic, Rhodic Kandiudult) to which six rates of aerobically digested biosolids (0, 42, 84, 126, 168, and 210 Mg ha^{-1}) were applied in 1984. The third study was on a Pamunkey sandy loam (fine-loamy, mixed, semiactive, thermic Ultic Hapludalfs) to which five rates of anaerobically digested biosolids (0, 14, 42, 70, and 98 Mg ha^{-1}), with and without sawdust, were applied in 1996. Total soil organic C concentration and bulk density were measured to calculate C accumulation. The organic amendment-treated soils increased C in the surface soil depth (<15 cm), ranging from 2 to 12% of C across all three sites. Soil C movement was limited to a depth of 15 cm. evidence of C saturation was revealed in the third study site. These results demonstrate that organic amendments applied over a long time remain in soil and may contribute to C sequestration in the Mid-Atlantic region.

Document#: MSC.CA.MIN.5.1

TITLE: Temporal effects of food waste compost on soil physical quality and productivity

Author: Reynolds, W.D., C.F. Drury, C.S. Tan, and X.M. Yang

Source: Canadian J. Soil Sci. 2015 95: 251-268.

Abstract: The benefits of compost additions on soil organic carbon content and crop productivity are extant in the literature, but detailed studies of compost effects on soil physical quality (SPQ) are limited. The objective of this study was therefore to describe how one-time additions of compost impact the immediate, mid-term and long-term SPQ and crop yields of an agricultural soil. Food waste compost (FWC) was incorporated once into the top 10 cm of a humid-temperate Brookston clay loam soil at rates of 0 (Control), 75 dry t ha1 (FWC-75), 150 dry t ha^{-1} (FWC150) and 300 dry t ha^{-1} (FWC-300); measurements of SPQ parameters and corn yield were then made annually over the next 11 yr. The SPQ parameters included bulk density (BD), organic carbon content (OC), air capacity (AC), plant-available water capacity (PAWC), relative field capacity (RFC), and saturated hydraulic conductivity (KS), which were obtained from intact (undisturbed) soil core samples. Prior to compost addition, BD, OC, AC, PAWC, RFC and KS were substantially non-optimal, and BD had increased relative to virgin soil by 46%, while OC, AC and PAWC had decreased relative to virgin soil by 60, 56 and 43%, respectively. Improvements in SPQ 1 yr after compost addition were negligible or small for FWC-75 and FWC-150, but FWC-300 generated optimal values for BD, OC, AC, PAWC and RFC. The SPQ parameters degraded with time, but 11 yr after compost addition, OC and AC under FWC-300 were still within their optimal ranges, as well as significantly (PB0.05) greater than the Control values by 65 and 26%, respectively. Soil cracks and biopores apparently induced substantial annual variation in KS, but average KS nevertheless increased with increasing compost addition rate. Corn grain yield varied substantially among years, which was likely due to weather and compost effects; however, 11-yr cumulative yields from the compost treatments were greater than the Control by 22006500 kg ha^{-1}.

Document#: BIN.CA.MIN.5.7

TITLE: Impact of biosolids and tillage on soil organic matter fractions: implications of carbon saturation for conservation management in the Virginia Coastal Plain

Author: Stewart, C.E., R.F. Follett, J. Wallace, E.G. Pruessner

Source: Soil Sci. Soc. Am, J. 2012 76:1257-1267

Abstract: In the Virginia Coastal Plain, growers have practiced rotational no-tillage (RT) and continuous no-tillage (NT) for more than 30 yr to reduce runoff and improve soil quality. We sampled 48 grower's fields representing three soil series varying in texture and managed under RT and NT. Half the fields received biosolids (S) application in 2001. We evaluated soil organic carbon (SOC) stocks, C distribu- tion, and potential saturation limits in particulate organic matter (POM) and silt+clay (<53 μm) fractions in three soil series with different silt+clay protective capacities. Across the three soil series, NT increased SOC stocks compared to RT (33.2 ± 1.8 vs. 28.3 ± 0.9 Mg C ha^{-1}) and S compared to no biosolids application (33.1 ± 1.8 vs. 28.4 ± 1.1 Mg C ha^{-1}) for the 0- to 20-cm depth. Tillage and biosolids effects on SOM fractions were only significant for POM and showed no evidence of C saturation with statistical modeling.

To request information or documents, please contact Sally Brown via e-mail: slb@u.washington.edu or phone: (206) 616-1299.

Silt+clay-associated C showed no tillage or S effects and in one soil were better fit with a C saturation com- pared to a linear model, indicating saturating dynamics. In two soils, measured silt+clay C content was significantly greater than the calculated 1:1 and 2:1 pro- tective capacity, also suggesting silt+clay saturation. Since these soils are near or exceed their silt+clay protective capacity, additional C storage will primarily occur in aggregate and POM C pools that are sensitive to subsequent changes in management practice. Best management practices that decrease soil disturbance and increase C input are crucial to these agroecosystems where even single till- age events can cumulatively cause significant C loss.

Document#: BIN.CA.MIN.5.8

TITLE: Surface and root inputs produce different carbon/phosphorus ratios in soil

Author: Wuest, S.B., and C.L. Reardon

Source: Soil Sci. Soc. Am, J. 2016 80:463-471

Abstract: Formation of soil organic C (SOC) is influenced by inputs. We applied organic amendments for five consecutive years at 250 g C m^{-2} yr^{-1}. Seven years after the applications ended, the effects of biosolids and manure on SOC were greater than alfalfa (*Medicago sativa* L.), wood, wheat (*Triticum aestivum* L.) residue, sucrose, brassica residue, cotton (*Gossypium hirsutum* L.), wheat compost, or the unamended check. Soil C increases ranged from 3 to 49% of C applied and had changed little in the previous 28 mo. Plots sown to continuous winter wheat during the period of amendment had 10% more SOC than plots that had been fallow, an effect more than twice as large as most amendments. This suggests that the contribution of roots to SOC was more important than aboveground crop residues. The effect of amendments on SOC was highly correlated to their initial P content. In addition, for a similar available soil P and soil S content, SOC was significantly greater where wheat or perennial grass was grown. Wood caused an increase in the C/N ratio that persisted >3.5 yr but almost disappeared by the seventh year. This study indicated that continuous cropping or the addition of animal waste or municipal biosolids had the greatest impact on the formation of SOC, and this positive effect remained stable for many years after the end of the continuous treatment applications.

Document#: BIN.CA.MIN.5.9

TITLE: Nutrient availability limits carbon sequestration in arable soils

Author: Kirkby, C.A., A. E. Richardson, L.J. Wade, J.B. Passioura, G. D. Batten, C. Blanchard, and J.A. Kirkegaard

Source: Soil Biol. &Biochem. 2014 68:402-409

Abstract: Soils are the largest reservoir of global terrestrial carbon (C). Conversion from natural to agricultural ecosystems has generally resulted in a significant loss of soil organic-C (SOC, up to 50% or ~30- 40 t ha^{-1}) and 'restoring' this lost C is a significant global challenge. The most stable component of soil organic matter (SOM), hereafter referred to as fine fraction SOM (FF-SOM), contains not only C, hydrogen (H) and oxygen (O), but substantial amounts of nitrogen (N), phosphorus (P) and sulphur (S), in approximately constant ratios. The availability of these associated nutrients is essential for the formation of FF-SOM. Here we show, in short term (56 day) incubation experiments with 13C labelled wheaten straw added to four soils with differing clay content, that conversion of straw into "new" FF-SOM is increased by up to three-fold by augmenting the residues with supplementary nutrients. We also show that the loss of "old" pre-existing FF-SOM increased with straw addition, compared to soils with no straw addition, but that this loss was ameliorated by nutrient addition in two of our soils. This finding may illuminate why the build-up of SOC in some productive agricultural soils is often much less than expected from the amounts of C-rich residues returned to them because optimum C sequestration requires additional nutrients above that required for crop production alone. Moreover, it provides greater understanding of short-term dynamics of C turnover in soil, and in the longer term, may have important implications for global strategies aimed at increasing soil C sequestration to restore fertility and help mitigate climate change.

Document#: GEC.CA.MIN. 5.1