Plant residues are utilized by a wide diversity of soil biota, including fungi, bacteria, invertebrates and arthropods. Bacteria & Fungi utilize these root exudates / sugars, which mineralize nutrients. Mycorrhizal fungi assist in nutrient & water acquisition.

\[
\text{N}_2 \text{ fixation} \quad \text{by bacteria}
\]

\[
\text{NH}_4^+ \text{ fixation}
\]

\[
\text{Nitrification process}
\]

\[
\text{Denitrification}
\]

\[
\text{Ammonification}
\]

\[
\text{Getting root exudates/sugars}
\]

Plant – Microbe Interaction – C:N Ratio

Mineralization: Plant residue, dead microbes or manure with C:N of <30:1 have sufficient N for microorganisms to decompose residues with out taking from the soil. (N>2.5% in crop residues, Va Tech Edu.). Immobilization happens when C:N ratios of residues exceeds 30:1. Microbes will then take ammonium and nitrate out of the soil to fuel decomposition. (N<1.5% crop residues, Va Tech Edu.).

Soil Health

A diversity of plants on rangeland and cropland improves nutrient cycling. Mobile/available nutrients are taken up by plants and soil biota or are lost through leaching/run-off and/or volatilization. Inhibitors of immobilization: mobile nutrients, high C:N ratios (>30:1), low soil pH (<6.5) and biologically active carbon (C:N ratio <10:1). Biological immobilization of nitrate or ammonium into root tissues of plants.

Soil organisms decompose dead organic matter, plant and animal wastes. There is also a predator/prey relationship between microbes. Microbial activity produces plant available Nitrogen and Phosphorus.

Photosynthesis

\[
\text{Carbon dioxide + water + root exudates + oxygen} \rightarrow \text{Sugars} \rightarrow \text{Plant growth}
\]

Energy as fixed Carbon

\[
\text{NH}_4^+ \text{ fixation}
\]

\[
\text{Nitrification process}
\]

\[
\text{Denitrification}
\]

\[
\text{Ammonification}
\]

Faster

Slower

Improved Soil Food Web

in the top few inches of the soil surface. Soil Microbes need C:N: 24:1 with 16 parts (C) for energy and 8 parts (C) for maintenance.

Carbon to Nitrogen Ratio (C:N), Temperature, Moisture, Aeration and Soil pH affect organic matter decomposition.

USDA is an equal opportunity provider and employer

Pasture & Range Health
- Plant diversity
- Living roots throughout the year
- Cover the soil
- Less disturbance
- Livestock integration
- Proper grazing mgmt.

Agronomy Tech Note 76: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nm/technical/?cid=nrcs144p2_068965

Barley Straw 85:1
Rye Straw 82:1
Wheat Straw 80:1
Oat Straw 70:1
Corn Stalks 60:1
Pea Straw 29:1
Rye Cover Crop 26:1
Mature Alfalfa 25:1
Ideal Microbe Diet 24:1
Clover 21:1
Manure 17:1
Young Alfalfa 15:1
Hairy vetch 11:1
Humus 10:1
Plant diversity & other materials. Barley Straw 85:1
Rye Straw 82:1
Wheat Straw 80:1
Oat Straw 70:1
Corn Stalks 60:1
Pea Straw 29:1
Rye Cover Crop 26:1
Mature Alfalfa 25:1
Ideal Microbe Diet 24:1
Clover 21:1
Manure 17:1
Young Alfalfa 15:1
Hairy vetch 11:1
Humus 10:1
Soil microbes 8:1 avg. (ranging 3 – 10:1)

(C) & (N) are in all dead and living things and serve as the building blocks of plants and animals including: proteins, carbohydrates, lipids, nucleic acids, lignin, and chlorophyll.

Energy as fixed Carbon

\[
\text{NH}_4^+ \text{ fixation}
\]

\[
\text{Nitrification process}
\]

\[
\text{Denitrification}
\]

\[
\text{Ammonification}
\]