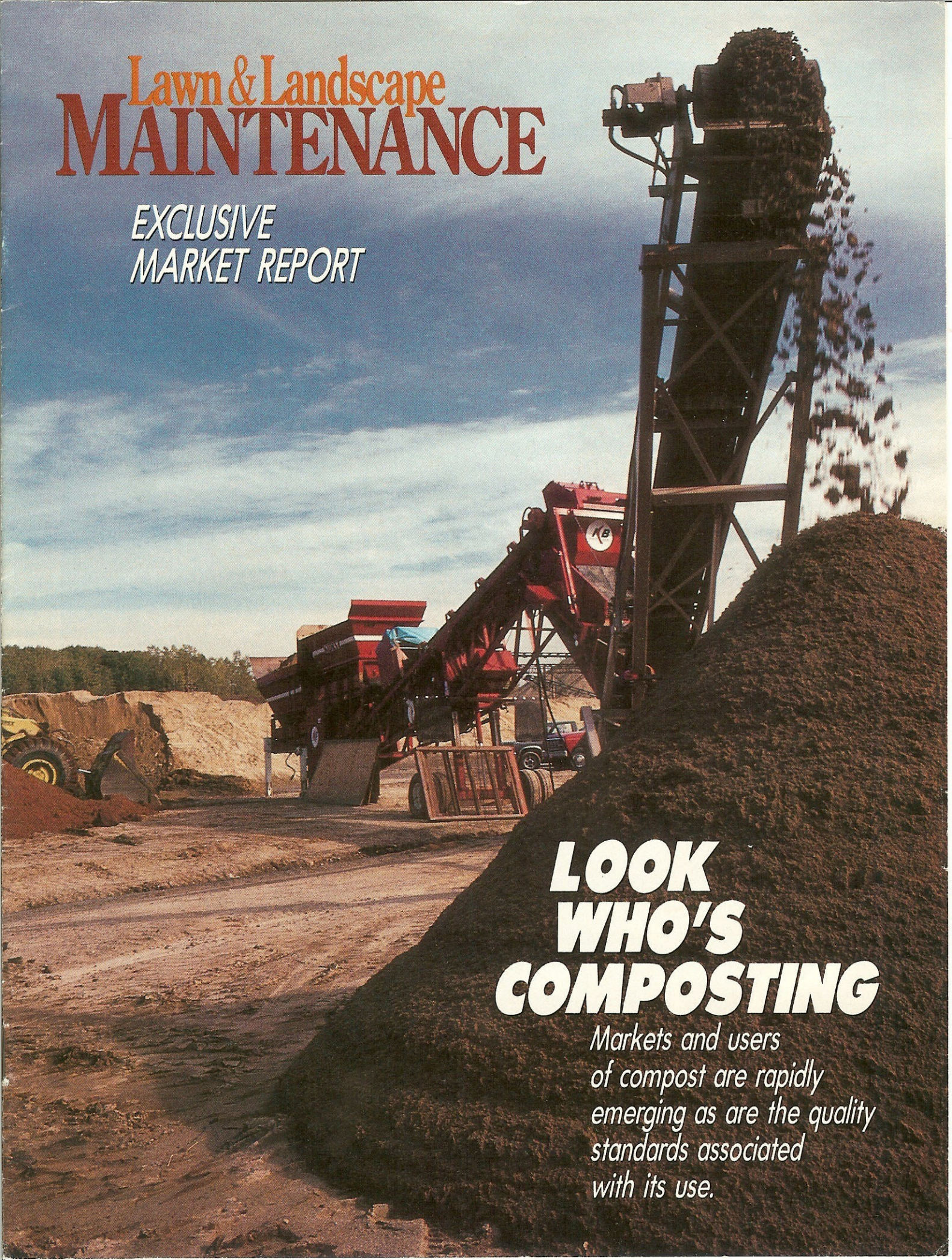
Lawn & Landscape
MAINTENANCE

EXCLUSIVE
MARKET REPORT



LOOK WHO'S COMPOSTING

Markets and users of compost are rapidly emerging as are the quality standards associated with its use.

Using Compost Successfully

Landscape contractors and their customers will require proof of high quality, environmentally safe products before purchase.

Composts of various quality and characteristics have been used in numerous applications, but what type of compost is really best for you and the properties you're managing?

By Ronald Alexander and Rod Tyler

Composts are being produced out of many feedstocks with the use of various bulking agents and under various environmental, chemical and biological conditions. Consequently, finished composts exhibit a range of characteristics and varying qualities.

It is important that compost manufacturers, marketers and end-users understand this variability exists, and that individual composts possessing specific characteristics are more likely suited to specific applications under specific conditions. Understanding these facts can help manufacturers produce higher quality composts, marketers distribute their products to the appropriate end-users and end-users purchase and use the compost products best suited for their specific use.

In order to better address this concept, we will describe the major markets for compost use, including landscaping, nursery growers and sports turf, offer an explanation of product uses within each particular market and outline the desired compost characteristics for those uses.

LANDSCAPERS

Landscapers have been using composted products for many years and in many applications. So it should be no surprise that landscapers are currently using large quantities of composts produced from various municipal and agricultural wastes. Composts of varying qualities and with varying characteristics have been used in soil upgrading; turf establishment and maintenance; mulching; and in the establishment and maintenance of ornamental plants.

The type of compost used by an individual depends on product availability, the specific application and customer preference.

SOIL INCORPORATION/UPGRADING. Compost is an excellent amendment for soils low in organic matter content, those suffering from poor nutrient retention properties, highly compacted soils or those lacking water holding capacity. The addition of compost improves the soil both physically and chemically, allowing for healthy growth of turf and ornamentals.

Research has shown that the application of sludge compost at a rate of 260 metric tons per hectare (approximately 235 cubic yards/acre) enhances the establishment of turfgrass from seed. The application of 180 metric tons per hectare (approximately 160 cubic yards/acre) of compost was adequate for the establishment of turfgrass sod. In experiments, compost significantly improved the rate of establishment and general appearance of the turfgrass (Angle 1981).

The application of a 1- to 2-inch layer of compost is often cited as a general application rate for upgrading soil for the establishment of turf from seed or sod. This layer of compost should then be incorporated to a depth of 5 to 8 inches for maximum effectiveness.

Compost used in soil upgrading should be rich in organic matter (more than 50 percent), free of weed seeds and possess a texture and moisture content allowing for easy spreading.

Most states have legislation governing landscaping loading limits for various fertilizer and organic materials. Chemical analysis of composts will be required to satisfy these laws. The pH and soluble salt content of the compost depends on the characteristics of the soil being amended and the plant materials to be established.

In turfgrass situations, these characteristics are not as critical as when improving a garden area for annual or perennial plants. In these latter applications, the soluble salt content of the compost is significant in that excessive levels in the soil mixture may be damaging to certain species (i.e., geraniums and asters).

It has been shown that various annuals and herbaceous perennials respond favorably to compost applications at a rate of 10 percent to 30 percent of a garden soil mixture (Smith 1991). A 1-inch application rate of compost tilled to a depth of 5 inches is a 20 percent inclusion rate. It is also important that compost used in this manner is stable (well cured), so that nitrogen immobilization does not occur.

Higher quality and more refined composts, up to this point, have proven to be more popular in soil incorporation projects for garden areas and on home lawns. Less refined products, such as composts containing foreign matter and ones which are odorous, are more acceptable in commercial and/or industrial applications.

TOPDRESSING. Topdressing has long been a reliable turf maintenance practice in the golf course industry and has grown in popularity for commercial and home lawn applications. The practice entails applying a thin layer (approximately 1/8- to 1/2-inch) of topdressing material over an established and usually declining turf area. Topdressing is usually done in conjunction with aeration and reseeding.

Compost used as a topdressing must not only be consistent in its chemical characteristics, but also in its physical characteristics. The materials used must have a texture making it easy to handle and one that is finely screened. It must also be free of foreign matter and objectionable odors, since much of the material will be left on the soil surface.

This market is expected to grow with the popularity of low input landscaping and/or maintenance practices which use organic materials. The chemical and biological characteristics of compost have also been suggested to improve the degradation of thatch which may be a nuisance in some established turf areas.

PLANTING MIXES. Composts have been used as a component of various landscape growing mixes such as those for roof tops, raised planters, planter boxs and backfill mixes. These mixes may include topsoil, peat moss, sand, styrofoam, vermiculite, perlite and compost usually at a rate of 25 percent to 33 percent of the mixture.

Compost in these applications will improve drainage and water holding capacity of the mixes, encourage deep rooting and will supply a rich source of organic matter and nutrients. The organic matter supplied by compost will also increase the cation exchange capacity of the mix and supply valuable humic acid, which aids plant uptake of some nutrients. The compost used in these applications must have a pH and soluble salt content which, when mixed with the other planting components, are acceptable to the growing plants. This material must be weed free, have a workable texture and must be stable to avoid nitrogen immobilization.

MULCHING. Some composts have been successfully used as a decorative mulch in garden beds. They are usually applied to the soil surface at a depth of 2 to 3 inches. Compost mulches are used to conserve moisture, lower soil temperature, reduce erosion, provide nutrients and discourage the establishment of weeds.

Using backfill mixes with 10 percent to 30 percent compost improves the performance of trees in the landscape environment.

The compost must have a uniform appearance, possess a dark color and should readily absorb moisture. The compost must also be free of weed seeds and have a pH and soluble salt content which will not negatively affect the growth of the plant materials being mulched. Composts produced from both sludge and leaf/yard waste are currently being used successfully as decorative mulches, while composts produced from municipal solid waste have not been as popular in this application because they often contain foreign matter, giving it a non-uniform appearance.

SPORTS TURF

Each year a tremendous and ever growing amount of acreage is maintained as sports turf. New golf courses continue to be built as the popularity of the game increases. At the same time, the popularity of many other field-played sports has forced the construction of new fields and has increased the use intensity of existing fields. Compost used in the construction and maintenance of sports turf has both a proven track record and bright future in this market.

The golf course industry has a great appreciation for the importance of organic matter and for this reason the use of many composted products is commonplace. New uses for compost on golf courses are also gaining momentum, but have not gained total acceptance by this conservative industry. The most popular of these uses are discussed below.

TOPDRESSING. This market niche is slightly different than previously noted in the landscape section. Golf courses historically have less margin for error in the maintenance of turf as a result of high intensity management programs. Therefore, the compost products used in topdressing mixes will normally be of high quality, possess a high organic matter content, a low odor potential and be low in heavy metals and soluble salts.

Composts used in topdressing mixes may have a pH of six to eight and will need to be fully mature with minimal inert contaminants. Particle size of compost used for topdressing should be less than one-quarter inch since most mixes are screened at least to this size.

Typical topdressing mixes for golf courses are comprised of 70 to 90 percent sand and organic material. Peat moss is the reliable organic standard, but some research indicates compost may be an acceptable substitute (Nelson 1992).

Fairways, although not currently topdressed as frequently as greens, comprise the largest potential percentage of the total topdressing budget. Golf courses have used finely screened compost alone as a topdressing on fairways, or as a component in a mix.

The future for compost use through topdressing mixes looks extremely promising. Early research indicates compost may have disease suppressive properties. Therefore, future topdressing programs may use funds from current disease control budgets giving increased value to

STEP-BY-STEP USE OF COMPOST ON ATHLETIC FIELDS

TOPDRESSING

1. Heavily core aerate entire athletic field, concentrating on most heavily trafficked areas.
2. Apply approximately a half-inch layer of compost or 50/50 sand/compost mixture. The most uniform and efficient way to apply the compost is with a topdressing unit or manure spreader.
3. Smooth the surface using a raking device or using a weighted drag mat. The raking/dragging will break up the soil plugs, mix it with the compost and backfill the holes.
4. Seed and water the topdressed area. It is important not to leave the grass seed on the soil surface. It should be mixed into the soil/compost layer.

RENOVATING

1. Mechanically till the entire field, turning the soil and destroying the remaining vegetation. A rototiller or farm disk are the best pieces of equipment to use. Killing the existing turf cover with a non-selective herbicide may be worthwhile if weed infestation is significant.
2. Apply two to three inches of compost over the entire field. More product can be used in areas on the fields which have received the most wear. (e.g., center of football fields).
3. Incorporate the compost into the field to a depth of six to 10 inches. Normally, the deeper you can incorporate the product, the better. Work the soil until it is thoroughly mixed and clump free.
4. Shape and smooth the field using a raking device. Firm the field using a light roller. Establish a crown on the field if desired.
5. Seed and water the field. Make sure the seed is incorporated into the top one quarter inch of modified soil.

CONSTRUCTING

1. Using front-end loaders or other bulk blending machinery, manufacture your field mix. To ensure uniformity, manufacture the mix in small, controllable batches. Mixing should be done off the construction site.
2. Spread the athletic field construction mix using a grading blade over the entire field, starting from the center of the field and working out. For optimum results, the mix should be spread to a depth of 12 inches.
3. Shape and smooth the field using a raking device. Firm the field using a light roller. Establish a crown on the field if desired.
4. Seed and water the field. To improve seed germination, incorporate the grass seed into the top one-quarter inch of construction mix.

Source: Ron Alexander

Table 1.

compost products offered to support this avenue of golf course management.

CONSTRUCTION MIXES/RENOVATION. The same general guidelines for product quality apply to golf course construction mixes, although larger amounts of product are used more quickly, especially in whole course construction. As many as 250 to 500 yards of a mix may be used for each green, indicating a large initial outlay of compost for an 18-hole course. Additionally, greater amounts of compost can be used in bed preparation and landscaping of the grounds. (Refer to the landscape section.)

ATHLETIC FIELDS. As the desire and need to create more resilient, more attractive and safer athletic fields has increased, so too has the need grown for an inexpensive, versatile product. The need for an organic product which can be used in the maintenance, renovation and construction of athletic fields will help fill this void, and help a market strapped by shrinking budgets.

As discussed earlier, the addition of compost to soils high in sand or clay content will improve the structure and friability of the soil. The use of compost will also improve the drainage in athletic field soils, and the addition of organic matter will slow the rate of compaction. The use of compost in the maintenance (topdressing), renovation (soil amendment) and construction (mix component) is explained in more detail in Table 1 (Alexander 1991).

The use of compost on athletic fields will continue to grow as long as the product stays price competitive and consistent in quality compared to peat moss and commercially available topdressings. Compost used in athletic field maintenance (topdressing) must fit the specifications outlined earlier in the landscape section. Again, the material must also be finely screened in order to be easily backfilled into aeration holes, and so as not to smother existing growth.

The compost must be mature and free from significant foreign matter since traces of the material may be visible on the soil surface. Compost used in the renovation or construction of athletic fields may be slightly coarser than material used in topdressing.

Compost screened through a three-eighths to one-half-inch screen is acceptable for use in the renovation and construction of athletic fields, while materials used as a turf topdressing should be screened through a one-fourth to three-eighths screen. Compost used in the construction of athletic fields must have a texture which allows it to be easily mixed with other athletic field mix components like silica sands. Ratios and possible combinations of topdressing mixes are determined on a case by case basis, depending on native soil test data.

Material with a moisture content of 55 percent or more may be difficult to spread or mix efficiently. Since the majority of athletic fields are located at heavily populated schools and universities, the use of materials with objectionable odors or a significant amount of foreign material is not recommended.

TOPSOIL BLENDERS

Topsoil blenders are not actually an end-market for composted products because most materials produced are sold to other green industry professionals that use the soils. Landscapers, garden centers, nurseries and homeowners are often the end-markets where compost products end up after being professionally blended by a topsoil company. Many believe that the future of topsoil blending lies in the manufacturing of special blends to suit specific growing needs of specific plant families.

Adding compost to soils usually reduces potential runoff and erosion (Kashmanian 1992). Urban soils in most major metropolitan areas have had their soil structure destroyed from pulverization or multiple handling by large equipment (McCoy 1990). Research has shown that the addition of organic matter to these soils in a blending situation helps the resulting mix set up new structure when placed on the job site.

Recommended additions of compost to soils can vary greatly depending on what types of soils are used, however, a general guideline of 20 percent has been shown to be effective in the lab and field (McCoy 1990). Many composts also exhibit a wide particle size distribution which may or may not be beneficial in a blend, depending on the objective of each mix.

Composts used for topsoil production theoretically may be coarse as long as the final mix is screened. If a blend is made without final screening, compost should be supplied as three-quarter-inch or less in particle size. Heavy metals are less of a concern for horticultural applications. However, considering that many homeowners will purchase products for vegetable production, safety standards for food chain production should be followed.

Organic content should be consistent with the source of compost (i.e., if the feedstock materials do not regularly change, the end-product should be consistent in organic matter content). Changing compost sources midseason may alter blended topsoil appearance and create market confusion unless creative blending measures are taken.

Compost needs to be fully mature and low in soluble salts for most soil blend end-markets. The pH of composts used in blends may vary from six to eight. The pH of the final soil blend will depend greatly on the buffering capacity of the soil and the pH of ingredients. Many current topsoil mixes are manufactured to meet growing specifications per plant family, and pH may be adjusted accordingly by adding lime or ammonium sulfate.

SPECIAL BLENDS. There is a growing demand for special blends of soils for all types of horticultural applications. The specialization trend taking place across the United States is also predicted to occur in growing medias as well. The concept of offering blueberry mixes, azalea mixes, annual mixes, perennial mixes, etc., for future markets is very strong. However, the amount of research and documentation that needs to be done to support these budding markets is vast.

Currently, landscape architects specify potential compost products in their plans for new construction based on their knowledge of growing medias and the existing soils. It is vitally important that any new mix be studied and the addition of compost to this mix be compared to a standard such as peat moss, hardwood bark, etc.

Because many state laws mandate composting yard waste, sludge and other organic medias it seems only natural that local blending and specialized custom blends will some day be a large market for compost products.

Criteria for compost used in this market sector is highly variable with respect to pH and soluble salts due to the variable responses of plants. However, it is likely that consistent, mature, medium-textured composts with little or no inert contamination will be ideal for marketing through special blends.

RECLAMATION

The reclamation and revegetation of highly degraded sites is an excellent use for compost. Compost has been used with great success in the reclamation of strip mines and sand/gravel pits, and in the closure and vegetation of landfills. Compost has unique chemical, physical and biological characteristics which make it well-suited for use on sites that are difficult to re-establish with plant life. Compost has even been used to remediate soils which have been polluted and were unable to sustain plant growth. This market

also shows a great potential as a means to use lower quality compost.

STRIP MINES/SAND AND GRAVEL PITS. The potential quantities of compost used in renovating of surface mines, sand and gravel pits is tremendous. Compost can be used as a soil amendment at a quantity of 250 to 500 cubic yards per acre (approximately 2- to 4-inch layer) in order to help support vegetative growth. This vegetative growth stabilizes the soil surface and reduces the chance of soil erosion and runoff.

Previous work has shown that the use of sludge and other composted products applied in a large one-time application can be used to revegetate abandoned mines (Sopper 1991). Vegetating abandoned mine sites may be difficult because high levels of contaminants often found at many sites are toxic to plant growth.

In sand and gravel pits, the physical characteristics of the site may also make it difficult to vegetate. These sites are often low in organic matter and have a low water holding capacity, buffering capacity and cation exchange capacity.

The addition of organic matter, such as compost, improves these characteristics making the area habitable for vegetation and soil biota. When applying compost to mine sites in which high levels of heavy metals exist, the addition of compost has been shown to help "tie up" these contaminants, making them less available for plant uptake and allowing healthy plant growth.

A dense vegetative cover may also reduce the chances of heavy metal transport through surface runoff. These sites are considered to be a nuisance and have long been ignored in the past. Keeping this in mind, and knowing that these sites are not easily accessible to the public, it seems feasible that even low quality composts could be used in the renovation of these sites. Even compost containing large quantities of foreign material, excluding large quantities of film plastic, are probably acceptable for use.

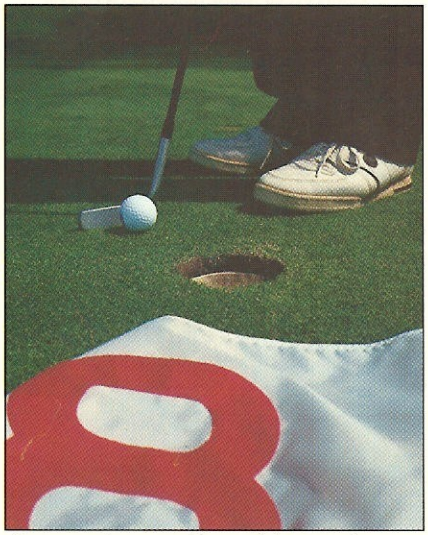
Film plastic may remain on the soil surface and be ingested by animals. Compost which contains a large amount of weed seeds and is considered unstable may also be acceptable for this use. In this application, any product that is low in cost and rich in organic matter is acceptable. Large quantities of compost have not been used, to date, on either of these types of sites because of economic, regulatory and environmental constraints.

LANDFILLS. Compost has been used successfully in landfill reclamation, closure and in daily cover. Many special mixes have been identified, used and tested, including a compost/sand mix, compost/soil mix and compost alone. Although quality control may be slightly less important for landfills, the compost still has to be of high enough quality to support plant life. After all, establishment of vegetation is a key objective for final closure of landfills.

Some municipal solid waste composting companies have planned from the outset to use their compost as daily cover in adjacent landfills and have opted not to take an aggressive marketing approach. This strategy works well because by composting the organic fraction of the solid-waste stream, a large volume of solid waste can be diverted from the landfill. The composting process itself will then significantly reduce the volume of that organic material through biodegradation. As a result, this strategy can extend the life of the landfill and create a ready market for municipal solid waste composts.

Consulting engineers can usually lend a hand in identifying and quantifying slopes so that compost mixtures used for closure can be mixed accordingly. Compost still should be mature enough to support plant growth, low enough in heavy metals to meet state standards and possess physical properties which allow it to be easily spread or blended.

Composts which do not support vegetation may be used for daily cover or mixed with other material such as sand or soil and then used as daily cover depending on state regulations.



Compost is normally used in containers at 10 to 30 percent (top), and can provide many benefits. Golf courses are considering increased disease suppression by using compost as an organic component in blended topdressings (bottom).

NURSERY GROWERS

Greenhouse, container and field nursery growers have a long history of using composted products, such as wood barks, peat moss and various other organic amendments in the production of their ornamented crops. Because research has shown that composts of various feedstocks perform well in conjunction with these products, its use in commercial operations has grown.

Compost has proven to be a cost benefit to growers in that it can often be purchased at a

lower cost than other organic amendments used in the industry. Compost manufacturers have proven that they can produce a product which is of high enough quality and which is consistent enough for use in this industry.

The quality and consistency of the product used by growers is important because of the valuable crops they grow and because these crops are grown in a closed system.

GREENHOUSES. Greenhouse growers have been using more composted materials since the industry shifted toward using soil-less growing media several years ago. Compost is used as one of the organic components to soil-less mixes, usually at a rate of 10 percent to 33 percent of the mix depending on the crops being grown. A significant amount of research has been performed demonstrating the use of sewage sludge compost in potting mixes; therefore, composted sewage sludge is probably the most popular compost used in growing operations.

Compost has also been used because it is a local, high quality source of organic matter and is usually less expensive than other organic components used in growing mixes. The compost used by growers must be very consistent, stable, have a pH preferably between 5 and 6.5, be low in soluble salts and free of weed seeds.

Compost has been found to contain naturally occurring disease suppressive properties which have the ability to help control many soilborne diseases. Because growing mixes are often adjusted to suit the pH needs of the crops being produced, compost which has had lime added to it during the production process is often not used. The addition of lime to compost makes it much more difficult to buffer (its pH), and the use of this material may cause trace elements in the growing mix to be immobilized (Gouin 1992).

CONTAINERS. Compost has been widely used in the production of container-grown nursery stock. Normal compost inclusion rates vary but, generally, a 10 percent to 30 percent inclusion rate is average. It is imperative that any extra labor required to add compost as an additional ingredient to the container mix be offset by savings in the overall cost of the mix. Research with sludge compost indicates a good success rate in the replacement of peat moss in the production of woody ornamentals (Smith 1990).

Some suppression of disease associated with the production of specific plant species has also been documented when compost has been added to container medias (Hoitink 1986). Although market potential for large volumes of compost used through container production is not great, it does represent a specific niche market that may be capitalized on through successful marketing programs. The possibility of providing special pH and nutrient adjusted composts as organic amendments to container mixes may be a very specialized area for future market development.

Using compost successfully in container medias includes using medium to coarse, well-drained, low soluble salt, mature composts. Due to the hands-on nature of many container operations, contamination of composts with inerts will not likely be tolerated in the marketplace. Composts have been known to add valuable micronutrients and improve plant vigor due to water retention properties. However, dangers of rapid material decomposition and shrinkage also exist which may create slow draining, anaerobic growing conditions if mixes are improperly formulated.

FIELD. Field nursery growers are currently using compost in two ways: field incorporation and mulching. These methods are discussed below.

Nurserymen are a significant market for composts, but are quite geographically dependent. For instance, Ohio has an approximately $1 billion nursery-related business compared to other states with limited nursery production.

Field-harvested nursery stock (ball and burlap) remove significant amounts of soil mass and nutrients. As much as 50 to 250 tons of soil per acre may be lost at harvest (Tyler 1991). Additionally, the normal soil loss from erosion makes replenishing the soil (and especially organic matter) a necessity to maintain productivity.

Often, farmers will take their fields out of production in order to grow a cover crop, a vegetative cover which is plowed into the soil, in order to return valuable humus and nutrients back to the soil. This loss is estimated at just under 3 billion tons per year for all agricultural erosion, or about 6.7 tons per acre, per year (Kashmanian 1992). Losses in the nursery may be slightly less due to reduced tillage practices over the life of each crop. Costs associated with using compost cover cropping are competitive when all factors are considered (Logsdon 1991).

Applications of 2 inches of compost, plowed to a depth of 6 to 8 inches significantly increases organic matter in native soils. Native clay soils break up easier and form new aggregation as organic matter decomposition takes place. Sandy soils generally hold 25 percent of their weight in water while many composts hold up to 180 percent of their weight in water (Seattle 1990). Consequently, sandy soils retain more moisture with additions of compost and give plants a better chance for survival during drought conditions.

Compost applications profitably replace normal cover cropping at nurseries by allowing applications, tillage and planting of a new crop to occur in a short window of time. Approximately one full growing season can be saved by using this approach, and the amount of organic matter returned to the soil is at least 10 times the amount delivered by cover crops (Tyler 1991).

Various feedstocks of organically compostable materials with various chemical and physical properties requires a greater understanding of quality control.

Compost used in field incorporation programs must be fully mature, high in organic content, low in heavy metals and low in soluble salts. Concerns with heavy metals usually arise when the land may be used for future food or animal production.

The level of acceptable contamination of the compost with inerts will depend on what loading limits are acceptable to nurserymen using multiple applications. However, since most field crops have growing cycles of two to seven years, a buildup of inert materials in their soils is less likely to occur than fields receiving yearly compost applications.

The pH of a compost may be adjusted after application to suit specific needs for various families of crops or soils. Many nurserymen prefer a coarse grade product because of the resistance to decomposition over time, which helps increase field soil friability and provides adequate aeration for tender roots.

Nurseries can use large quantities of compost by mulching plant rows in field situations. Applications usually range from 1 to 2 inches. Mulch primarily conserves moisture, but also helps reduce weed growth, reduce soil temperatures and eventually add significant amounts of organic matter to the native soils when incorporated into the soil post harvest. This is especially handy when another planting is planned for the same field immediately after harvest.

Compost used for mulch can be coarse, but must still be able to be worked in and around individual plants if needed. Nurserymen have noticed using compost as a mulch in place of normal hardwood bark mulch has increased growth and reduced injuries to plants associated with stringier hard-wood bark mulches. Compost processed with a 2-inch screener works especially well (Hendricks 1992).

Heavy metals need to be within acceptable food chain levels unless the land is never again intended to be used for food production. Organic contents should be high to aid in the absorption and conservation of water. The compost should be fully mature and may possess a slightly elevated level of soluble salts due to the high leaching potential of mulch. However, many salt-sensitive crops such as those planted as bare-root cuttings, may react negatively to high salt levels. The pH of the mulch will also depend on the needs of the individual crop being cultivated, but generally may be between six and eight.

ROADSIDE

The use of compost on roadside development and maintenance projects continues to grow as more waste derived composts are produced. Composts are being "specified" as "approved equals" to other organic products such as topsoil or peat moss used in these projects. The need to create markets for the large volumes of waste-

derived composts being produced have lead some states to develop research programs aimed at determining the optimal methods for using compost on roadside projects.

The roadside environment is often hostile. Lack of irrigation, minimum fertilization and the use of road salts often makes it too difficult for vegetation to persist. The use of compost can improve the environment for roadside vegetation, giving it a better chance of survival.

Currently, compost is being used on roadsides as a soil amendment in the establishment of planting beds and as a component of backfill mixes for trees and shrubs. In several states, compost is included to improve the organic matter content of soils used on roadside construction projects, or similarly, in the production of manufactured soils used for the same purpose.

In Europe, compost has been accepted as the growing media in "living walls" which border roadsides and have been shown to perform well in sound minimization. Compost used in these applications should meet the specifications described earlier, for similar purposes. However, characteristics which affect product handling, such as moisture content, may not be as pertinent in projects where mechanical equipment is used to apply and incorporate the compost.

Additionally, characteristics which deal with aesthetics, such as foreign matter content and color, may not deter use – especially if the product is used as a soil amendment rather than for surface application.

The application of compost for weed and erosion control on roadsides warrants more discussion because of the promising results being documented on an ongoing basis.

WEED CONTROL. In many states, coarse composts are approved for use on roadside maintenance projects as a mulch for weed control. Even though the materials are high in organic matter and hold moisture well, they have also been found to be effective in controlling weed growth. This is probably due to the dark color of the products which absorb heat, causing its' surface to readily dry out (Kilbourn 1991).

This hot, dry surface makes it difficult for weeds to establish and, as long as the product is properly composted before its use, the compost itself should be weed-free. Compost used in this application should be coarse in texture, weed-free and low in inerts, as well as aesthetically appealing. The product should also possess characteristics which make it easy to handle and spread. It is possible that the product could be mechanically blown onto areas that are difficult to access (i.e., steep slopes).

EROSION CONTROL. Compost may also be used as a surface application to slopes and embankments in order to control erosion. Once again, coarse composts have been shown to work well in this

Compost used as a mulch for landscape plants during a research at The Ohio State University.

application as have some municipal solid waste composts because of their absorbent nature. Coarse, sludge-based composts (containing a high percentage of wood chips) have shown excellent results applied as a surface application on 2:1 slopes (Rattie 1992).

A mixture of coarse compost and sand, used in similar conditions, has shown similar results. The erosion reduction capabilities of this mix have been attributed to its ability to allow for improved water infiltration. The erosion controlling effects of coarser composts, applied as a surface application, have been attributed to the ability of the product to "knit together," creating excellent coverage over the soil surface and having the density and physical structure which resists surface erosion.

According to research, the addition of compost reduces erosion in three ways (Tietjen 1969). First, soil structural strength is increased leading to heightened resistance to erosional forces. Second, the compost mulch near the soil surface absorbs the energy of raindrop impact and third, soil water holding capacity is increased, providing less water for runoff (Tietjen 1969).

In both weed control and erosion control, further research is and will be required to prove theories regarding the effectiveness of these products. Compost used in erosion control should have similar characteristics to products used in weed control, except for one major difference—its ability to grow vegetation.

In specific applications, where erosion control is desired, a compost which is considered unstable or contains substances which may be detrimental to plant growth, may actually prove to be a benefit in this application. However, in many erosion control practices, the growth of weeds on the soil surface may not be considered negative in that the most practical and effective method for controlling erosion is by densely vegetating the soil surface.

GROWTH MARKETS

Although there are many other potentially large markets for compost use, two in particular may prove to be the most important to develop as more organic residuals are transformed into compost. Both the agricultural sector (food production) and the general public are large potential markets for composts of various feedstocks.

The potential acreage and resources controlled by these groups may make them the key to solving our country's solid-waste management situation. Composting will be used as a means to manage a large portion of the residential, commercial and agricultural organic waste stream. The industry's growth will be closely related to our success in developing large, long-term markets for the resultant products.

AGRICULTURE. The agriculture market has been considered by some to be the "dumping grounds" for composts which are not of the highest quality. It should be noted that farmers are usually in tune with their soils, often working with agronomists to determine fertilizer loading capacities, etc. Although many perceive that composts used by this market sector may be lower in quality than in other sectors, lower quality products which contain inert materials (i.e., glass, plastics, etc.) will be more recognizable in soil over time. Whether American farmers will allow this to take place is yet to be seen.

Market potential in agriculture is by far the largest (Slivka 1992), but many farmers are also turning to composting as a safe way to handle conventional farm wastes. Given the option, it will be interesting to see whether a farmer will produce his own compost or buy (or be paid to receive) compost produced from waste products.

One thing is for sure, the value of compost when used in sustainable agriculture proposals is significant. It may also be possible to reduce traditional fertilizer and pesticide applications due to benefits associated with composts.

Composts used in agriculture must be safe enough to avoid permanent contamination of soils with inerts or heavy metals. Some composts may be applied in an immature state, however, they are usually less effective than fully mature composts. It is wise not to plant immediately following the application of immature composts due to nitrogen immobilization or low oxygen concentrations that prevail in soil immediately after incorporation of such composts.

The use of composts in agriculture has been shown to offer a variety of benefits, one of the largest being reduction of erosion (Kashmanian 1992). High intensity farming erodes valuable topsoil faster than it can accumulate naturally (Kashmanian 1992). By adding compost on a regular basis, farmers can maintain healthy soils and remain profitable.

Topsoil blends have become a highly specialized market to address individual growing needsof various families of plants.

Loading limits need to be established for agricultural uses of all types of composts with respect to macro- and micronutrients, heavy metals, salts and inert contaminants. The potential amount of compost generated from source separated organic wastes, about 180 million tons, is dwarfed by the amounts of farm manures (and, therefore, possible compost) which may be produced. About 1.4 billion tons of manure are disposed of annually (Kashmanian 1992).

Although many studies have been performed illustrating the benefits of compost use on agricultural land, the market still refuses to pay high costs for these materials. In general, normal farming practices can deplete more than 50 percent of a native soil's organic matter over time (Lucas 1978). Also, losses of humus and other soil nutrients from erosion are significant in agriculture, but compost can help replenish these by being added on a regular basis.

Studies show that the regular application of raw agricultural materials, such as manure, do not readily change the organic matter content in soil over many years (Lucas 1978). Soil humus is lost on a regular basis to soil erosion and soil micro flora, and is also converted to carbon dioxide and water through natural processes. In the United States alone, 3.6 billion metric tons of topsoil are lost to erosion annually, some of that being natural humus (Lucas 1978).

Most farms, in an attempt to rectify soil losses from erosion, land apply the majority of their manures. However, many of the manures currently being applied may contribute to non-point source pollution because they are more easily eroded and leached than products which are composted prior to application.

Composted manures and farm wastes may help reduce non-point source pollution by converting nutrients into less leachable forms.

Compaction may be reduced by the addition of compost or organic matter to the soil, thus helping reduce runoff and erosion from farm fields. Depending on application rates, the addition of compost to agricultural lands can increase organic matter dramatically, whereas applications of raw manures or green manures usually add less total organic matter.

Benefits associated with the addition of compost to agricultural fields seem to far outweigh the extra effort and associated costs. However, an educational system is needed to lead the way for market development in this large area.

By looking at compost products as natural resources which can be used to help offset losses of soil from erosion, we cannot forget that the base soils that receive applications are also one of our largest natural resources. Thoughts of permanent damage or contamination to these vast markets should lead quality control planners to stand strong on high quality standards to ensure adequate land is indefinitely available for these applications.

HOMEOWNERS. As the general public becomes more educated about the benefits of using compost, its acceptance within this market segment will grow. Public interest in organic gardening and sustainable agriculture will also improve the marketability of composted products. Teaching the general public what is fact and what is fiction about compost, especially when it comes to health and safety issues, is of utmost importance.

Currently, the most popular composts being used by homeowners are leaf/yard waste and various animal manure composts. In specific areas, sludge compost has also been marketed to homeowners with great success, however, it has proven to be more difficult due to the natural stigma attached.

Municipal solid-waste compost will, no doubt, be more difficult to market to homeowners than other types of compost. This is because many MSW composts are not as aesthetically appealing as other types of compost. Most likely, only the MSW composts which are of the highest quality will gain wide acceptance with 'John and Jane Q. Public'. It has many of the same benefits as other composted materials possess and can be used in much the same way.

Composts which are marketed to homeowners must have a texture which makes them easy to work with and must have an attractive look. They must be consistent, free of weed seeds and objectionable odor. If the material is high in soluble salts or is unstable and causes a plant kill, homeowners will be turned off to the product for a long time.

Since homeowners do not have a technical background in the production or use of compost, the product we market to them must be of the highest quality. It is widely believed that the key to creating long-term markets for compost depends upon creating acceptance with the general public (homeowners).

As the popularity of compost application grows, it becomes increasingly more important that we understand how various composts are best used, as well as understand how specific end-users use the product and for what reasons. For this knowledge to grow, continued monies must be made available for appropriate research to develop new uses for our compost products.

As the production of composts increase, largely due to more scrutiny of our waste management practices, the need for knowledge and public support becomes a national and international issue, rather than a regional one. This fact makes it extremely important that as more research is completed and information obtained, that the data is shared throughout the industry in a way which will benefit all interested parties. Accomplishing this goal will benefit us in many ways from avoiding the duplication of research, to improving public relations.

SPECIAL **REPORT**

Compost, when meeting the proper standards and applied correctly, can result in enhanced annual and perennial flower plantings.

Alexander is product marketing/utilization specialist for E&A Environmental/EMCON Inc., Cary, N.C., and Tyler is manager of product and market development for Kurtz Brothers Inc., Cuyahoga Heights, Ohio.

REFERENCES

Alexander, R.A.,"Sludge Compost: Can It Make Athletic Fields More Playable?" Lawn & Landscape Maintenance, July 1991, pp. 46-52.

Angle, J.S., D.C. Wolf and J.R. Hall III, "Turfgrass Growth Aided by Sludge Compost". Biocycle, Nov.-Dec. 1981, pp. 40-43.

Personal Interview with Francis Gouin, 21 May 1992.

Personal Interview with Bill Hendricks, Klyn Nurseries, Aug. 10, 1992.

Hoitink, H.J., Kuter, G.A., Effects of Compost in Growth Media on Soilborne Pathogens. The Role of Organic Matter in Modern Agriculture, ISBN 90-247-3360-x, 1986.

Kashmanian, R.M., Composting and Agricultural Coverage: Part I, State, Local and Agricultural Activities and Composting and Agricultural Coverage: Part II, Implications for Reducing Water Pollution for Livestock Operations and Erosion, publishing pending.

Personal Interview with Jay Kilbourn, Resource Conservation Services, Inc., 17 July 1992.

Logsdon, Gene, Plant Nurseries Cut Costs With Compost, BioCycle, May, 1991.

Lucas, R.E. and Vitosh, M.L., Soil Organic Matter Dynamics, Michigan State University Agricultural Experiment Station Research Report, Nov., 1978 32.91.

McCoy, E.L., Assessment and "Renovation of Residential Soils", Urban and Sports Turf Soil, 2nd Edition, 1990.

Nelson, Eric B., the Biological Control of Turfgrass Disease, Golf Course Management, April, 1992.

Personal Interview with Alfred Rattie, Compost Management, Inc., 17 July 1992.

Seattle Solid Waste Authority, Ceder Grove Compost Users Guide for Landscape Professionals, 1990.

Slivka, McClure, Buhr, Albrecht. Potential U.S. Applications for Compost Applications. Commissioned by the Proctor and Gamble Co. for the Solid Waste Composting Council, Jan., 1992.

Smith, E.M., and S.A. Treaster, Composted Municipal Sludge From Two Ohio Cities for Container Grown Woody Ornamentals, 1990.

Smith, E.M., and S.A. Treaster 1991.. Production of Annuals and Perennials Grown in Soil Amended and Mulched with Composted Landscape Waste.

Tietjen, C., and S.A. Hart, 1969. Compost for Agricultural Land Journal San. Eng. Division, Proc. American Society - Civil Eng. 15(SA2): 269-287.

Sopper, W.A., "Long-Term Effects of Reclamation of Deep Coal Mine Refuse Banks with Municipal Sewage Sludge," XII National Symposium on Mining, Sept. 22-27, 1991 (Lexington, Kentucky: University of Kentucky).

Tyler, R., Benefits of Using Compost in the Nursery, The Buckeye, January, 1991.

PEER REVIEW COMMITTEE REFERENCES

Dr. Joel Alpert
Vice President
E & A Environmental/Emcon, Inc.

Dr. Ed McCoy
Professor of Agonomy
The Ohio State University/OARDC

Dr. William Mitchell
Professor Emeritus, Agronomy
University of Delaware

Dr. Harry A.J. Hoitink
Professor of Plant Pathology
The Ohio State University/OARDC

Tom Kurtz, vice president
Kurtz Brothers Inc.

This article has been professionally reviewed by experts in related industries with relevant experience. This peer review committee has served to help ensure this paper contains accurate information as well as applicable concepts.