Vegetation Management Section

Materials

Organic Fertilizers

Prior to the 1920's, compost and organic fertilizers (farm-yard manures) were extensively used in the US. With the development of technologies to derive nitrogen from the atmosphere to produce synthetic ammonia, the use of naturally occurring organic fertilizers declined rapidly. This was primarily because farm-yard manures have very low concentrations of nutrients compared to commercially available fertilizers. However, in recent years there has been a revival in their use because of various environmental concerns. In 1991, North Carolina's House Bill 1109 and Senate Bill 111 helped to pave the way for the use of alternative (recycled or recyclable) products where economically feasible. Although no monies were allocated to assist with this movement, many pro-active, progressive units within the Department of Transportation have begun to utilize these products. The Roadside Environmental Unit has utilized a variety of organic recycled products in the installation and maintenance of right-of-way vegetation.

The addition or incorporation of compost/organic matter to soil provides many benefits which are considerably more important than their nutrient values. When used as a mulch on ornamental beds, organic materials will: help reduce erosion by decreasing the impact of falling water; increase infiltration; decrease evaporative moisture loss; and help reduce weed competition.

Over the last decade numerous research projects have evaluated the effects of organic matter/compost on plants. The loading rate (amount of end-product added to a site) is based on the nutrient content of the product and the physical parameters of the soil. Therefore, each recyclable product type must be evaluated on an individual basis.

Another very important issue to consider is the carbon to nitrogen (C:N) ratio of the product. Available N in the soil is used as an energy source by organisms responsible for biological activity and organic matter decomposition. Therefore, the associated plants may decline due to competition with microorganisms for the available nitrogen. A high C:N ratio means that the product will require N to breakdown carbon compounds present in the material. Thus, available N will be used for organic matter breakdown rather than to support plant life. Some products such as fresh wood chips may have a C:N ratio as high as 600 to 1. Such products are undesirable for incorporation. It is generally accepted that if the C:N ratio is below 20 to 1, the product is suitable for incorporation because the competition for available N will be low (see Table 3.9).

Sources

There are numerous organic recyclable products available. Many of these are referred to as "natural organic nitrogen sources" and are recommended for landscape use. Three of these sources are: yard waste debris, sewage sludge, and animal manures.

Raw Material	C:N Ratio (Weight to Weight)
Poultry carcasses	5
Broiler litter	12-15
Cattle Manure	19
Turkey Litter	16
Sewage sludge	5-6
Wheat Straw	100-150
Hardwood Bark	116-436
Softwood Bark	131-1285
Newsprint	398-852
Leaves	40-80

Yard Waste Debris

In an attempt to conserve landfill space, most cities have diverted yard waste debris such as tree limbs, grass clippings and leaves from their waste treatment flow and have begun to stockpile this debris. Because yard waste has a high C:N ratio, it is not a good product to incorporate into the soil. Some drawbacks that can be experienced when using yard waste include: handling difficulty, bulkiness of the product, product longevity once applied, and the costs of transportation and application.

Sewage Sludge

As the population of our major cities continues to grow, the questions regarding disposal of sewage (municipal) sludge also grows. Processing criteria and product stability are utilized to define the various end products of sewage sludge management. On the whole, sewage sludge is characteristically low in potash (K 2O) and high in certain heavy metals.

In North Carolina, the Department of Environment and Natural Resources (DENR) is responsible for sewage sludge regulations. NC Administrative Code Title 15 A: 2 H.0200 "Waste not Discharged to Surface Water" is the legislation regulating sewage sludge.

There are four major types of sewage sludge organic end products: digested, activated, composted, and lime-stabilized. Digested sewage sludge is the least stable form of sewage sludge end products and typically has a pH of about 6.5. This product may contain detectable levels of pathogenic bacteria like salmonella (responsible for gastrointestinal disorders), viruses, parasitic eggs, and viable weed seed. Since it is not fully processed, it also emits a strong undesirable odor. In North Carolina, digested sewage sludge is classified as a Class B product and therefore, by law, it is not available for public utilization.

Because of the processing criteria, activated, composted, and lime-stabilized municipal sludge are referred to as Class A (unrestricted use products). These products may be used by the general public provided that the product labeling information is followed. The labeling information provided by the product supplier is intended to protect the user and the environment.

Activated sewage sludge is derived from highly specialized processing. Sewage sludge, once freed of grit and coarse solids, is aerated, inoculated with special microorganisms, filtered/screened, and finally steam sterilized before it is pelletized. The steam sterilization process kills all pathogenic bacteria, viruses, weed seed, and other undesirable microorganisms.

Since 1937, the City of Milwaukee, Wisconsin has marketed "Milorganite" (Milwaukee Organic Nitrogen) the most widely utilized form of activated sewage sludge. Other cities sell similar products.

Since the early 1980's, sewage sludge composting (a process through which microbial activity converts biodegradable organic carbon into carbon dioxide) has gained favor. A process known as aerated static pile composting is most widely utilized. This sludge management technology has grown in popularity because it is economical, environmentally sound, and publicly acceptable. During composting, air is forced through slotted pipes and through the sludge mixture. Internal temperatures often exceed 55 degrees C (131 degrees F). All bacteria, weed seed, and disease causing organisms are killed after three days. Composted sewage sludge has N-P 2 O 5-K 2O values of 1-1.5, 1.5-2, and less than 1, respectively. For this reason, supplemental K is needed to insure turf and ornamental growth when using composted sewage sludge.

Recently, a new technology known as advanced alkaline stabilization has become popular for processing municipal sludge. The end-product, lime stabilized municipal sludge, is derived from mixing one of several liming agents with wastewater biosolids. Agricultural limestone, kiln dust (a recyclable product from concrete production), or quick-lime (calcium oxide) are the most popular stabilization additives. The resulting product is marketed under several trade names such as: "Lime-Plus," "Nutrified lime," and "N-viro soi." Applications or loading rates of lime-stabilized municipal sludge are based on liming needs of the site, any nutrient limiting factors in the final product, and the calcium carbonate equivalence (CCE) of the product. The CCE can be thought of as the product's neutralizing power and is always compared to the neutralizing ability of agricultural limestone. Typically, one must apply more lime-stabilized municipal sludge than agricultural lime. However, cost/benefit ratios in some cases have made lime-stabilized municipal sludge an acceptable, cost-efficient alternative to agricultural lime. Characteristically, lime-stabilized municipal sludge has N,P 2 O 5,K 2O values of 0-1, 2-3, and 0- 0.5.

Lime-Stabilized Sludge

In conjunction with DENR, the NCDOT has developed criteria for utilization of lime-stabilized municipal sludge. The following criteria were generated to formalize the selection process and to promote the use of recycled materials in highway construction and maintenance activities. The alternative of using lime-stabilized municipal sludge is not an attempt to delete the use of agricultural limestone. The contractor can select either material but must adhere to specific application guidelines. This approach is a more equitable method for lime procurement rather than completely penalizing the agricultural liming industry, which has serviced the Department's needs for many decades.

Project Selection Criteria:

- Proximity to the municipal production plant
- Watershed impact
- Environmental commitments
- DENR permit status
- Generators permit performance (compliance vs. non-compliance)
- Local ordinance restrictions

NCDOT Permit Restrictions:

- Cannot stockpile on job site for more than one week.
- Cannot apply within 100 feet of a dwelling, well, stream, or on areas with steep slopes (to minimize run-off).
- Cannot have discharge from target application site.

Only recently has DENR permitted NCDOT to utilize lime-stabilized municipal sludge as a top- dressing (non-incorporated) application to turf areas.

Soil amendments Soil amendments and by-products commonly considered by NCDOT:

- Yard Waste:
  
  The Department has begun to utilize yard waste as mulch in ornamental plant beds. NCDOT is committed to using yard waste debris as a mulch where economically feasible.

- Agricultural (dolomitic) Limestone:
  
  This product is used extensively to adjust the pH of acidic soils prior to the establishment of grasses and ornamental plants.

- Composted Poultry Litter: The Roadside Environmental Unit, in cooperation with the NCDA&CS Fertilizer Section, NCSU and DENR, has developed comprehensive specifications for the purchase of composted poultry litter. The specifications are written to describe the minimum requirements of the composting process and to focus specifically on the characteristics of the end product.

- Composted Sewage Sludge: The Department utilizes a limited amount of this material in its Vegetation Management Program as a soil amendment and as a mulch.

- Lime Stabilized Municipal Sludge:
  
  The Department currently uses this type of stabilized sludge as an incorporated liming agent in lieu of agricultural limestone in wildflower beds, when the cost is competitive.

- Digested Sewage Sludge: The Department does not apply any of this sludge to the rights-of-way due to this material's classification as a Class B product not available for public utilization.

- Activated Sewage Sludge: The Department does not utilize activated sludge due to the high cost of this material compared to commercially available fertilizers.