

# Nitrogen Release Rates from Soil Amendment Materials – Report March 1998

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[Excerpted from: GENERATION OF WATER-STABLE SOIL AGGREGATES FOR IMPROVED EROSION CONTROL AND REVEGETATION SUCCESS<sup>1</sup>]

**Introduction** In the past, revegetation projects in California have commonly utilized soluble fertilizer materials. Typically the fertilizer would be 560 kg/ha (500 lb. / ac.) of ammonium phosphate sulfate (16-20-0)—or about 82 lb. N per acre. This fertilizer application rate promotes rapid annual grass growth to the detriment of native species. When establishment of slower growing perennial species is a priority, control of soil N levels can be an important method for establishing desired plant composition on the revegetation site. An additional negative effect of the use of highly soluble fertilizer materials is that all of the N that is applied is rapidly available and is easily depleted. High initial application rates encourage rapid plant growth and nutrient uptake, while unincorporated soil solution N is easily leached from the profile. Without reapplication or N release from mineralized organic matter in the soil, available N levels rapidly drop to deficiency levels and plant growth on the site declines. Proper fertilizing requires amendments that are large enough to support long term plant growth but which have low N release rates that correspond to uptake by perennial species and do not promote weedy invasion.

The objective of this study is to compare the N release rates from a wide variety of potential amendment sources, to check the incubation and leaching procedure for precision between duplicate experiments, and to compare release rates to those measured in a field situation.

Table 1. List of amendments grouped by category of 4 major groups of N releasing materials

CATEGORY / AMENDMENT	MANUFACTURER	N%	PRODUCT DESCRIPTION
<b>FAST RELEASE NITROGEN</b>			
Ammonium phosphate	Bandini Fertilizer	16%	ammonium phosphate chemical fertilizer
Gro-Power 5-3-1	Grow-Power Inc.	5%	urea, ammonium phosphate, Leonardite
<b>SLOWER RELEASE SYNTHETIC</b>			
Osmocote 18-6-12	Scotts, Sierra	18%	resin coated urea and nitrate chemical
Polyon 38-0-0 and 40-0-0	Pursell Technologies	40%	polymer coated urea chemical fertilizer
<b>ORGANIC, BLENDED</b>			
Biosol 6-1-3 and 7-2-3	Rocky Mtn. (Distributor)	6%	fungal biomass from pharmaceutical production
Fertil-Fibers, NutriMulch	Quattro Environmental	6%	alfalfa, seed meals and chicken manure
RTI Nova 8	Reforestation Technologies	8%	biosolids with IBDU, ureaformaldehyde
chemical			
Ringer 5-10-5	Ringer Corporation	5%	animal byproducts, plant meals, chemical
Sustane 5-2-4 Natural	Natural Fertilizer of Am.	5%	aerobically composted turkey litter, f. meal
<b>VERY SLOW YARD WASTE COMPOST</b>			
Gilton	Gilton, Ca Resource Rec.	1.2%	yard waste compost
Hydropost	Organics International	1.6%	yard waste compost
Sonoma	Sonoma, Ca Compost	1.5%	yard waste compost

Amendment Selection producers as listed in Table 1. The materials represented a range of chemical and organically based materials, with slow to rapid N release rates.

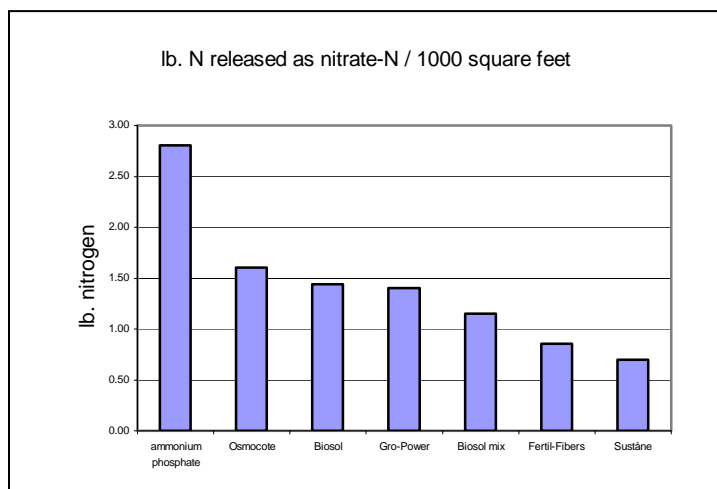
## CONCLUSIONS:

- After the first four months, about half of the organic based amendments continue to release statistically significant levels of N, including RTM, Biosol, Sonoma Compost and Sustane.
- The remaining materials have exhausted their releasable N and do not differ ( $p < 0.05$ ) from the minus control.
- Within this group, the rate of release is probably increased by residues that are steadily degradable (thus releasing N) as in the fungal mycelium of the Biosol, the microbial biomass of the Sustane compost, or by the release of N from the fertilizer supplement as with RTM.
- The sustained N release from the organic fractions of these amendments results from microbial mineralization of carbon for energy and the subsequent release of N, depending on the ratio of the available C and available N in these materials. Characterization of the chemical makeup of the

organic materials and their residue products can indicate the likely outcome of long-term N release rates.

- The release pattern of Gro-Power, for example suggests that the main mechanism for N release is dissolution and hydrolysis of its urea fraction.
- The three amendments with the highest movements of N from the surface to the unamended bottom were ammonium phosphate, Gro-Power and RTI Nova Organics (biosolids and IBDU blend). This is largely attributable to the conversion of ammonium or urea to leachable nitrate.
- The mineralization curves of the organic fertilizers suggest a slower, biologically mediated release of the organically bound N in the amendment residues.
- Amendments that have high C contents (high available C: available N ratios) may retain (immobilize) N within the amendment for longer periods before it is released by mineralization. This does not provide N for plant establishment, but may retain N for later release as long as sufficient N is available in the initial period to support plant growth.
- Examples are Hydropost, which released a very low fraction of its N during incubations. Because Hydropost and Fertil-Fibers are both derived from shredded plant materials with a high C:N ratio, the N release may occur at a much later time.
- The Osmocote and ammonium phosphate produced rapid initial N release rates in the filed trial similarly to the lab incubations. This rapid release of nutrients suggests that leaching might potentially remove N before plant growth and uptake begins. Also, Osmocote released much faster in the field experiment data than in the lab.
- Some of the organic based materials (Biosol, Fertil-Fibers) also had high rates of nitrate production.
- Plant compost materials (Hydropost, Gilton and Sonoma) showed no nitrate production, which is interpreted as microbial immobilization of mineralized N during decomposition of the plant residues in the amendment consumed all available mineralized N. This does not provide N for short-term plant establishment.
- Various amendments can be used to provide appropriate amounts and release rates of N to the revegetation project, depending on the objectives for the plant community (i.e. rapid versus slow growth; erosion control versus perennial plant establishment).
- The addition of organic substrates will improve other soil remediation characteristics including soil pH, soil physical structure, water release characteristics, mulch protection, biological inoculation, and other (non-N) nutrient requirements. Further, the addition of organic substrates will increase microbial activity, which is a major factor in the generation of water-stable aggregates.

Table 8. (Selected amendments adapted from report. Cumulative N release from various amendments in field situations at the Livingston site, Jan. 23-April 24, 1998, converted to lb. N /1,000 ft.<sup>2</sup>)



1. Note: The information above is a brief summary of nitrogen release rates from soil amendment materials found in Chapter 4 of the 111-page report that covers many aspects of water-stable soil aggregates including functions, mechanisms, characteristics and interactions with plant revegetation communities. The complete study is Report No. FHWA/CA/TL - 98/18 available to the public from the National Technical Information Service, Springfield, Virginia.