Soil Carbon and Nitrogen Changes as Influenced by Agriculture Practices in Mollisol Soils

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Introduction.

Carbon to Nitrogen ratio (C:N) is a ratio of the mass of carbon to the mass of nitrogen in almost any substance, with this case it will be with soil used in agriculture specifically with corn fields harvested by Monsanto. The C:N ratio of the soil can have a significant effect on crop residue decomposition but it can also describe the microbial activity in the soil. Soil microorganisms have a C:N ratio near 8:1, which allows them to acquire enough carbon and nitrogen from the environment so that they can live and maintain that ratio of carbon and nitrogen in their bodies.

Because soil microorganisms burn carbon as a source of energy not all of the carbon a soil microorganism eats remains in its body, a certain amount is lost as CO₂ during respiration. To acquire the carbon and nitrogen a soil microorganism needs to stay alive (body maintenance + energy) it needs a diet with a C:N ratio near 24:1.

In regards to agriculture, if we added crops that had a higher C:N ratio to the soil such as wheat straw with a C:N of 80:1 then the excess carbon will require microorganisms to find additional nitrogen to go through the excess carbon (USDA). Excess nitrogen has to come from that available in the soil creating an immobilization of nitrogen and create a deficit of nitrogen in the soil until some microorganisms die, decompose, and release nitrogen (mineralization) contained in their bodies (Paul).

Monsanto uses land for corn harvest one year and then gives the land a rest year, in order to then use it again the following year. In the terms made by Monsanto a rest year means that the land can not be used for any type of harvest with harsh chemicals. The harsh chemicals they try to avoid are the exact ones they are using when harvesting corn: Roundup, also known as glyphosate. Although glyphosate is not intentionally applied to the soil, a significant concentration does reach the soils’ surface during the pre-plant or early season applications.

The effects of roundup on soil microbial activity will be assessed by testing the carbon and nitrogen ratios in the soil from selected locations where permission was granted in Adams County on different properties from different resting cycles.

Methodology.

Soil samples were drawn randomly from four selected locations where samples were taken from 0-30 in. depth in the increments of 10 inches, using a shovel and density soil corer. The soil belonged to Mollisol soil order according to the USDA soil taxonomy throughout the locations in Adams County, WA.

The locations were selected as such according to the soil usage:

• Site 1: Carrot field then summer 2015 was first corn harvest.
• Site 2: Corn has been harvested continuously annually.
• Site 3: Corn was first introduced 2006 and odd years are the resting years, therefore summer 2015 was not harvested with corn.
• Control: No corn crops had been harvested, also no pesticide application

For each location 1-3 holes were made each about 30 inches deep where 3 layers were identified and samples were collected. Soil samples were then prepared by being air-dried and grinded with mortar and pestle, placed in small yellow envelopes that were labeled respectively with location and order, soil samples were then taken to test via CHN Analyzer that was made by PERKIN ELMER Co. where it went through a dry combustion method to test C and N.

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Results.

The control field where it had no corn crops harvested, and no pesticide application had a C:N ratio of 11.5 at the top layer, 7 at the 10-20 in layer and 6.6 in layer which was the lowest C:N ratio for each layer. We can state that the control site has a higher decomposition rate and more microbial activity. Decomposition lowers the C:N ratio, but if soil microbes can maintain a 8:1 ratio then their goal for building essential organic compounds and to obtain energy for life processes is possible (Brady).

Site 1 and Site 3 had comparable C:N ratios which is a good sign for the amount of nitrogen that Monsanto is putting into the land is keeping up with the land use and rotational crops. Site 1 has been a carrot field and then in the summer of 2015 it had it’s first corn harvest, while site 3 has had corn harvested since 2006 and every even year with odd years being the resting years. As you can see site 2 has a higher C:N ratio to the soil which leads to excess carbon which will require microorganisms to find additional nitrogen in order to go through the excess carbon (USDA). In order to obtain excess nitrogen, it has to come from that available in the soil creating an immobilization of nitrogen and create a deficit of nitrogen in the soil until some die, due to the intense competition among microorganisms for available soil nitrogen, decompose, and release nitrogen (mineralization) (USDA) (Brady). In order to repair this issue farmers should consider harvesting a low C:N ratio crop such as pea or soybean, which will decompose during the next growing season to make nutrients available to the following crop (USDA).

Future Research.

An assessment of C and N mineralization should be recorded immediately after application of herbicide it can provide a more realistic understanding of the true effect of this herbicide on soil microbial activity, since there has been no glyphosate applied soils research reported. The significant effect on crop residue decomposition, particularly residue cover on the soil and crop nutrient cycling (predominantly nitrogen), it is important to understand these ratios when planning crop rotations and the use of cover crops in agricultural systems (Brady).

References.