Compost Application to Rangelands and Croplands

Based on a webinar presented by Jeff Creque (Carbon Cycle Institute), Jonathon Watcher (Marin Agricultural Land Trust), and Michelle Katuna (Marin Resource Conservation District), Article compiled by Michelle Katuna, June 2020.

What is photosynthesis and how is it the foundation of agriculture’s interaction with the atmosphere?

Photosynthesis is the process by which plants transform solar radiation into biochemical energy through the synthesis of carbohydrates from carbon dioxide (CO2) and water (H2O). Carbon is the backbone of nearly everything found in our farms and pastures. The starch in our grain, the leaves of our crops and forages, the protein in our livestock, the organic matter in the soil, are all made up of carbon that originated from the atmosphere. Agriculture, simply put, is sunlight-driven carbon harvesting, and is the way humans can engage, through plants and then animals, with managing carbon in the atmosphere.

The process of photosynthesis feeds both the plant and the soil ecosystem. Up to 40% of the carbon photosynthesized by a plant is excreted by its roots into the soil, with the remaining 60% returned to the atmosphere through respiration, such as decomposition of plant matter. A healthy soil ecosystem in turn supplies living roots with the nutrients, water, and other ecosystem services necessary for plants to survive and grow.

What is compost?

One example of deliberate carbon management is the production and use of compost. Compost serves as the “end product of a managed, aerobic (happens in the presence of oxygen), thermophilic (large quantities of heat are generated during compost production) organic matter decomposition process, suitable for beneficial application to soil” (Jeff Creque, 2020).

Organic materials, water (H2O), and oxygen (O2) (added passively or by forced air or pile-turning) are added to a composting system. Heat is generated in the process of microbes breaking down raw materials. Compost piles typically reach between 130 and 170 degrees Fahrenheit. CO2, water vapor, and other gases are produced by microbial respiration and are recycled or leave the pile. The finished product, compost, can be used as a stable and safe soil amendment.

How does compost relate to soil health and fertility?

“Fertility is the ability of soil to receive, store, and release energy” — Aldo Leopold, “The Land Ethic”, 1949.

Most importantly and fundamentally, compost is a source of energy (in the form of complex carbon compounds) for the soil ecosystem. It is energy that drives soil-plant-water relations and underlies a host of ecosystem processes. Rather than gauging soil health by asking only if our soils are nutrient-limited, we should also ask whether our soils are energy-limited, and how efficiently are our soils producing energy? Farming practices can deplete or build up soil carbon. Compost application is one way to build soil carbon.

What does the research say?

In 2006, the Marin Carbon Project (MCP) was born as a collaboration among Marin agricultural organizations and Dr. Whendee Silver of UC Berkeley, to explore the potential to increase the carbon content of working-lands soils in Marin County by applying compost, and to measure the effects. In 2008, MCP ran their first trial, applying 1/4” of compost to grazed grasslands in Nicasio, and replicated the trial at the UC experimental station in Yuba County. MCP saw, right away, that cattle were gravitating to compost-treated plots. When the group analyzed Agriculture Croplands, pack in compost-treated plots, they found it was higher in protein than control plots, likely the direct result of the small amount of nitrogen in the compost they applied.

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