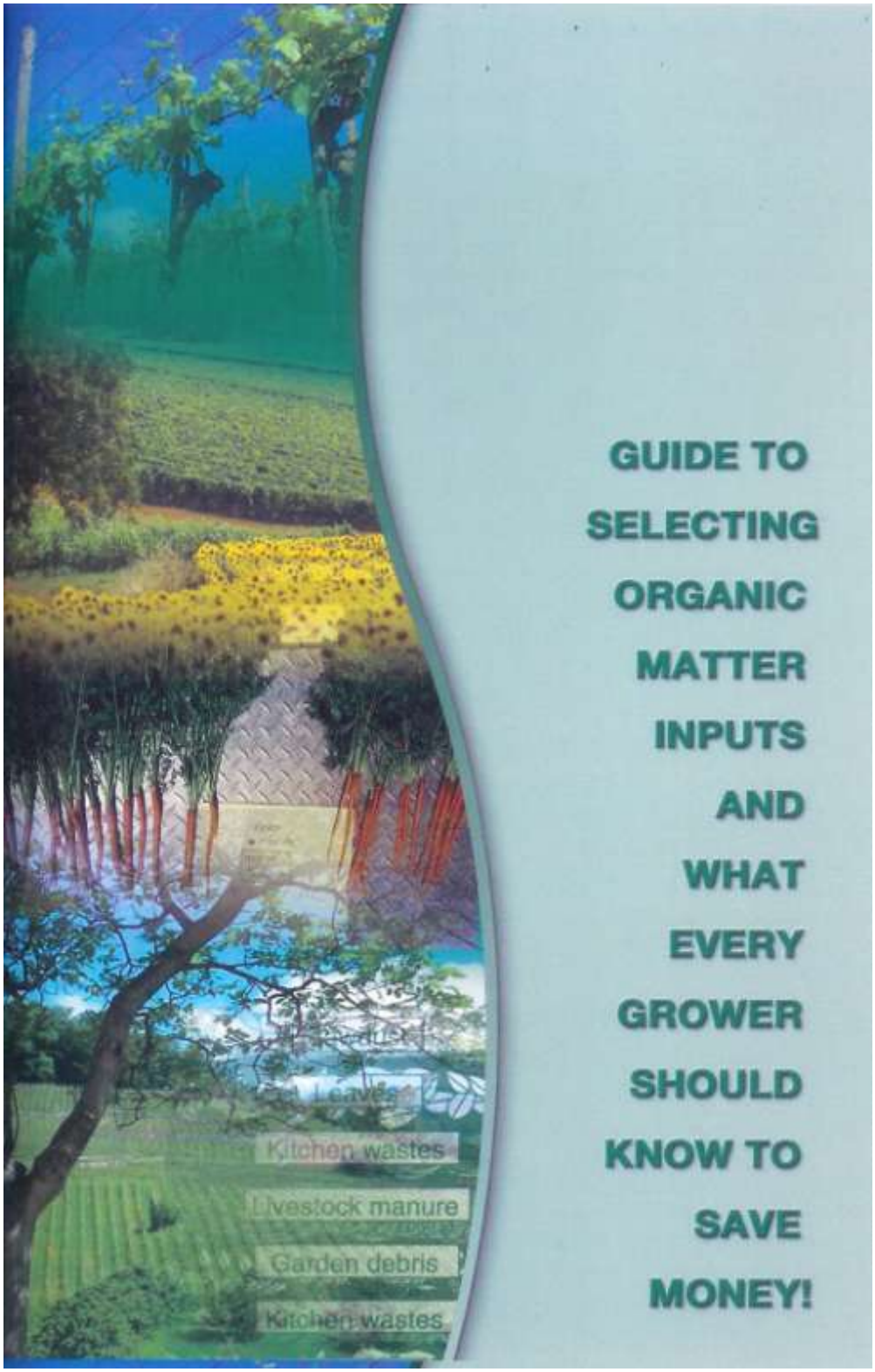


GUIDE TO SELECTING ORGANIC MATTER INPUTS AND WHAT EVERY GROWER SHOULD KNOW TO SAVE MONEY!

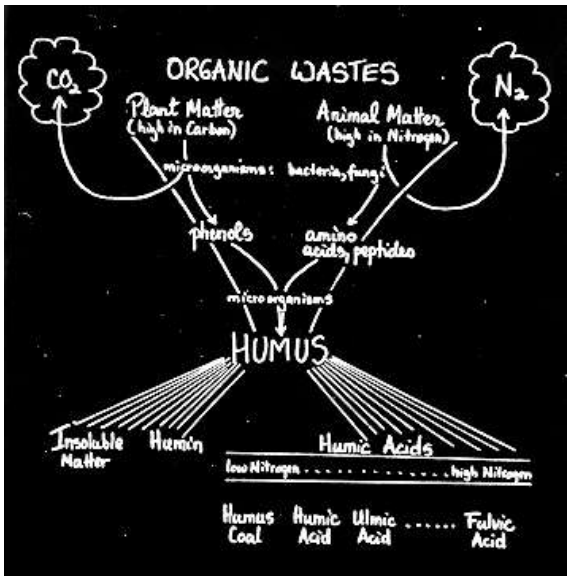
Guide to Selecting Organic Matter Inputs and What Every Grower Should Know to Save Money!

A Word about Carbon:

The study of Organic is the study of Carbon.

The most influential element affecting plant productivity is carbon. Carbon is directly used by plants, from the atmosphere, for respiration. Plants also benefit from the indirect utilization of carbon by soil microorganisms consuming (cycling) soil organic matter to humus. Through the plant's process of respiration the carbon is fixed into molecules, that create many useful compounds; and Oxygen is released. Some of these useful compounds are sugar (sweet fruit), protein (nutritious grains), and cellulose (lumber).

Carbon is such an important element, that when examined, it is called the "study of Organics." Indeed the word organic only means "carbon containing". When one says "this is an organic fertilizer" they mean that it has carbon as part of its molecular makeup. For the last 60 years, productive conventional agriculture uses primarily fertilizers that are inorganic. Nitrogen, phosphorus, potassium, and minor nutrient fertilizers do not, generally, have carbon in them. Plants derive most of their carbon requirements from, predominately, the soil in which they are grown. Each season more of this carbon is depleted, from the soil, and is not being added back by modern fertilizer inputs. This continual treadmill, although initially productive, is not sustainable and the basis of declining soil fertility over time. A new University of California study shows that "Total Soil Carbon" has declined in California soils between 1945 and 2001, a statistic that "deserves attention."



Successful growers and those that are concerned over the value of their land are augmenting their inorganic fertility program with inexpensive organic inputs, that are not necessarily certified Organic products. Crop residues, animal manures, green manures, compost, and processor waste are all sources of organic matter. These sources continue the organic cycle of soil that strongly influence sustained soil fertility.

A Word on Organic Matter

The benefits of Organic Matter are widely misunderstood. Although dairymen regard cow manure as a waste, commercial farming operations value it as a soil amendment; while many growers value it only as a fertilizer. As a source of primary nutrients, though, Organic Matter offers much less, pound for pound, than inorganic fertilizer. So what are its benefits?

First, Organic Matter does contain primary nutrients -Nitrogen, Phosphate, and Potash - but in small amounts. For example, a grower would need 8 times as much horse manure as compared to a 5-10-10 fertilizer in order to supply a given amount of nitrogen. If you rely solely on manure to supply primary nutrients, you'll need a pile! (literally.) Most growers supplement manure with other fertilizers.

> "It's the ultimate recycling; We're giving nutrients back to the land that we took out of it."

Primary nutrients don't supply all of the plant's requirements, though. Secondary elements, such as; sulphur, calcium, and magnesium, are required in substantial amounts. Micronutrients; including zinc, boron, iron, and copper, are also needed in minute quantities. Organic Matter is usually an excellent source of these elements, as most inorganic fertilizers are not supplying them.

Not only does Organic Matter supply nutrients, it helps hold them in the soil. Particles of humus derived from Organic Matter carry a negative electrical charge which allows them to combine with many plant nutrients that carry a positive electrical charge. Sand is electrically neutral, which explains why it doesn't hold nutrients well. Adding Organic Matter to sandy soil greatly enhances that soil's ability to catch and retain nutrients and water.

The most important benefit of Organic Matter is as a soil conditioner. Mixing Organic Matter into a sandy soil is like introducing thousands of tiny sponges that help retain moisture. Organic Matter also helps loosen and aerofy a compacted clay soil.

ORGANIC MATTER USE:

What are the economic benefits?

- Improved productivity
  - Yield
  - Quality
  - Nutrition
- Reducing the use of Pesticides
  - Healthier plants/soils
  - Disease suppression
- Reducing the use of chemical fertilizers
- Creating markets for local waste generators
- Avoiding landfill disposal costs for green material
- Positive public perception
- Maintain productivity and value of your land and aquifer

What are the environmental benefits?

- Increased soil fertility and revitalization
- Improved soil structure
- Increased water holding capacity (i.e. conserve water)
  - Improved water quality
- Increased resistance to erosion
- Improved disease resistance (by plants)
- Decreased reliance on landfill and incineration
  - Decreased green house gasses

Organic Matter also transport useful microbial hitchhikers. These living components of organic matter manufacture glues-like substances that cement soil particles into crumbs (aggregates). Crumbly soil is ideal as far as most plants are concerned because its structure allows it to hold both air and water. Thereby allowing roots to move easier through the soil profile and helping the plant conserve energy.

Once dissolved in water, most inorganic fertilizers are quickly available to plants. But slow release fertilizers, like Organic Matter, are also beneficial because they provide small amounts of nutrients over several years. When Organic Matter is applied each year, you'll maintain a small reserve of nutrients that plants can draw on throughout their growing period.

Organic Matter does have some drawbacks though. However, careful selection, handling and use can minimize these drawbacks will accentuating the benefits of Organic Matter use.

Definition of Manures

Animal: Refers to the fresh, stockpiled or unrefined excrement of Animals that includes; but is not limited to Beef, Sheep, Swine, Dairy. (Does not include Human waste)

Green: Refers to plant residues that include, but are not limited to: cover crops, crop residues, processor waste, and landscape cuttings, prunings or clippings.

Definition of Human waste

(Note: The historical term of Sewage Sludge has become so wrought with negative public perception that a new moniker of "BioSolid" is now being used)

Sewage Sludge or BioSolid: is a by-product of the municipal wastewater treatment process.

Definition of Compost

"Composting" and "compost" are two distinct terms. The former refers to the bio-oxidation process and the latter refers to the resulting product: stabilized organic matter.

As generally agreed upon, compost is: "A solid mature product resulting from composting, which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase."

General Facts about Animal Manure Management

Animal manure is recycled and utilized as a natural fertilizer, providing nutrients to soil and crops.

Pathogen reduction is a major component of manure containment, treatment and application procedures. In the past, it was secondary to nutrient stabilization, volume reduction, and storage.

The large volumes of animal manure generated on livestock feedlots, dairy barns, and other areas of highly concentrated wastes is a concern because of the risk of food-borne and water-borne transmission of bacterial pathogens and parasites to humans.

In the farm environment, direct and indirect pathways of pathogen transport from manure to food and water exist. The level of risk that these vectors impose on human health is unknown.

The application of raw manure to soil growing fresh produce is a direct route of contamination. Surface water that supplies municipal systems or is used for crop irrigation can be indirectly polluted by runoff to farm ponds, streams and reservoirs. Vectoring by insects, birds, and wildlife is another indirect transport route. For example, wild geese may ingest *Cryptosporidium parvum* oocysts that are still viable when excreted. The level of risk that vectors impose on human health is unknown.

The Federal Food Safety Initiative Consortium has targeted the following pathogens for immediate attention *Salmonella spp.; Campylobacter jejuni/coli; Escherichia coli O157:H7* and other strains; and *Cryptosporidium parvum*.

Water-borne transmission of *Cryptosporidium parvum* is a concern because the parasite can remain viable for months in natural waters and is resistant to many disinfectants.

Food-borne transmission of bacterial pathogens that can colonize within food (i.e. wounds to food surface) or within surface biofilms are also of particular concern.

Fresh produce is often contaminated by improperly treated manure used as fertilizer or by manure-contaminated irrigation water.

Re-colonization or cycling pathogens back to farm animals or animal feed is also a consequence of inadequate pathogen reduction treatments to animal manure.

Manure treatments available include both active and passive processes. Passive processes are deep stacking, stockpiling, drying, and storage lagoons. Active treatments are composting, heat drying, digestion, aerated lagoons, and constructed wetlands.

Animal feedlots can be a large source of runoff. The EPA regulates the management of such waste contributing areas, known as Concentrated Animal Feeding Operations (CAFOs), in order to minimize water contamination.

To reduce runoff of pathogens to surface water some proposed agricultural management practices include vegetative buffer strips, riparian zones, and constructed or natural wetlands

The Six Criteria for Selecting Organic Matter Inputs:

Source, Maturity, Rates, Foreign Matter, Trace Elements and Pathogens

I. Source

Organic Matters, in the most simple terms, is any matter that contains elemental Carbon as part of it's molecular make up. In more general terms Organic Matter, for agricultural use, can be Animal or Plant derived.

Animal products are generally considered to contain more Primary and Secondary nutrients. While Plant derived Organic Matter is generally thought to have more carbon and soil structure improvement qualities. On the other hand, some sources of bulky unrefined organic matter may inhibit the growth of certain crops. Compounds known as allelochemicals may inhibit the growth of subsequent crops. However, each of these sources have other benefits and drawbacks which will be expounded upon later.

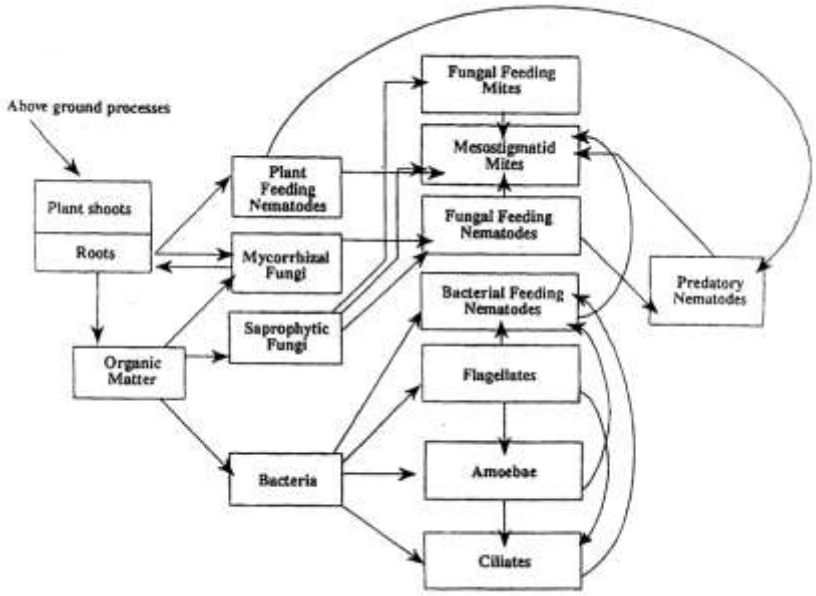
II. Stability-Maturity

Is a term most closely related to Composts, however, one must be aware that raw manures have potential hazards as well:

ANIMAL MANURES:

All Organic Matter and unrefined manures, in particular, have deleterious components that include: Diseases (Plant, animal and human), salts, heavy metals, weed seeds, hazardous gasses and difficult to handle forms. *Care should be taken in the selection and utilization of animal manures to minimize or eliminate the affects of these deleterious components.*

Diseases: Can be reduced through proper composting and sterilization. However, selection of the type of manure that contains less disease is more important. Native manures or those coming from animals without husbandry may contain more diseases. (On the other hand, domestic animal feces may contain antibiotics which are an issue for another day). Within sources from domesticated animals Dog, Cat and Pig feces are considered to contain the most human pathogen. (e.g. round worms, nematodes, toxoplasmosis, *Cryptosporidium parvum, Salmonella spp., Campylobacter jejuni/coli,* and *Escherichia coli O157:H7* and other strains).



Every animal manure can contain fecal coliforms (E. coli and Salmonella). Likewise any soil that ever had an animal (walk, run, jump, fly, crawl or burrow) across it has the potential for fecal coliforms. Sterilization or composting are the only reasonable ways to reduce the chance for fecal coliform transmission. Care

should be taken to ensure that manures do not come in contact with the harvested crop.

Salts: are a fact of animal manures. Some manures like beef and dairy have a higher incidence of salt as 'supplemental salt' is administered in their nutrition. Ways to minimize salts are to minimize the amount of animal manures being applied. Salts can be leached from stock piled manures and composting. However, selection of some manure's like Bat or Poultry will give you a higher fertilizer to salt ratio. Also, blending manures, or fertilizers with plant organic matter reduces the amount of salt loading while maintaining adequate carbon contribution.

Heavy Metals: are of most concern in Sewage sludge because refinement or processing of the Sludge tends to concentrate them. Although, other animal manures contain heavy metals, these forms of manures can be handled more safely in their raw form.

Weed seeds: are harder to digest by most animals than the more nutritious parts of plants for feed. Animal feeding operations that produce the highest quality (Milk or Meat) usually have feeds that contain less weedy material. They also use milled (cracked or Rolled) grains that increase the feed value and destroy germination potential of undigested seed.

Gasses: Five types of gases are of primary concern as a plant, animal or human hazards; these are ammonia, carbon dioxide, carbon monoxide, hydrogen sulfide, and methane. Among the most troublesome are:

Hydrogen sulfide: is especially dangerous during agitation and pump out of liquid pits. It can reach lethal concentrations and kill animals, both livestock and humans.

Methane: is produced by manure decomposition under strict anaerobic conditions. Methane is not toxic, but at high concentrations it may cause an asphyxiating environment or explosion.

Ammonia: is an eye, nose, throat and lung irritant. It will also damage plant tissue and destroy beneficial soil ecology at high enough concentrations.

Difficult to handle forms: of animal manures may necessitate specialized applicators or spreaders. Also, liquid forms, if allowed to escape from storage facilities have the potential to pollute on-farm and off farm sites (in particular, water ways).

COMPOST:

Stability and maturity are terms often used to characterize compost, yet opinions about what these terms mean vary widely. The term "stable" typically refers to a compost that is not undergoing rapid decomposition and whose nutrients are slowly released into the soil. The term "mature" typically refers to the degree of completeness of the composting process. In mature compost, raw feedstocks have sufficiently decomposed for 60 to 90 days under controlled moisture and aeration conditions and cured for another 30 days to result in a stable product that is non-phytotoxic to plants. Immature compost may contain one or more growth-inhibiting compounds (e.g., short-chain organic acids that are phytotoxic to seedlings), weed seeds, or other undesirable characteristics.

Compost stability and maturity are difficult to assess by simple sight or smell. In general, though, mature compost will not contain recognizable feedstock material, should smell like rich soil, and should not smell foul or ammonia-like.

Indicators of Compost Stability

Composting Pile Temperature. In moderate climates, if the temperature of the composting pile is more than 15°F (8°C) higher than the ambient air, the compost may be unstable.

Respiration Rate. The rate of oxygen utilization and/or carbon dioxide release may be used to assess respiration rate, a measure of biological activity. The Solvita test, available from Woods End Research Laboratory, is a quick test for respiration rate. However, composts that are cold or dry or that have a high salinity content may not respire even though they are unstable.

Length of Composting Process. In general, compost from an aerobic windrow should be processed for a minimum of 60 to 90 days, although even after this time the compost may still be unstable. Most compost should be actively processed 90 to 120 days to be considered stable. This additional processing time results in compost that is sometimes referred to as being "cured." Some experts believe that compost should be cured for six months before use.

Carbon:Nitrogen (C:N) ratio. The C:N ratio usually decreases during the composting process and consequently is sometimes used to indicate compost stability. However, for this ratio to be used meaningfully, you need to know relative C:N ratios at the beginning and end of the composting process. Ideally, C:N should be approximately 30:1 at the beginning. If the C:N ratio is low at the beginning (e.g., around 10:1 or 15:1), then a low C:N at the end may not indicate stability. Assuming the beginning C:N is approximately 30:1, the C:N of stable compost at the end of the process will be between 10:1 and 20:1, with the most stable composts falling in the lower end of this range. A final C:N above 20:1 may indicate a compost that will not readily release nitrogen, while a final C:N above 30:1 may indicate a compost that will inhibit nitrogen mineralization and tie up nitrogen from the soil.

Indicators of Compost Maturity

Maturity cannot be described by a single property. Some laboratories assign a maturity index to compost based upon germination rate, root tissue growth, and other factors. The California Compost Quality Council (CCQC) developed a numerical *Maturity Index* that uses standard laboratory tests to rate compost maturity. To qualify as "mature" or "very mature," a compost must have a C:N ratio of less than or equal to 25 and pass two additional tests performed concurrently from each group:

- Group A tests, which indirectly measure the degree of organic matter decomposition, include carbon dioxide release or respiration; oxygen demand; and Dewar self-heating test.
- Group B tests, which measure chemical characteristics of the product (some of which can be toxic to plants) include ammonium nitrate ratio; ammonia concentration; volatile organic acids concentration; and plant bioassays.

www.CCQC.org publications describe how to apply the index and interpret test results to determine whether a compost is very mature, mature, or immature, and provide general guidelines on best uses of composts based on the Maturity Index rating.

Seed Germination. Whether or not the index is used, growers concerned about phytotoxicity may perform a simple seed germination test themselves using radish seeds or the seeds that they will be planting. The following Web site includes guidelines for conducting germination tests: www.compostinfo.com/tutorial/MaturityTests.htm. Many laboratories also will perform seed germination tests.

III. Rates

High rates of un-decomposed organic matter may be competitive to plants for fertilizer or may be toxic to plants.

Unstable compost and undigested bulky organic matter (crop residues), because it is still decomposing, can use or "tie up" nitrogen from the soil, although it still may be useful in certain situations. For example, conventional growers may apply unstable compost to increase soil organic matter; if they also are applying an appropriate amount fertilizer, they may not be concerned about a small amount of nitrogen immobilization from unstable compost. Most uses of compost, though, require a stable product that prevents nutrients from being tied up.

Moreover undesirable organic compounds (allelochemicals) excessive rates of organic matter, if decomposed anaerobically will produce toxic by products.

IV. Foreign Matter

Foreign matter is defined as: "Any matter over a 2 mm dimension that results from human intervention and having organic or inorganic constituents such as metal, glass and synthetic polymers (e.g. plastic and rubber) that may be present in the compost but excluding mineral soils, woody material and rocks."

Manures do not have Foreign Matter unless contaminated through their handling. Composts that are from municipal green waste usually have the greatest incidence of Foreign Matter contamination.

Safety and aesthetics constitute the key considerations in the foreign matter content standards in compost. The safety criteria, relating to sharp foreign matter content may vary depending on intended use.

FOREIGN MATTER -- SAFETY CRITERIA

Organic Matter should not contain any sharp foreign matter that may cause damage or injury to humans, machinery animals and plants during or resulting from its intended use. Such as, plug an irrigation system or puncture a tire, in the field.

A recent trend has been the accumulation of Herbicides in municipal green-waste compost. For info see: http://www.solidwaste.com/content/news/article.asp?docid={dc4efc7d-fa29-11d5-a788-00d0b7694f32}

FOREIGN MATTER -- AESTHETICS

Organic Matter should not contain any foreign matter in any dimension that would diminish the desired effect of the intended use. Such as, top-dressing a pasture or mulching your flower beds would have a different standard than a deep tillage incorporation.

V. Trace Elements

A "trace element" is defined as "*a chemical element present in Organic Matter at a very low concentration*." Compost standards identify trace elements that are essential to plant growth in addition to identifying heavy metals which, depending on their concentration could be harmful to human health and the environment.

The maximum cumulative amounts are regulated by state and federal standards. Additional elements may be added to the list according to the availability of new scientific data.

Rocket Fuel Found in Milk

http://www.lubbockonline.com/stories/102203/edi_102203016.shtml

PERCHLORATE is a substance that is found in rocket fuel. It has raised concerns on the South Plains of Texas because it has been found in well water in cities, and now it has been found in milk that has been sold in local supermarkets. The discovery of perchlorate in milk was discovered through a Texas Tech study that was done by The Institute of Evironmental and Human Health at Tech and the Department of Chemistry and Biochemistry.

Graduate student Andrea Kirk found and analyzed the substance in seven bottles of milk and one can of evaporated milk while working on her dissertation. The milk was bottled in at least three different plant locations, and two of them were outside the state. We don't know why the contaminant is showing up in milk, but it clearly is something that needs to be studied further. Ernest Smith, associate professor at TIEHH, noted that the small number of samples is too small to determine a potential health hazard at this point. The Texas Department of Health's Division of Milk and Dairy will determine what is done next.

VI. Pathogens

Animal Manures:

Pathogens (microorganisms which cause disease) can be transferred from animal manures to humans. The pathogens salmonella, listeria and E.coli, as well as parasites such as roundworms and tapeworms, have been linked to applications of manure to agricultural land. Animal manure is a food safety concern because of the negative impact it can pose to the environment and public health. If not properly contained or treated, it can lead to waterborne and food borne illnesses.

Publicity about illnesses due to E.coli 0157:H7 has made people more aware of the potential risk of food borne illness from manure contamination. As a result, many are now asking whether it is safe to use manures. So, how risky is the use of manure in on farms and in compost piles? If you use fresh manure on your soils, there is a small risk that pathogens which cause disease may contaminate produce. The risk is greatest for root crops, like radishes and carrots, and leafy vegetables, such as lettuce, where the edible part touches the soil. Careful washing and/or peeling will remove most of the pathogens responsible for the disease. Thorough cooking is even more effective.

Effective management strategies must be developed and tested to limit and prevent microbial risk from animal manure.

To reduce the risk of disease:

1. Apply fresh manure at least 60 days before harvesting of any produce which will be eaten without cooking. If you apply manure within 60 days of harvest, use only aged or composted manure to minimize risk.
2. Never apply fresh manure after planting.
3. Thoroughly wash raw vegetables before eating.
4. Do not use cat, dog or pig manure fields or in compost piles, because some of the parasites which can be found in these manures may survive and remain infectious for people.

People who are especially susceptible to food borne illnesses should avoid eating uncooked vegetables from manured fields. Those who face special risks from food borne illness include pregnant women, very young children, and persons with chronic diseases, such as cancer, kidney failure, liver disease, diabetes or AIDS.

For more information on manure management see: http://www.nal.usda.gov/fsrio/research/fsheets/fsheet03.htm#manure

Compost:

Pathogenic organisms are sometimes present in the feedstocks (raw materials) used to make compost. As a result, the compost may also contain pathogens. The process choice reflects both the feedstock in addition to the composting method being used. To reduce any potential health concerns, treatment processes as well as biological specifications should not exceed the following limits: (note: these standards vary by state, region and intended use.)

- The quantity of fecal coliforms must be < 1,000 Most Probable Number (MPN)/g of total solids calculated on a dry weight basis; and
- There can be no salmonellae present (< 3 MPN/4g total solids), and
- There can be no E. coli present (< 3 MPN/g total solids).

Additional process guidelines can followed to meet pathogen limits,(particularly *if the compost does not originate from feedstock known to be high in human pathogens),* by testing to meet the limits identified above or the following process should be done:

- Using the **in-vessel composting method**, the solid waste shall be maintained at operating conditions of 131° F (55°C) or greater for three days.
- Using the **windrow composting method**, the solid waste shall attain a temperature of 131° F (55°C) or greater for at least 15 days during the composting period. Also, during the high temperature period, the windrow shall be turned at least five times.
- Using the **aerated static pile composting method**, the solid waste will be maintained at operating conditions of 131° F (55°C) or greater for three days. The preferable practice is to cover the pile with an insulating layer of material, such as cured compost or wood chips, to ensure that all areas of the feed material are exposed to the required temperature.

For more information on compost quality:

- **California Integrated Waste Management Board:** www.ciwmb.ca.gov/Organics/, (916) 341-6620.
- **California Compost Quality Council:** www.ccqc.org, (530) 265-4560.
- **U.S. Composting Council:** www.compostingcouncil.org, (440) 989-2748.
- **Compost Council Research and Education Foundation:** http://tmecc.org
- **Wood's End Laboratories:*** www.woodsend.org/, (800) 451-0337.
- **BBC Laboratories, Inc.:*** www.bbc-labs.com, (602) 967-5931.

A word on Sewage sludge.

Sewage sludge is a by-product of the municipal wastewater treatment process. Federal regulations have been developed to ensure that the public health and the environment are protected when sewage sludge is (1) applied to the land as soil conditioner or fertilizer, (2) disposed on land by placing it in a surface disposal site, (3) placed in a municipal solid waste landfill unit, or (4) incinerated.

Contaminated sludge or poor disposal practices can pose a threat to public health and the environment and are subject to enforcement actions. However, properly managed sludge can have beneficial uses.

Sludge is heavily regulated at the federal, state and local levels and is politically sensitive. Guidelines for it use should be determined by applicable laws and regulations for your area. For more information on its use see:

- EPA Use and Disposal Guidelines for BioSolids can be found at http://www.epa.gov/owm/mtb/biosolids/index.htm

- **Guide to Field Storage of Biosolids and Other Organic By-Products Used in Agriculture and for Soil Resource Management** http://www.epa.gov/owm/mtb/biosolids/fsguide/fsguide.pdf

- Sewage Sludge is Being Dumped on (Non-Organic) Farms All over the US http://www.duluthsuperior.com/mld/duluthtribune/6992757.htm

- Sludge Spread on Fields Is Fodder for Lawsuits : By JENNIFER LEE The New York Times http://www.nytimes.com/2003/06/26/national/26SLUD.html

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Organic Matter:

Matching Performance Needs to Product Characteristics

Introduction:

Most suppliers are required to meet specific regulatory requirements for fertilizers, pesticides and soil amendments to protect health and safety. However, because no state or national standards exist for rating the quality of Organic Matter products, you must perform your own quality assessment. In addition to a visual inspection, you may want to assess other

characteristics to ensure that you're getting a product that meets your specific needs within the price range that you're willing to pay.

Before shopping for organic matter, determine your reasons for using it. Once you've determined the performance requirements (e.g., improved productivity, fertilizer, microbial inoculation, water holding capacity, improved land value), look for a source with appropriate characteristics. The following information is designed to help you assess organic matter products.

Matching Performance Needs to Product Characteristics

Source of available nutrients

Origin **- Type** **- Ingredients**	Is the product plant or animal derived? If composted the nutrients in the feedstock will determine the available nutrients in the final product. Compost made from manures and biosolids is frequently higher in nitrogen (N) than that made primarily from yard trimmings or wood (green wastes).
Salinity	More of an issue for animal manures. Not generally a significant factor for compost and green manures depending on rates.
Effect of handling, storage and composting	Anaerobic storage conditions and the composting processes generates significant amounts of ammonia (NH_3) that are released into the atmosphere, leaving less nitrogen in the product. Compost that is produced through an aerobic process (exposed to adequate amounts of oxygen) generates less volatile ammonia.
Stability/Maturity	Stable and mature compost contains a variety of available macronutrients and micronutrients. Unstable and un-decomposed Organic Matter can immobilize nitrogen (N) and make it unavailable for plant use.
Nutrients	Most suppliers will give an analysis of major nutrient content in their product. However, not all of the nutrients are available for plant use. Typical mineralization (plant availability) rates are 10 percent to 15 percent for N and 30 percent for P for the first year. Approximately 85 percent of K is available during the first year. To calculate available nutrients, multiply the mineralization rate by the total amount of nutrient in the compost. Although significant N may not be readily available for fast-growing crops, its slow release contributes to soil nutrient levels over time. For more information on breakdown rates see the Western Fertilizer Handbook, Chapter 8.
pH	The pH of the soil plays a large role in the availability of plant nutrients.

Source of beneficial microorganisms

Origin	Some research suggests that carbon-rich organic matter produce a soils with a higher fungal content and that nitrogen-rich organic

	materials produce a soil with a higher bacterial content. More diverse Organic Matter sources may result in a more diverse population of microorganisms. Carbon-rich Organic Matter include Crop residues and green wastes. Nitrogen-rich organic matter include manures.
Species Richness and Diversity	A useful, healthy soil ecology is the most conducive to plant health and productivity. Selection of products that contain the most number and types of beneficial organisms give the best value and performance over a broader range of environmental factors. For further information see: www.bbs-labs.com
Augmentation	Some suppliers augment, inoculate or process their product to create beneficial microbial species richness and diversity. This can be particularly valuable if a particular additional benefit is desired. (e.g. nematode suppression, nitrogen uptake, water holding capacity, etc.)
Effect of handling and treatment Method	Aerobic material is more likely to contain beneficial microorganisms than anaerobically digested or processed materials. Large compost piles may be more difficult to keep aerobic. However, large piles may be kept aerobic through frequent turning.
Stability	In general, beneficial microorganisms are living or viable dormant organisms. As such there viability should be ensured and handling should be in a way that ensures they remain alive.
pH	Alkaline (pH greater than 7) soils tend to be dominated by bacteria. Acidic (pH less than 7) soils tend to be dominated by fungi.

Will not introduce viable weed seeds or pathogens

Origin of ingredients	The type of ingredients will determine the likelihood and the type of noxious weed seeds and pathogens that may be present. E. coli and salmonella are most prevalent in manure and biosolids. Seeds would be most likely in plant residues. Composting and some forms of processing (sterilaztion) may reduce prevalence.
Effect of Composting Method	Most weed seeds and pathogens are killed by high temperatures during the thermophilic stage of the composting process. However, some weed seeds are resistant to high temperature. Pursuant to State regulations (Title 14, California Code of Regulations, Section 17868.3), compost must be exposed to high temperatures for specified periods of time to kill weeds seeds and pathogens: • Windrow method (elongated piles of compostable material that is turned on a periodic basis): 131^{o}F (55^{o}C) for 15 days with a minimum of 5 turnings. • In-vessel method (compostable material that is enclosed in a container): 131^{o}F (55^{o}C) for 3 days Aerated static pile method (compostable material exposed to an air

distribution system that either blows or draws air through the material): 131°F (55°C) for 3 days.

Will not introduce contaminants

Origin of Ingredients

Contaminants in Organic Matter products are dependent upon the type and cleanliness of the ingredients used and the level of processing (purification, grinding, screening). Visual inspection may identify some contaminants while others may need to be tested for.

Trace Elements: Animal manures and Biosolids may be significantly higher in trace elements, including heavy metals, than green wastes. However, heavy metals in compost produced by a permitted facility cannot exceed U.S. EPA Part 503 maximum levels.

Glass, Plastic, and Metal Objects: Municipal green wastes vary in the degree of inert contamination. Plastic sheeting from trash bags and nails is common. However, most of these contaminants can be removed by the processor through adequate screening.

Enhances water holding capacity, soil structure, organic matter, drainage, and nutrient holding capacity of soil

Ingredient Type

Higher organic matter content in the product will increase water-holding capacity. For example those with a higher C:N ratio or larger particle size, will also improve soil structure in both clay and sandy soils. Because it can break up clay soils, organic matter can help improve drainage. Organic matter also increases cation exchange capacity (CEC). Soils with a high CEC hold onto nutrients and reduce leaching to groundwater.

Effect of Composting Method

Compost that is ground and/or screened to a smaller particle size (less than ½ inch) may improve cation exchange capacity (CEC).

pH

At high rates of application, the CEC from Organic Matter may be a significant proportion of the total CEC in the soil, especially on sandy substrates.

Does not significantly increase soil salinity

Ingredient Type

The composition of the ingredients will determine the salinity of the final product. The composting process actually concentrates salts so the finished product is higher in salinity than that the starting material.

Compost made from animal manure may not be appropriate in specific situations since it is frequently higher in salinity than compost made primarily from plant residues.

Salinity Certain crops may not tolerate high-salinity compost. For most established crops, electrical conductivity (used to measure salinity) of the growing medium (after compost has been applied and blended) should not exceed 5 dS/m.

Additional Resources

Internet Sites

- **Integrated Waste Management Board:** www.ciwmb.ca.gov/Organics (916) 341-6620.
- **California Compost Quality Council:** www.ccqc.org/ (530) 265-4560.
- **U.S. Composting Council:** www.compostingcouncil.org/ (440) 989-2748.
- *** Woods End Research Laboratory:** www.woodsend.org/ (800) 451-0337.
- *** BBC Laboratories, Inc.:** www.bbc-labs.com/ (602) 967-5931.
- *** Soil Foodweb, Inc.:** www.soilfoodweb.com/ (541) 752-5066.

** Reference does not imply endorsement by the Integrated Waste Management Board*

Publications

- ***How Do I Know That Compost Is Mature? An Introduction to the CCQC Maturity Index.*** California Compost Quality Council. Available at www.ccqc.org/.
- ***Compost Quality Standards & Guidelines.*** William F. Brinton, Woods End Research Laboratory, December 2000. Available at www.cfe.cornell.edu/wmi/Compost/.
- ***How Agricultural End Users Can Assess Compost Quality.*** Jean VanderGheynst, UC Davis. Available from the IWMB at (916) 341-6620.
- ***Field Guide to Compost Use.*** U.S. Composting Council, (440) 989-2748.
- ***Interpretation Guides to Compost Stability and Compost Maturity.*** BBC Laboratories, Inc., (602) 967-5931.
- ***Compost Quality Standards.*** Organic Ag Advisors and BBC Laboratories, Inc. Available from the IWMB at (916) 341-6620.
- ***Test Methods for the Examination of Compost and Composting.*** U.S. Composting Council, (440) 989-2748.
- ***Compost Production and Utilization: A Growers' Guide.*** Mark Van Horn, UC Division of Agriculture and Natural Resources, (510) 642-2431.
- ***Compost—A Guide for Evaluating and Using Compost Materials as Soil Amendments.*** William Darlington, Soil and Plant Laboratories, Inc. Available from the IWMB at (916) 341-6620.

How Growers lose money on the selection of Organic Matter:

Increased reclamation costs	Salts: If you apply excessive salts you will increase the need for soil amendments and yield may suffer. Weeds: If you apply additional, new species or noxious weed seeds herbicide and cultivation cost will increase. Compaction: Additional trips across the field increase compaction.
Increased fertilizer	Excessive rates of Organic Matter and High C:N will immobilize nutrients and require increased rates. This could be particularly detrimental at critical timings of increase plant demand.
Application Cost	Some Organic Matter seems inexpensive but requires specialty equipment or custom application. Some Organic Matter can be mixed with fertilizers or injected through an irrigation system to save application cost.
Marketability	Some processors, packers and shippers prohibit the use of certain Organic Matter (Manure) application for as much as 5 yrs proceeding a crop. This concern is based in fecal matter and disease contamination of the crop. This may severely limit the potential markets for your product.
Dumping	The municipal landfill and BioSolid handlers are compelled by state regulations to reduce the land fill and incineration contributions they make each year. They look to agriculture as a dumping ground for their problems. Some are even paying growers to apply free fertilizer. The problem lies in the fact that there may not be any assurances that you are not contaminating your land with foreign materials, diseases or heavy metals. This may severely limit the uses and value of your land in the future.
Placement and Cultural Timing	Many growers apply Organic Materials and leave them on the soil surface for some time. Ultra Violet light will irradiate any beneficial microbes that are present in the material. Indeed, these are a valuable component of your investment and paramount to making the Organic matter work for you. In minimum tillage Tree and Vine crops some growers do not till their Organic Materials at all. Most of this application usually dries-up and blows away. In minimum tillage, products that can be delivered in the irrigation water are tremendously effective as they get to the root-zone immediately.

What you should ask any supplier of Organic Matter:

A Checklist

What is in your product?	A guaranteed certificate of analysis or label should be supplied for every product. Do not rely on verbal claims. What are your assurances of quality and consistency? As an example: Municipal green waste compost is predominantly pruning in the early spring, grass clippings in the summer and construction residues in the fall.
Is your product safe?	Ask them to prove or show documentation that the product does not contain detrimental amounts of: Pathogens, weed seeds, foreign materials or salts. Are there any drawbacks to the use of your product? They also need to provide you with a MSDS.
Do you have product liability insurance or bonding?	You want to make sure they will stand behind their product or service.
How does your product compare to competitive alternatives?	Is this product the best value for your dollar, or is there a compelling reason to use the product that fits your specific needs.
Application Costs?	What are the application costs and do I need any specialty equipment or storage.
Placement and Cultural Timing?	Many growers apply Organic Materials and leave them on the soil surface for some time. Ultra Violet light will irradiate any beneficial microbes that are present in the material. Indeed, these are a valuable component of your investment and paramount to making the Organic matter work for you. In minimum tillage Tree and Vine crops some growers do not till their Organic Materials at all. Most of this application usually dries-up and blows away. In minimum tillage, products that can be delivered in the irrigation water are tremendously effective as they get to the root-zone immediately. Some products may be more effective at different timings and/or fit with previously scheduled cultural operations.
Efficacy data?	University level or credible third party data should be provided to substantiate and claim.
References?	Who do I know or trust that has used your product?
Where should I not use your product?	In what situations or on what crops should I not use your product? Are there any circumstances where I may not get the desired affect.

-BACK COVER-

BioScientific's *Soil Maximizer™* is a, fine filtered, liquid carbon containing fertilizer, soil amendment and microbial nutrient that significantly improves the effectiveness of conventional inorganic fertilizer programs. *Soil Maximizer™* is a "liquid compost," that contains a balanced content of organic materials that are used by chemical and microbial processes to enhance soil fertility and soil disease suppression. *Soil Maximizer™* is cleaner, safer, less expensive, easier to handle, more effective, and has greater versatility than the alternative of Compost, Manure, Sludge, Cover crops or organic fertilizers. Here's why:

- Cleaner

Soil Maximizer™ is fine filtered to 140 microns to ensure the most trouble free applications. There is no foreign materials and absolutely no weed seeds, and It will not plug micro-irrigation systems.

- Safer

Soil Maximizer™ is the only product that is certified through laboratory testing as being free of Plant and Human pathogens. This not only adds safety to your operation, but prepares you for Food Quality Protection Act and Fresh Market Processor residue standards. Because some animal and green manures have diseases in them, some Processors are prohibiting there use. *Soil Maximizer™* is a sustainable alternative.

- Less Expensive

20 gallons of *Soil Maximizer™* per acre has shown the same response as 2 tons of poultry manure, at a fraction of the cost. In addition to material cost savings, *Soil Maximizer™*, saves you the cost of spreading and incorporation. Also, without weed seeds, herbicide cost go down. Without salts soil reclamation costs go down.

- Easier to Handle

As a liquid, *Soil Maximizer™* is compatible with fertilizer applications and irrigation injections. A combination application will save you a trip across the field and gives more accurate results than spreading.

- More Effective

Through modern manufacturing techniques the benefits of manures are optimized while omitting the drawbacks of manures. These benefits go straight to the root zone.

- Greater Versatility

Allows *Soil Maximizer™* to provide benefits that are not available from animal and green manures. Such as, University and field testing proving *Soil Maximizer'™* ability to reduce nitrate leaching, which is good for you and the environment.

***SOIL MAXIMIZER™* has qualities that are not found in animal and green manures:**

SOIL MAXIMIZER™	**Manure/Compost**
Low salts	**Higher salt**
Easy to handle in liquid form	**Extra cost of application**
More accurate application	**Un-uniform applications**
No weed seeds	**Weed seeds**
Certified pathogen free	**Contains pathogens**
No trash	**Foreign materials**
Easy to incorporate (Water Run)	**Extra tillage**
Compatible with liquid fertilizers	**Not compatible**
Saves time and money	**Costly/time consuming**

This guide is made available with the complements of:

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