RUTGERS
New Jersey Agricultural Experiment Station

THE SOIL PROFILE

A newsletter providing information on issues relating to soils and plant nutrition in New Jersey

Volume 21 2013

Organic Lawn Care

Grass thrives on fertile soils around the world wherever tree cover is limited, herbivores roam, and climatic conditions are favorable. Grassland soils typically have naturally high levels of fertility and are among the most productive and agriculturally important land areas. Under the right conditions, growing grass naturally builds humus rich fertile soils.

Human management and input is not a requirement to make grass to grow. However, in the case of the land area surrounding our homes, a modest level of husbandry can transform our "personal grassland" into a beautiful verdant sod we enjoy as lawn.

Cool season grasses, especially the improved cultivars of Kentucky bluegrass, perennial ryegrass, and tall fescue, are capable of producing a dark green dense sod on most soils of New Jersey. A key factor is creating the right soil conditions before seeding or establishment to allow these grasses to grow and express their natural genetic potential.

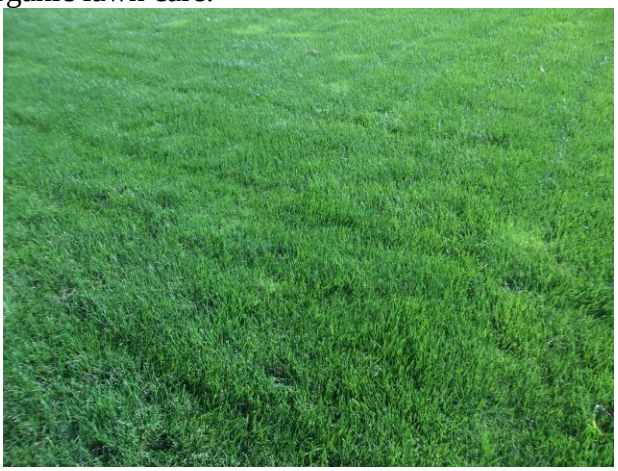
Organic methods of farming are in many ways rooted in ecology, especially with respect to soil fertility. One of the fundamental principles of organic farming is to create soil fertility conditions that optimize the biological and physical conditions along with nutrient supply such that crops (and animals, including people) thrive and resist challenges from pests and disease.

From the organic perspective, soil fertility is a much broader term than its use in conventional agriculture where it tends to be defined primarily in terms of chemistry. Soil fertility in organic farming is a more inclusive and has historically considered factors that are now being called soil health or soil quality. Soil fertility is a function of the whole farming ecosystem where biology fully employs synergisms among diverse organisms in the cycling of nutrients and organic matter while producing plant and animal benefits.

In the case of organic lawn care, what needs to be accomplished is translation of organic farming principles into a uniquely managed ecosystem. Cultural practices must be adapted to a grass growing area while achieving acceptable quality for human utility and viewing pleasure.

In organic farming the main function of growing grass is the feeding of livestock such as cattle. But in the case of an organic lawn, the mechanical lawn mower displaces the living grazing cow. On pasture grazed by herbivores, roughly 80% of the plant nutrients derived from the soil are returned to the soil as manure. This local nutrient cycling goes a long ways towards sustaining soil fertility. In the case of organic lawn care, the practice of mowing and leaving clippings, wherever possible, serves essentially the same function.

The above is a preamble for an article describing how to implement the general principles of organic culture as they apply to organic lawn care.



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The highlights of organic culture include 1) practicing the law of return, 2) composting, 3) amending soils with naturally occurring materials as may be needed to supply essential nutrients, 4) break up soil compaction, 5) seeding lawns with the best adapted cultivars from conventional plant breeding, 6) encouraging biodiversity, 7) landscape as a whole living system, 8) avoiding the use of prohibited materials, 9) husbandry has priority over commercial inputs, and 10) honesty and integrity about organic lawn care.

1) The Law of Return

Simply put, the law of return is emulating the waste recycling processes that naturally occur in a forest or on grassland. In a forest, a leaf or a tree falls to the ground and it decomposes while feeding the soil food web. This enriches to soil with organic matter. On grassland the same ecological processes occur but perhaps some of the biomass may pass through herbivores and be partly digested by the above ground food web.

Organic farmers, by taking great pains in practicing the law of return principle, effectively sustain the fertility of soil with minimal need for external inputs. Of course crops are harvested and taken away from the land, but on an organic farm all types of nature's waste products are valued as assets and every effort is made to find a way to return them back to the land.

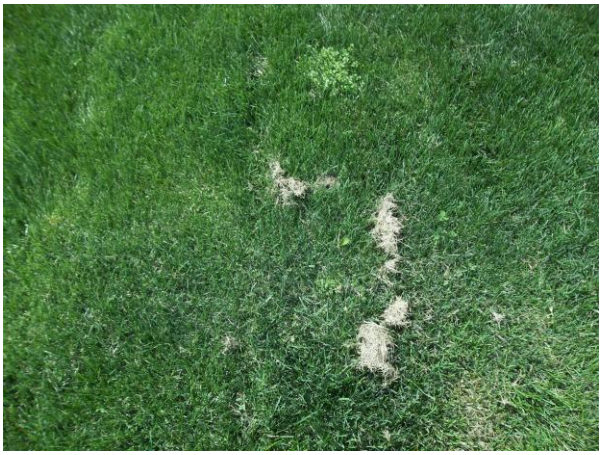
The law of return principle, while it is not specifically stated as a rule in the USDA-NOP standards, it has long been part of the creed of organic farming and gardening. The pioneers of the organic farming movement placed great emphasis on the law of return.

Historically it was practiced with due diligence in Asia as described in *Farmers of Forty Centuries or Permanent Agriculture in China, Korea, and Japan*. The author of the book, F.H. King was a soil scientist from Wisconsin. In the book (published 1911), King chronicles his observations on how the farmers in Asia where he traveled utilized every type of natural waste material – including livestock and human manures, crop residues, and wood ash. By doing so they very effectively maintained soil fertility for centuries while supporting large populations. This book was quite influential in the early organic farming movement and so the law of return became a vital ecological principle of the organic system.

In the case of organic lawn care, or organic land care in general, the law of return principle applies to grass clippings, shade tree leaves, and other yard waste. These materials can be collected for composting on site or delivered to a commercial composting facility. The finished compost can be applied to lawns as a soil fertility supplement as needed.

An even better alternative is to leave the grass clippings when mowing the lawn. Field research conducted by Rutgers NJAES on conventional lawn turf has shown that the need for N fertilizer application is reduced by more than half. Similar turf research conducted at the University of Connecticut has confirmed this finding.

To use this cultural practice effectively and to homeowners satisfaction there are several guidelines that must be followed. 1) Mow as frequently as practical so that the amount of clipping residue is minimized, 2) Use a mower specially designed for leaving the clippings, 3) Avoid heavy applications of N fertilizer. Excessive N fertility encourages a surge of growth and greatly contributes to clipping residue and system failure,



4) When N fertilizers are needed, early fall applications are preferred because they are less likely to cause a growth surge, 5) Slow release N fertilizers cause less surge growth than use of soluble N sources. Chilean nitrate is the only completely soluble N source permitted in organic systems (While permitted with restitution by the

USDA National Organic Program, it is not permitted under Northeast Organic Farming Association Organic Land Care guidelines). Most organic N sources are slow release materials that feed the soil food web that feeds the grass, 6) Frequent spring rains can sometimes interrupt the normal mowing schedule. In this event, accept the fact that occasionally clipping removal is necessary to display an attractive lawn surface. These clippings can be used to make compost or serve as mulch in an organic vegetable garden.

Besides grass clippings, shade tree leaves can also be shredded in place by running a good mulching mower over a lawn. Shredded leaf residues in moderation are not harmful to lawns and quickly decompose over the winter months with the help of earthworm activity.

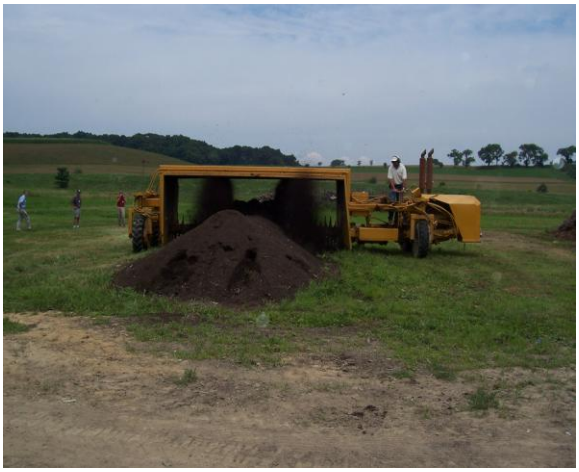
When shredded grass clippings and shade tree leaves remain on a lawn nearly all of the nutrients are recycled in place. On lawns that already have optimum levels of phosphorus (P), potassium (K), and micronutients, the soil fertility levels can be easily sustained for many years with little or no fertilizer input. Nitrogen, which cycles through the atmosphere and is susceptible to leaching from soil, is less long lasting and may require occasional replenishment.

Implementing the law of return principle in organic lawn care can sustain soil fertility and greatly reduce the need for fertilizer application for long periods.

2) Compost

Compost is a very beneficial soil amendment for organic lawns, especially when mixed into the soil at the time of establishment. On poor quality soils (with less than 2% organic matter content), a two inch application of compost, when tilled into the surface 6 to 8 inches, can greatly improve soil conditions as necessary for lawn establishment. On better soils with about 3% organic matter content, one inch layer application of compost is very helpful.

The compost should be obtained from a properly prepared source. The temporary high temperatures of the composting process should kill most pathogens and weed seeds. Stable finished compost should have carbon to nitrogen ratios that are range from 20:1 to 10:1.



Kentucky bluegrass, more so than other cool season grasses, has especially high requirement for phosphorus (P) at time of new lawn establishment. Composts are a rich source of plant available P, a nutrient that is critical for rapid establishment of lawns from seed or sod. Unless the initial soil test level for P is very low,

an application of a one inch layer of compost should supply ample P as necessary for lawn establishment. Compost will also supply useful to adequate amounts of N, K, and mironutrients for lawn establishment. If additional soil fertility is needed based on a soil test, supplemental fertilizer from an organic approved source may be warranted.

For surface application to established lawns, compost should be screened to remove larger particles.

While compost is a great resource for building soil fertility, repeated applications tend to cause soil tests P levels to rise to levels of environmental concern. Compost should not be relied upon as the single source of N fertility on established lawns. When the mowing practice is such that clippings are being removed, more frequent applications of compost may be acceptable. Regular soil testing for P and K, can be used to monitor soil fertility levels to see if further application of compost is acceptable.

3) Amending Soils with Essential Nutrients

In an organic system most nutrients can be supplied by compost but sometimes specific minerals are deficient from the local soil and must be imported as mineral supplements. On the other hand, some soils have excessively high soil test P or K levels and this may be a reason to avoid further applications of compost. But on soils that are deficient in P, it provides a great opportunity to apply extra compost that will satisfy the need for most other nutrients.

In general, in organic farming, when plant nutrients are needed and compost is not a viable option, the fertilizers are derived from naturally occurring mined mineral sources, or plant or animal resides.

Nitrogen is typically the nutrient that is most often applied to lawns to stimulate growth, green up, and sod density. A good supply of N to grass also makes the sod more competitive against weeds. Organic farming, and by translation to organic lawn care, artificially manufactured N fertilizers sources are prohibited materials.

The main challenge in finding N sources for use on organic lawns is that most organic fertilizers contain more P or K than may be required based on soil test requirements. When both P and K nutrients are needed, there are many good organic approved NPK type fertilizer choices. But the choices of organic approved N fertilizers that contain little or no P or K are very limited. Dried blood typically has an analysis of 12-0-0. It is one example of an organic approved N source that is practically free of P or K. While dried blood is a fast acting N source that quickly stimulates plant growth, it is a very expensive N fertilizer.

Chilean nitrate (16-0-0) is obtained from a natural mineral deposit in Chile where it is mined. Currently it is an organically approved N fertilizer that can be used in the USA with certain restrictions. In Europe, Chilean nitrate fertilizer is not approved for certified organic production of foods. In the USA, Chilean nitrate is allowed for use as fertilizer N so long as its use is restricted to just 20% of a given crop's N requirement. In addition to N, Chilean nitrate also contains about 26% sodium (Na). Although small amounts of Na may be beneficial to some plant species, there are concerns about adding too much since Na tends to disperse clay particles and harm soil structure. The compatibility of sodium nitrate with organic practices is controversial and its use is up for re-consideration by the National Organic Standards Board. And Chilean nitrate is not permitted by NOFA Organic Land Care.

The practice of leaving clippings on an organic lawn and the inclusion of clover in the sod can minimize the need to ever apply N fertilizer. While clover is an ecologically sound way to use biology to provide N, the presence of clover in a lawn does not appeal to everyone's concept of a beautiful lawn.

In the rare cases of severely P deficient soil, where more P fertilizer is needed beyond what can be supplied by a compost application, the soil can be amended using bone meal or rock phosphate. Because of the limited supply, bone meal tends to be rather expensive. Phosphate rock contains about 12 to 16% P, but is only very slowly available to plants as it is transformed by weathering. The presence of clover in a lawn and its associated biological N fixation process helps to convert the phosphate rock into plant available P.

When K is deficient it may be sourced from one of several naturally occurring mineral sources such as rock powders, langbeinite (potassium magnesium sulfate, 18% K, 22% S, and 11%Mg), wood ash, greensand, or potassium sulfate.

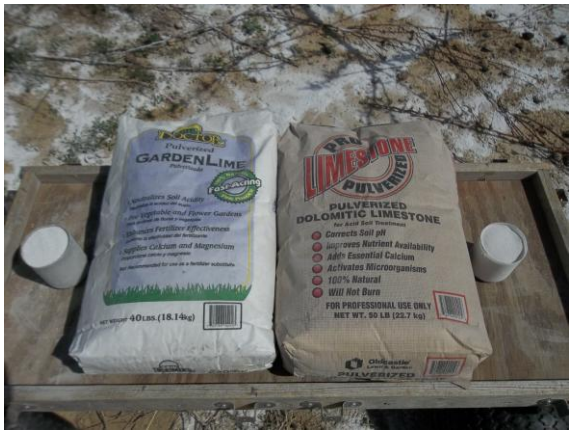
Potassium from rock powders and greensand is not so readily available for plant uptake. Although the K in wood ash (about 5% K, 1% P, 23% Ca) is readily available to plants, this material should only be applied to acid soils or where an increase in soil pH is acceptable.

Langbeinite is also a good source of plant available nutrients but it is not recommended for soils that are already well supplied with magnesium (Mg).

The Great Salt Lake in Utah is a major source of organically approve potassium sulfate which contains 40% K and 17% S. This source provides an excellent source of plant available K and S.

Sulfur (S) is generally not a limiting nutrient for lawns in New Jersey except perhaps on very sandy low organic matter content soils. A valuable amount of S becomes available to plants from atmospheric deposition. Also, compost is an excellent source of S.

The practice of liming soils for organic lawn care is much the same as with conventional lawns. The main exceptions are that, as in organic farming, burned lime (calcium oxide) and slaked lime (calcium hydroxide) are prohibited soil amendments. Limestone is the main source for the nutrients calcium (Ca) and magnesium (Mg). Calcite limestone is recommended for liming soils that need Ca but already have adequate levels of Mg. Dolomite limestone is recommended for liming soils that need both Ca and Mg.



On some soils with drainage problems due to poor soil structure it may be useful to apply gypsum (calcium sulfate dehydrate). Calcium from this soil amendment can help to improve soil structure and drainage. Gypsum is most beneficial to soil structure when applied along with organic matter such as compost. To be compliant with organic standards, the gypsum must come from an approved source rather than some common industrial by-product.

Micronutrients (boron, chlorine, cobalt, copper, iron, manganese, molybdenum, nickel, and zinc) play essential roles in plant metabolism and health. Deficiencies of these trace elements on lawns are not common. In general, proper soil pH management is a big factor in availability of micronutrients. Manganese deficiency occurs on some sandy coastal plain soils when the soil pH levels are raised too high by excessive application of limestone. When a micronutrient deficiency occurs it can be corrected by application of many of the same fertilizer materials as used in conventional farming. However, in organic lawn care (as in organic farming) micronutrient fertilizer products cannot be routinely applied without prior soil or plant diagnostics to confirm the specific micronutrient deficiency.

Silicon recently gained recognition as a beneficial substance for plants. Research in New Jersey has shown that supplemental may be beneficial to Kentucky bluegrass. See the previous issue of The Soil Profile newsletter for further information on silicon:

http://njaes.rutgers.edu/pubs/soilprofile/

4) Tillage to Break Up Soil Compaction

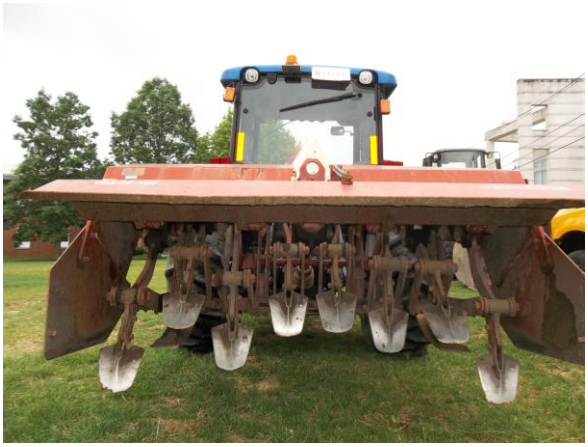
Natural soil profiles often become severely damaged as a result of home construction. Sometimes the fertile organic matter rich surface soil has been stripped away and at other times it is buried under subsoil material. At construction sites traffic from heavy machinery is often operated at times when the soil is much too wet for normal farming activity. This crushes soil pore space and tightens the soil into such a massive structure that it becomes difficult to impossible for plant roots to grow.

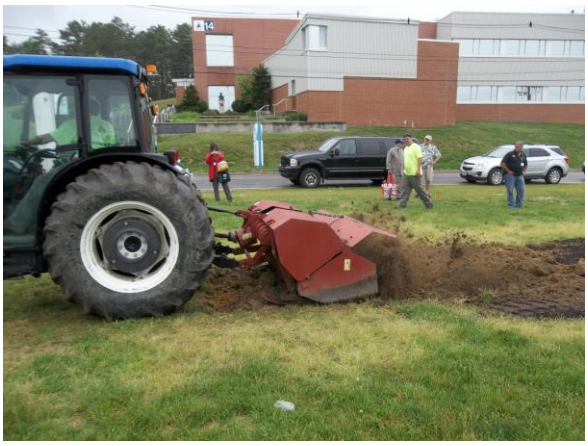
The destruction of soil quality from construction activities is the number one problem confronting landscapers. Often times a lawn is seeded or started from sod after using some surface tillage to loosen the upper soil profile. However, this is not enough tillage to open the deeper soil profile and break up the compaction that prevents good soil drainage, water and air infiltration, and root penetration. Water storage in the soil profile and the ability of grass roots to access that moisture is what is needed to sustain a lawn during droughts.

Any lawn where it is not possible to push a rod or a soil probe into the soil beyond the six inch depth at a time when the soil is moist has a soil compaction problem. The only practical way to really correct compaction is with deep tillage. Ideally some type of deep mechanical tillage should go as far down into the soil profile as necessary or practical to break up the compacted soil layers. New machines are being designed for this purpose.

Application of gypsum and incorporation with tillage may be helpful to improve the structure and open pore space of soils that have high clay content. The gypsum may be applied at rates ranging from 50 to 100 lbs. per 1000 sq. ft. The application of good compost in a one inch layer, and incorporation of this organic material into the surface 8 inches, is also highly beneficial for creating the environment that will support a healthy lawn.

Once the soil compaction problems have been corrected, one should never drive heavy equipment (especially when the soil is wet) over site again. This would only cause the soil to become compacted again.





5) Seeding Lawns with the Best Cultivars

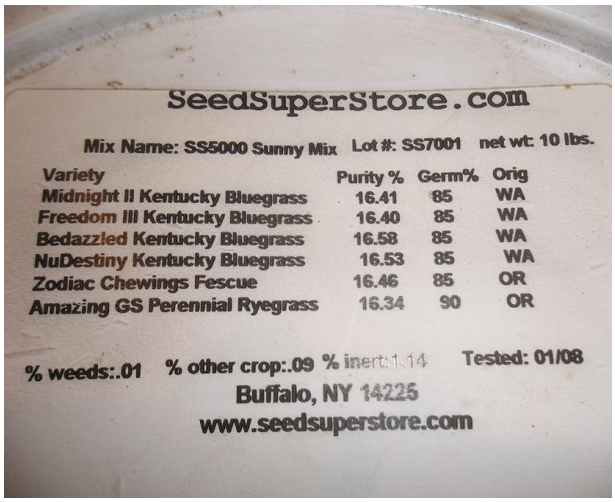
Starting over is not only an opportunity to correct compaction problems and build soil quality, it is also a chance to reseed with new and improved cultivars of grass. Rutgers NJAES has a world renowned breeding program for the development of better lawn grass cultivars. Many of the newly released grass varieties have been selected to resist disease, tolerate environmental stress, and have better color.

Some of the new Kentucky bluegrass cultivars provide excellent leaf color that makes very attractive dark green lawns. The new turf type tall fescues have a finer leaf blade and create an attractive stress tolerant lawn with less maintenance.

In organic crop production, organic growers are required to seek out certified organic seed. Although certified organic seeds are becoming

more widely available, it can still be difficult or impossible to purchase such seed. Organic growers are permitted to plant seeds from conventional sources but they must document that efforts were made in attempting to find certified organic seed.

In purchasing seed or plant material, one thing organic growers must avoid is genetically modified organisms (GMO). The USDA organic program standards prohibit the planting of GMO crops on certified organic cropland.



Traditional plant breeding has long been associated with the organic farming movement. Organic farming pioneer Sir Albert Howard worked in India where he developed new varieties of wheat. While breeding for disease resistance is very helpful for organic growing, Howard emphasized that beyond selecting for disease resistance traits farmers must also build soil fertility using organic methods for best plant performance.

New plant breeding programs are now underway that focus on selecting for crops that will perform well in organically managed systems. I am not aware of any turfgrass breeding programs currently designed for organic lawns.

6) Biodiversity

Monocultures are not normal features of natural ecosystems. Crop rotations and fostering biodiversity on the farm is an important principle of organic farming. Except for where perennials are being grown, crop rotation is the expected norm for organic systems. But even in the case of perennial crops, mixed stands of species and varieties within a species are preferred over monoculture.

Before the introduction of herbicides white clover was a welcome component of a home lawn. Herbicides used to take out certain weeds may also remove clover. The traditional image of a lawn that included clover was replaced by a pure grass lawn. The same commercial interests that promoted chemical herbicides also found a new market for manufactured N fertilizer that was needed to replace the biologically fixed N that was no longer freely provided by the clover.

A strong argument can be made that a real organic lawn must include clover. Organic growing is more than a set of ecological practices that function in concert to produce a viable healthy living environment. Organic is also about a new mindset where functional thinking – about how nature actually functions – replaces dysfunctional thinking. Life is not a machine; neither are lawns, or farms. Biodiversity is normal. Pure monocultures are abnormal, not found in nature, and they are impractical maintain.

If people can relearn the concept of a lawn, one that welcomes clover as a vital part of the turf, the ability to have and maintain an organic lawn becomes normal and almost effortless. Acceptance of the traditional lawn concept that nature grows grass and clover with ease on any fertile soil is the future of organic lawn care.

White clover is an aggressive low growing spreading plant that thrives along with most cool season grasses. Even where it is not seeded, white clover tends to naturally appear in lawns where no herbicides are used. It quickly grows into and covers bare spots. It fixes N biologically and offsets the need to apply N fertilizer. On soils that are rich in organic matter content and where clippings are recycled in place, there is little if any need for supplemental N fertilizer application. On biologically active soils organic N is metabolized to feed the grass and clover provides supplemental N biologically.

When lawns are well fertilized with N, the easily available N tends to encourage the growth of grass which then may displace some of the clover. Kentucky bluegrass is also a very

aggressive low growing spreading plant. It thrives when well supplied with readily available N and displaces clover.

The same principle applies with most weeds. Cool season grasses growing on truly fertile soil tend to crowd out weeds. A few weeds like dandelion and plantain are normal to grasslands but can be removed by weeding if their population exceeds the lawn owner's tolerance.

Crabgrass is a weed that appears on lawns that are poorly managed, mowed too short, or where the soil is degraded or compacted. On healthy well managed organic lawns, crabgrass is not able to effectively compete with cool season grasses except perhaps in during a summer drought.

Organic plant breeding programs are needed to develop better varieties of lawn clover and grasses that are more competitive against weeds. Unfortunately conventional turf breeding programs generally use herbicides on the land where they do their breeding work.

Consequently, conventional turf grass varieties are not yet being selected for ability to compete against the weed pressure that may be found in organic lawns.

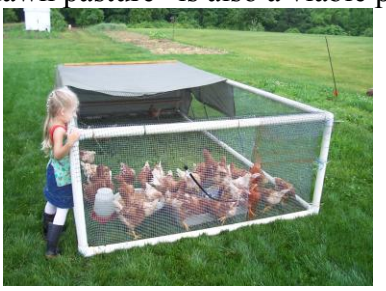
7) Landscape as Whole Living System

When transitioning to organic, farmers are asked to develop an Organic System Plan. This may be thought of as a kind of rood map about how to begin farming organically. Increasing biodiversity, cover cropping, crop rotations, making compost, integration of livestock into the system may be parts of a plan.

The transition to organic can be challenging because there may be much to relearn about how to farm. A farmer must begin to think of the farm as an integrated system. It is about using a holistic approach to work with sunlight, soil, crops, animals, and weather. And at the same time manage weeds, insects, and disease. There are few quick fix commercial chemical answers to deal with pest problems under the organic system. Building soil fertility using organic methods and an integrated system of check and balances to prevent pest problems are therefore essential to an effective organic farm plan.

In the case of organic lawn care, the caretaker will need to consider how this concept translates to their lawn. It may be helpful to think of how the organic lawn fits into the larger landscape and into the system of organic land care. Although crop rotation is not something fitting to lawns one can certainly apply the law of return principle and composting as ways to manage the flow and cycling of soil fertility nutrients.

How the lawn interfaces with the rest of the landscape that may include woody perennials, flowering annuals, and perhaps a vegetable garden or orchard are places to look for integration into the whole system. Backyard poultry grazing on "lawn pasture" is also a viable possibility.



As an historical note, Walter Northbourne was apparently the first person to use the term 'organic' in application to farming. In his 1940 book Look to the Land, he elaborated on the idea of the farm as an 'organic whole'. So in the philosophical sense organic refers to ''wholeness". According to Northbourne, an organic farm "must have a biological completeness: it must have be a living entity" where every "branch of the work is interlocked with all others."

8) Avoidance of Prohibited Materials

Organic lawn care should operate within the list of Allowed and Prohibited Substances as applies to USDA Certified Organic Farming. http://www.ams.usda.gov/AMSv1.0/NOPPetitionedSubstancesDatabase

Substances and inputs of allowed or prohibited substances is a common source of questions about the organic system. In general materials derived from nature are permitted and synthetic inputs are prohibited but there are exceptions. Black plastic mulch is an example synthetic material that is allowed. Synthetically manufacture N fertilizer is a prohibited material. Manures from conventional livestock farms are allowed as fertilizers so long as they are free of prohibited synthetic materials. Fertilizers mined and changed by physical processing are usually allow so long as no synthetic chemicals have been added. Fertilizers derived from sewage sludge are prohibited. Besides sewage sludge, other notable prohibited inputs or processes are genetic engineering and food irradiation.

http://www.omri.org/

The Organic Materials Review Institute (OMRI) is an organization dedicated to reviewing band name and generic products for allowance in organic farming. The OMRI label on products provides a useful guide at this link: https://www.omri.org/

9) Husbandry Takes Priority over Commercial Inputs

The most important input in organic farming is the talents of the farmer. Good farming is as much art as science. An organic farmer is a kind of "conductor of an orchestra" directing soils, crops, and animals to work in "concert".

An organic farm ideally minimizes use of commercial inputs to grow quality crops with maximum use of on-farm resources. Careful husbandry of the living resources takes priority over commercial inputs.

The same principles may be applied to organic lawn care and organic land care. An excellent article written by Wendell Berry on the value of husbandry in farming is available at this link: http://www.orionmagazine.org/index.php/articles/article/160/

10) Organic with Honesty and Integrity

Organic food and farming is a multibillion dollar market that has continued to grow even during the current economic recession. Consumers may choose to pay a premium for organic food for a variety of reasons. Organic produce has lower levels of pesticide residues compared to conventional. And organic foods are grown without the use of genetic engineering. The unique economics of organic market contributed to the need for verification that organic practices were in fact used to produce the food.

Before the Organic Foods Production act of 1990, conventional foods could be fraudulently labeled as organic with little means of verification or enforcement. The National Organic Program offered a means of regulating certification and labeling of products. Federal oversight has not completely eliminated fraud but now the criminals sometimes get caught and convicted. For example, a California man was caught defrauding

organic farmers with a synthetic fertilizer that he represented as organic. In 2012 a federal judge sentenced the man to 6.5 years in prison and ordered him to pay a $9 million fine.

Certification is essentially about communicating trust with verification. Patrons of organic products and services are often passionate about their choice to buy organic. To the extent that the USDA National Organic Program fails to ensure organic integrity, there are watchdog organizations such as the Cornucopia Institute that provide a valuable service.

The National Organic Program is designed primarily for certification of organic food and fiber products. At the present time organic lawn care is not regulated by any federal or state program. The organic cultural practices and materials associated with the USDA National Organic Standards could be adapted to and extended to organic lawn care by public demand. The National Organic Standards serve as a benchmark for guidelines and language for communicating about what customers have in mind and what landscape professional have to offer in terms of organic lawn care.

Organic lawn care at present lacks a government run certification program to verify that a lawn is being managed in accordance with the officially recognized organic growing practices. It is therefore incumbent upon landscape professional offering organic lawn care services to communicate with honesty and integrity so that people will be served genuine organics.

The Soil Profile
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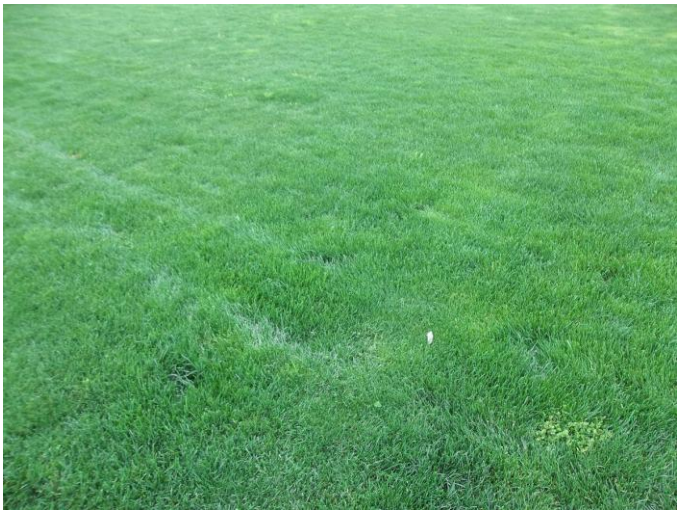
"To simplify information in this newsletter, trade names of some products are used. No endorsement is intended, nor is criticism implied of similar products not named."
Desktop Publishing by Stephanie Romelczyk



The above organic lawn was established in 2008. This lawn illustrates what is possible using organic cultural practices as described in this newsletter. A one inch layer of compost was tilled into the soil prior to seeding. The clippings are never removed during mowing. A dark green dense turf has been maintained now for over four years without application of any fertilizer or pesticides. This organic lawn is almost free of weeds even though no special effort was ever taken to control weeds. It also includes some clover. However, the Kentucky bluegrass tends to out compete and limit the growth of both weeds and clover. This is because the turf is growing on a healthy soil with excellent soil fertility that favors the growth of Kentucky bluegrass.

Organic Resources for Further Information

Northeast Organic Farming Association of New Jersey
334 River Road, Hillsborough, NJ 08844
P: 908-371-1111
http://www.nofanj.org/home

National Sustainable Agriculture Information Service
Organic Farming Resources
https://attra.ncat.org/organic.html

Organic Materials Review Institute
www.omri.org/omri-lists

Organic Trade Assocation
www.howtogoorganic.com

USDA National Organic Program
www.ams.usda.gov/nop

Rodale Institute On-line Course
http://www.tritrainingcenter.org/course/

A History of Organic Farming
http://www.westonaprice.org/farm-a-ranch/468-history-of-organic-farming.html