EROSION CONTROL
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WEB

Does Your Vegetation Establishment Practice Pollute Surface Waters with Nutrients?

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Establishing and maintaining vegetation on disturbed soils can be challenging. Post-construction soils are typically compacted and have been stripped of the soil horizons that contain organic matter and nutrients, thereby creating a soil (usually the subsoil) that is low in fertility, infiltration, water holding capacity, and biology. The standard practice for reestablishing vegetation, particularly for erosion control and slope stabilization, is to apply seed with commercial fertilizer, whether through broadcasting, drilling, or hydroseeding. Research is showing that runoff from sites where application of commercial fertilizers, used in vegetation establishment for construction site erosion control, may be doing more harm than good. In fact, fertilizer application for vegetation establishment near storm water conveyance systems or surface water bodies may be the leading pollutant source in a given watershed.

As part of the 1972 Clean Water Act (Section 303(d)), the USEPA has frequently listed streams for Total Maximum Daily Load (TMDL) designation for specific pollutants. Since 1995, nutrients have been one of the most frequently cited TMDL water impairing pollutants with 5,625 reported cases impairing 3,511 listed water bodies across the US (USEPA 2007). With 35% of our surface waters listed as severely impaired, and 75% of us living within 10 miles of one of these impaired bodies, we can certainly do more to make our nation's water bodies more suitable for swimming, fishing, and drinking (USEPA 2007).

Recent published research from land grant universities is consistently showing nutrient loading in runoff can be significantly reduced by using compost erosion control blankets instead of conventional practices such as hydroseeding and broadcasting of seed and fertilizer. Research conducted at the University of Georgia showed that hydromulch released 2.5 times more total nitrogen (N), 8 times more nitrate-N, 8 times more total phosphorus (P), and 9 times more soluble P in runoff relative to compost blankets used for erosion control vegetation establishment. In a follow up study, conducted jointly by Auburn University and the University of Georgia, straw mulch with seed and fertilizer, released 13 times more total N and 33 times more soluble P in runoff relative compost blankets used for slope stabilization.

Similarly, research conducted by Texas A&M University showed compost erosion control blankets relative to seed + fertilizer reduced total nitrogen by 88%, nitrate-nitrogen by 45%, total phosphorus by 87%, and soluble phosphorus by 87% (Mukhtar et al, 2004). Iowa State University reported that compost erosion control blankets used for slope stabilization on highway embankments reduced total nitrogen, total phosphorus, and soluble phosphorus by 99% relative to seed and topsoil applications (Persyn et al, 2004).

Why do compost erosion control blankets release so much less nitrogen and phosphorus in storm runoff? There are two reasons, the form of the nutrients (or species) and the capacity to reduce runoff volume. Compost erosion control blankets supply nitrogen and phosphorus in organic form. Organic nutrients are slow release, which helps to sustain plant growth, and are also less mobile in runoff than inorganic (or mineral) nutrient forms, such as ammonium-nitrogen, nitrate-nitrogen, and orthophosphate. Commercial fertilizers, whether broadcast or used in hydroseed mixtures, typically use inorganic nutrient forms. Additionally, compost erosion control blankets absorb much more rainfall than conventional seeding and erosion control management practices, thereby reducing runoff volumes. Published research shows that hydromulch increases runoff volume by 137%, and straw mulch by 200%, relative to compost erosion control blankets when used for slope stabilization applications. Nutrient loading (or any pollutant loading) is directly proportionate to the volume of runoff generated from a site or watershed surface.

Finally, while the form of these nutrients (organic vs inorganic) can affect its mobility or transport potential during a runoff event, once these nutrients enter a receiving water the form can be even more critical. Inorganic nutrients are generally soluble in water and thereby immediately available for plant uptake (organic and particulate bound nutrients typically are not), which is why they elicit a rapid growth response on land. Unfortunately, the same is true once these nutrients enter a water body. Because these soluble nutrients are immediately bio-available to aquatic plants they can trigger a rapid growth response once they enter a waterway. This leads to algae blooms, ultimately eutrophication and fish kills, and if left unchecked, the collapse of the local aquatic ecosystem. While both nitrogen and phosphorus can contribute to aquatic eutrophication, phosphorus is often of greatest concern, as it is typically the limiting nutrient in aquatic ecosystems. Just as nitrogen is the limiting nutrient in land based ecosystems (which is why we apply more N than P for vegetation establishment), contribution of the limiting nutrient to any ecosystem (terrestrial or aquatic) elicits the greatest growth response. The surface water concentration of total P and soluble P in which eutrophication is triggered is only 0.1 and 0.03 mg/L, respectively. Typical storm runoff concentration for phosphorus is 0.4 mg/L. Consequently, water treatment facilities are regulated so they do not discharge greater than 5 mg/L of total P into our surface waters (Brady and Weil, 1996).

The water concentration of nitrate-nitrogen that can be toxic to humans if ingested is only 10 mg/L.

The total annual loss of nutrients due to soil erosion in the US is estimated to be over 42 million tons costing society over $27 billion per year (Brady and Weil, 1996). Choosing best management practices that not only reduce erosion and sedimentation but also nutrient loading to receiving waters should be of concern to all of us considering water quality issues, the potential effect on our aquatic ecosystems, and the price we all pay for mitigation, loss of natural capital, and reduction in ecosystem services. Prevention is always cheaper than treatment.

Topics: Vegetation Management, Seed and Soil Amendments