PULSEUSA

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Understanding C:N Ratio

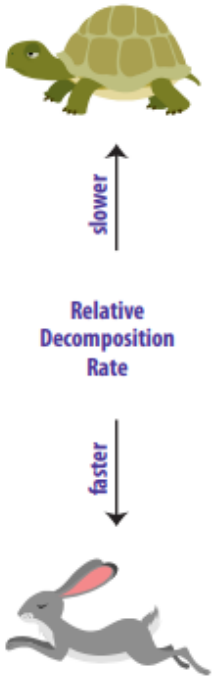
Using a diverse crop rotation and planting cover crops is a great start to begin improving soil health on your farm. Not only are you increasing biomass from a variety of different root structures, but also returning nutrients to the soil without the use of synthetic inputs. The next step to improving soil health on your farm is to understand C: N ratios and how you can alter that ratio to make a positive impact on your soils nutrient cycling abilities.

A C: N ratio is the ratio of carbon to nitrogen. This ratio can impact how quickly crop residue is broken down, and how nutrients such as nitrogen are cycled within the soil. Specific crops have different C: N ratios so it is important to keep them in mind when planting a cover crop or planning a rotation. According to the NRCS, soil microorganisms require a C: N ratio of around 24:1. A higher ratio means that it will take longer for the microbes to decompose the material. For example, wheat straw has a higher C: N ratio of 80:1, while hairy vetch has a low C: N ratio of only 11:1. The vetch will be decomposed faster than the wheat because there are only 11 units of carbon for every unit of nitrogen.

When the C: N ratio is higher than the desired 24:1, soil microbes must scavenge excess nitrogen from the soil to break down the material that contains extra carbon such as wheat straw. When soil microbes consume and tie up this nitrogen it causes a nitrogen deficiency in the soil known as immobilization. The only way this nitrogen can be released back into the soil is when the microbes die and decompose. When a crop is planted with a low C: N ratio like the vetch, you will end up with a nitrogen credit. This is because the soil microbes break down all the carbon and leave excess nitrogen in the soil.

Table 1. Carbon to nitrogen ratios of crop residues and other organic materials

Material	C:N Ratio
rye straw	82:1
wheat straw	80:1
oat straw	70:1
corn stover	57:1
rye cover crop (anthesis)	37:1
pea straw	29:1
rye cover crop (vegetative)	26:1
mature alfalfa hay	25:1
Ideal Microbial Diet	**24:1**
rotted barnyard manure	20:1
legume hay	17:1
beef manure	17:1
young alfalfa hay	13:1
hairy vetch cover crop	11:1
soil microbes (average)	8:1



Note. Table reprinted from Carbon to Nitrogen Ratios in Cropping Systems. USDA (2011)

It is important to keep C: N ratios in mind when planting cover crops or planning a crop rotation. If you have a crop with a low C:N ratio, it will be consumed quickly and not provide a good covering for the soil surface. This leaves the soil exposed to erosion, weed pressure, and evaporation. On the other hand, a high C: N crop may take a long time for the residue to fully decompose and be turned into organic matter. By planning a rotation with low C: N crops following a high C: N crop, you ensure that all the residue is decomposed and that the nutrients are released into the soil for the next growing season.

Understanding C: N ratios can help you manage crop residue, increase nutrient cycling, and increase organic matter in your soils. It is important to think about the crops you plant in your fields, but also the microorganisms within the soil. The biological system that inhabits the soil is the foundation of soil health.

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Carbon to Nitrogen Ratios in Cropping Systems. (2011, January).
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