Organic Land Care Best Management Practices Manual

RUTGERS
New Jersey Agricultural Experiment Station

ORGANIC LAND CARE BEST MANAGEMENT PRACTICES MANUAL

A guide to recommended practices and practices to avoid when conducting effective organic land care

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Rutgers Organic Land Care Program Best Management Practices Manual

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INTRODUCTION

The purpose of this manual is to provide recommendations to land managers and landscape contractors on best management practices for effectively conducting organic land care. Organic land care is a holistic approach to land management that integrates cultural, biological, and mechanical practices by fostering cycling of resources, promoting ecological balance, and conserving biodiversity. Organic land care is not simply about substituting organic-approved products for synthetic materials. Rather, it is a series of practices that together create a holistic approach to land management where the soil, plants, and animals within the system are interdependent and should sustain each other. In an organic land care program, an integrated system of pest and disease management is utilized with products approved by the Organic Materials Review Institute (OMRI). The goal is to decrease or eliminate the use of synthetic pesticides, synthetic fertilizers, and synthetic soil amendments. This document is meant to be a field guide with basic information about background theory for many of the recommendations.

These recommendations for organic land care are philosophically and technically based on the United States Department of Agriculture's National Organic Program (NOP) for food and other agricultural products that are produced through approved methods (USDA, 1990). The federal government, through the NOP, developed regulatory, national organic standards for *agriculture* and a certification program identified by the "USDA Organic" symbol, which certifies that agricultural products meet federal organic standards. Currently, there are ***no*** federal standards for organic land care. Practitioners that choose to adhere to the guidelines outlined in this manual do so voluntarily. Currently, there are no universally accepted standards or regulatory requirements for organic land care outside of agriculture production.

The Rutgers Cooperative Extension Organic Land Care working group developed this manual in order to educate and assist practitioners in determining what is acceptable under an organic land care program. Much of the recommendations come directly from the NOP, but with additional consideration for addressing issues such as tree and shrub care, lawn management, native and invasive plants, water management and incorporation of federal, state, and local regulations.

Federal, state, and local laws and mandated emergency protocols (i.e. USDA protocols for the eradication of specific invasive species) need to be followed regardless of the organic status of the property.

Several organic principles form the basis of any organic land care program and are repeated throughout the manual (Heckman, 2013). They include:

- "Do no harm" by protecting the natural elements of a site
- Treating the landscape as an integrated system
- Reducing energy, water, and material inputs
- Practicing the "law of return", such as returning grass clippings back to the landscape
- Promoting soil health which translates to healthy plants
- Fertilizing with naturally-occurring materials to supply essential nutrients based on a soil test
- Favoring cultural practices over chemical applications for managing pests and diseases
- Avoiding the use of prohibited materials
- Encouraging biodiversity and avoiding monocultures
- Running an organic business with honesty and integrity

A practitioner that is new to organic management might consider implementing recommended practices a little at a time and monitoring for changes in order to get used to how a landscape responds. Sites with

high quality soils where proper cultural practices have already been implemented will most likely respond quickly and positively to organic management. Severely degraded sites may take years to transition to a condition that is acceptable to clientele under an organic management plan. Open communication with clientele is paramount in order to have realistic expectations for organic management on a site by site basis.

SITE ASSESSMENT

Site assessment is the most important first step in determining if organic land care is a viable option for the landowner and landscape manager. An initial site assessment of a property should involve gathering information about soil and light conditions, the current drainage of the property, the development of a plant species list, and determining how the property is used by the owner or resident (Mazza, 2013). Energy consumption can also be addressed by examining the presence of wind breaks, tree placement, and the exposure of the site's buildings. The primary goals are to evaluate data collected from the site inventory and to try to resolve any existing problems while identifying new design features or identifying plants that are better suited for the site. These initial meetings with the client should also involve an explanation of organic land care management, how it is conducted, as well as what practices are encouraged and not recommended.

Recommended – Site Analysis First Steps

- **Review your business services and costs briefly with customers.**
- **Determine the level of interest of the customer before proceeding further with regard to organic land care, as well as if the customer will be involved in gardening on the site.**
- **Develop a list of client needs and desires.**
- **Site Inventory - Initial visit and walk of property**
  - ✓ **List all existing conditions such as: underground utilities, slope, grade, drainage, compaction, sunlight, shade, surface roots, impermeable areas, runoff from surrounding properties or roads, reflective mulches (white stone), current plants on the property, water bodies, soil conditions, etc.**
  - ✓ **List problem plants or issues that need immediate attention – hazard trees, plants that historically attract pests and/or are prone to disease problems.**
- **Create a rough sketch of the property.**
- **Discuss an agreement/contract based on the site inventory and preliminary analysis based on needs and desires of the client.**

When documenting site conditions on a property it is helpful to first acquire a copy of an existing map or plan of the site or to sketch out the general layout and dimensions of the property. Walk the property and note the positive and negative features and what should be saved, modified or removed (Hansen de Chapman, 2008).

Recommended – Site Analysis/ Site Inventory

- **Soil**
  - ✓ **Determine soil type, pH, nutrient levels and organic matter content from a soil test.**
  - ✓ **Assess whether the soil is compacted, shallow, gravelly, or limiting in another manner.**
  - ✓ **Look for and note on a map any inconsistencies of soil conditions across the landscape.**
- **Water and drainage**

- ✓ **Determine the water drainage from a property by assessing the slope from buildings or structures, hardscaped areas, and gutter and foundation drains.**
- ✓ **Note standing water or obvious problems with grade.**
- ✓ **Determine the location and type of irrigation systems.**

- **Mulches**
  - ✓ **Assess the types of mulch used, including wood chips or white reflective stone, and thickness of mulch around plants**
- **Plants**
  - ✓ **Determine whether existing plants are native or non-native (cultivars or varieties if known), the aesthetic value, location – distance from buildings and structures, sizes, and age.**
- **Waterbodies**
  - ✓ **Identify water bodies on site (if relevant for site); their flow patterns, water quality, and if there is erosion along bank.**
- **Light**
  - ✓ **Assess sunlight patterns or limitations on the property to assist in appropriate planting locations. Determine sun/shade patterns by determining the property orientation – identify North, South, East, and West.**
  - ✓ **Identify sunny locations – greater than 6 hours of sunlight. Identify shady location- greater than 6 hours of full shade**
- **Climate/Microclimate**
  - ✓ **Determine the direction of prevailing winds on the property. In general they will be from the northwest**
  - ✓ **Use data from local weather stations to determine average temperatures for each season and annual precipitation**
  - ✓ **Utilize USDA plant hardiness zone maps to determine climatic zones which will help in choosing appropriate plant types. New Jersey falls within zones 6a, 6b, 7a, and 7b. http://planthardiness.ars.usda.gov/**
  - ✓ **Microclimates consist of small scale temperature and exposure differences on the property. Document any enclosed areas, windbreaks, influence from buildings (wind blocks, color), and bodies of water that may influence microclimates.**
- **Wildlife/Ecology**
  - ✓ **Document the existence of deer, small animals, birds, and existing insects (both beneficial and problematic) as well as diseases, or weed problems on property or nearby.**
- **CALL BEFORE YOU DIG- 811 (http://www.call811.com/) In New Jersey, New Jersey One Call 811 or 1-800-272-1000 or www.nj1-call.org. It is the law and the contractor will be held liable for any damages to person or property if the markout has not been done.**
  - ✓ **If any digging will occur on the property call 811 before you dig to document existing utilities and power lines. Note locations of septic systems or underground tanks.**
  - ✓ **Maintain compliance with municipal and neighborhood development codes including ordinances for fencing, structures, and plant material.**
- **Current Use of Yard or Property**
  - ✓ **Determine family entertaining areas, recreational areas for children and pets, and personal preferences with regards to the landscape space.**

SOILS AND SOIL HEALTH

A healthy soil is the foundation for sound organic land care management. Creating optimum soil conditions will make all aspects of organic land care easier. The objectives of promoting healthy soil include:

- Increasing soil organic matter through the application of compost and other organic materials
- Correcting soil pH to maximize soil biological activity and nutrient uptake by plants
- Promoting beneficial soil organisms which help make nutrients available to plants
- Reducing unnecessary applications of fungicides and acidic fertilizers that may impact existing beneficial soil microorganisms.

The "Soil Food Web" is the term used to describe the complex interaction of life in the soil. A spoonful of soil contains millions of beneficial microorganisms including bacteria, fungi, actinomycetes, protozoa, micro-arthropods, and nematodes (Ingham, 2009). These beneficial organisms help plants obtain nutrients and water from the soil, protect plants from pathogens, and degrade compounds that could inhibit plant growth. In addition, a healthy soil food web can, over time, improve soil structure, and benefit overall plant health. Soil organisms create a living, dynamic system that can do all these things, but must be managed properly for optimal plant growth.

Recommended - Soil Testing

- **Soil should be tested for fertility, pH, and organic matter content. Organic fertilizers and amendments should be applied based on test results.**
- **Soil samples should be collected as per the procedure outlined by Heckman, et al., 2003, here.**
- **Tools and containers used for soil testing must be clean.**
- **Soil testing on a property should be performed every 3 years or less.**
- **In cases where the soil lab provides non-organic recommendations, adjust amendments to meet organic recommendations outlined in this manual.**
- **Maintain complete, up-to-date records for each site. Include all plant health care applications such as compost, compost tea, biological inoculants, organic fertilizers and other approved soil amendments. Document any changes.**

Not Recommended

- **The use of home field soil test kits or equipment to determine application of soil amendments is not recommended.**

Recommended - Soil Cultural Practices

- **If the soil is heavily compacted, consider some type of tillage to loosen the soil profile as deep as is practical. Mechanical aeration of compacted lawn areas should be done in the fall.**
- **For new lawn areas, apply approximately 1/2 inch of good quality compost and till into the soil to a depth of 2-4 inches (Landschoot, et al., 2013). Mix in any other soil fertility amendments as recommended by soil test prior to seeding.**
- **For established lawn areas, top dress with compost based on the following guidelines;**
  - ✓ **Turf: 1/4 inch 1-2 times a year followed by aeration (Landschoot, 2017)**
  - ✓ **Perennials: 2 inches or less at the beginning of the season (Finneran, 2012)**
  - ✓ **Woody ornamentals and shade trees: 3 inches or less (NOFA, 2011)**

- **Avoid the use of manure-based composts on soils that test optimum or high for available phosphate to reduce the risk of phosphate runoff.**
- **Leave grass clippings on the lawn after each mowing event and mulch mown leaves back into the turf. If not practical, then compost clippings and leaves onsite and utilize later as topdressing.**
- **Use an air excavation tool to reduce compaction in beds and in the root zone of shade trees.**
- **Maintain records for each site, including application and summary of any changes.**

Recommended - Soil Amendments

The following materials are acceptable as soil amendments in an organic land care program:

- ✓ **Any material that is acceptable under Section 205.203 of the NOP**
- ✓ **Organic Materials Review Institute-approved products**
- ✓ **Composted yard waste that was made on site**
- ✓ **Pesticide-free compost from local sources**
- ✓ **Aerobic compost tea and/or extracted compost tea made from local sources**
- ✓ **Fish hydrolysate, emulsion or meal**
- ✓ **Humic and fulvic acids**
- ✓ **Alfalfa meal, feather meal and other low phosphate organic materials**
- ✓ **Non-GMO microbial inoculants**

Not Recommended

The following materials are not acceptable as soil amendments in an organic land care program:

- ✓ **Any material prohibited under Section 205.203 of the NOP**
- ✓ **Synthetically-derived products**
- ✓ **GMO microbial inoculants**
- ✓ **Sewage sludge (sometimes referred to as biosolids)**
- ✓ **Compost that has gone anaerobic (It will often have a rotting, sulfur, or ammonia smell.)**

ORGANIC TURF MANAGEMENT

Turfgrass Selection

Whether seeding for the first time or overseeding an established turf, selecting a properly adapted turfgrass seed blend or mixture is important. Selection of turfgrass species and varieties that are well adapted to the landscape soil and climatic conditions is critical for a successful organic turf management program.

A thorough site assessment and understanding of the function of turf areas in a landscape provides information useful in the proper selection of turfgrasses. A land manager should match the strengths of various turfgrasses to the site conditions, maintenance plan and use.

Recommended – Turfgrass Selection

- **Full sun – Use blends or mixtures containing improved varieties of tall fescue, Kentucky bluegrass and/or perennial ryegrass. Select low maintenance fine fescues and tall fescues to reduce inputs of fertilizers and irrigation water (Murphy, 1996, and Park and Murphy, 2012, respectively).**
- **Shaded sites – Use blends or mixtures containing improved varieties of tall fescue or fine-leaf fescues (strong creeping red fescue, Chewings fescue, hard fescue). For dense shade, avoid turfgrasses and use appropriate groundcovers or mulch around trees and shrubs.**

- **Rapid establishment or repair – Use turfgrass blends or mixtures containing perennial ryegrass. Replace perennial ryegrass with lower maintenance blends of fescues for long term management (Murphy and Park, 2004).**
- **High traffic areas – Establish with blends or mixtures of improved turf-type tall fescue and Kentucky bluegrass; overseed for recovery with perennial ryegrass where appropriate.**

Mowing

Mowing is a fundamental practice of turf systems; key principles for mowing should not be overlooked.

Recommended – Mowing Practices

- **Mow as high as feasible based on the use/function of the turf. Taller-growing grass shades the soil, which suppresses weed germination and cools the soil. Organically managed turfs have been more successful at mowing heights of 3- to 4-inches (NOFA, 2011).**
- **Mowing height can be safely reduced to 2½- to 3-inches during autumn to:**
  - ✓ **Increase shoot density (thicken the turf).**
  - ✓ **Promote root growth.**
  - ✓ **Reduce lodging of leaves to inhibit snow mold diseases.**
  - ✓ **Enhance the removal of fallen tree leaves and other debris.**
- **Mow as often as needed to return clippings into the turf without clumping and smothering the grass.**
- **Mow with sharp blades as it causes less stress and damage to the turfgrass plant. Sharply cut grass blades will heal faster and reduce the potential for invasion of disease organisms.**
- **Alter mowing pattern to reduce wear damage/ruts that can occur from repeat mowing.**

Maintain or Improve Soil Health

Turf health and persistence is greatly affected by soil health. Soil tests help to guide practices needed to optimize soil health. See Soil and Soil Health section for more information.

Fertilization

Nitrogen is an essential plant nutrient that has the greatest impact on turf vigor and growth. Standard soil testing does not measure N levels. Rather, research has determined optimum fertilizer applications for each turf species and use situation. Other important factors that need to be considered when designing a fertility program include the age and vigor (health) of the turf, soil organic matter content, mowing (clipping removal), and availability of irrigation. For example, older turfgrass growing on high-quality soil will not require as much N fertilization as a new turfgrasses growing on poor soil. **Nutrient content of compost should be considered as part of the fertility equation. Compost needs to be tested to understand nutrient load in topdressing applications.**

Recommended – Fertilization Practices

- **Nitrogen inputs for turf areas can come from natural organic fertilizers and composts. Biological fixation from organisms such as clover and soil cyanobacteria is another possible source of nitrogen.**
- **Returned mower clippings will re-cycle nitrogen back to the turf/soil. Clippings can return up to 50% of the nitrogen needs for low maintenance turfgrass lawns (Qian, et al., 2003).**

- **Where appropriate, select turfgrass species that thrive under lower nitrogen levels. Turf-type tall fescues and fine fescues are the preferred species. Tall fescues have deeper and more extensive root systems to retrieve available soil nitrogen.**
- **If desired, dwarf white clover can be seeded at 2 to 4 ounces per 1,000 square feet in low maintenance turf areas to provide nitrogen for turfgrass (Murphy, 1995).**

Irrigation

Turfgrass grown in healthy soil will have a dramatically lower need for supplemental irrigation. Healthy, non-compacted soil will allow water to better infiltrate the soil and provide turfgrass plants the opportunity to establish deep, healthy roots. Keep in mind that irrigation is of little or no value if liming, fertilizing, and mowing and other practices are neglected or done improperly.

Recommended – Irrigation Practices

- **For established lawns, apply water as infrequently as necessary to maintain proper growth and avoid drought-stress of the turf.**
  - ✓ **Consider areas of turf in the landscape where irrigation can be reduced to encourage dormancy during drought and withhold irrigation.**
  - ✓ **Use irrigation systems with weather sensors to aid in determining irrigation frequency and volume.**
  - ✓ **Consider an irrigation audit to ensure that best practices are being followed.**
- **Allow the soil to become partially dry between irrigation events. Most grasses are adapted to occasionally dry conditions and will develop better root systems under this type of management.**
- **If watering is required, thoroughly water once or twice a week during periods of drought (no rain) as opposed to light daily sprinkling.**
  - ✓**Turf grown on very sandy soil may need more frequent irrigation during hot, dry conditions.**
  - ✓**Apply sufficient water in a single irrigation event to wet the entire root zone.**

Not Recommended

- **Excessive irrigation that produces runoff and leaching is not recommended. Excess irrigation can also increase the amount of weeds that may invade a turf.**

Overseeding

It is essential to overseed areas of turf that thin out from stress (use/play, pests, or climate).

Recommended – Overseeding Practices

- **Overseeding helps to maintain turf density, so seed/soil contact is critical. Overseed whenever thinning turf is observed. Disturbance of the soil surface should be minimized when overseeding during the spring and early summer to avoid increasing the risk of invasion by summer emerging weeds such crabgrass and goosegrass.**
- **During late summer and autumn, aerating, verti-cutting, dragging, and topdressing after overseeding will help work-in the seed. Repeated scattering of seed may be necessary if seed-to-soil contact is poor.**
- **Use a slit-seeder with vertical blades to slice open the soil surface and improve seed-to-soil contact, which will enhance the survival and establishment of new seedlings. Caution: disturbance of the soil surface during spring and early summer may encourage invasion of summer-emergent weeds.**

- **Use turfgrass seed that contains endophytes to produce turf with better tolerance to leaf- and crown-feeding insects. The seed of many new varieties of perennial ryegrass, tall fescue, and fine fescues contain endophytes. Seed containing endophytes should be stored under cool dry conditions because the endophytes in seed are lost (killed) when stored under hot, humid conditions for an extended period of time (several months).**
- **Frequent overseeding can be an effective tactic to reduce weed encroachment.**
- **Where possible, cover seed with a thin layer of compost and irrigate the area as soon as possible. Compost can help retain soil moisture needed for seed germination.**

Pest Management

Healthy turf is one of the best methods for reducing potential pest problems. Implementing the management practices discussed above will help maintain healthy turf and reduce pest activity. Unfortunately, even the best implementation of management practices can sometimes fail to suppress pest activity below levels (thresholds) that negatively affect the function of a turf. It is important to prevent large scale failure of turf. Loss of turf covers exposes soil to water (and wind) erosion, which will negatively impact water quality. Loss of turf cover will also encourage invasion of weeds.

Weed Management

Recommended –Weed Management Practices

- **Weeds can quickly invade thin turf, so effective weed management begins with maintaining a vigorous, dense turf. Cultural management practices (mowing, irrigation, soil fertilization and aeration) that enhance or maintain turfgrass density generally reduce weed competition and encroachment.**
- **Use an Integrated Pest Management (IPM) approach and scout for weeds based on the primary periods for germination and emergence. Be aware of the major weeds species and be familiar with weed life cycles.**
- **Strive to remove weeds at first appearance. Small immature weeds are easiest to remove. Hand-pulling of weeds is preferred.**
- **Organic herbicides should be used sparingly and applied typically as a spot treatment. Consider that organic pesticides can be toxic and pose a hazard to the applicator and the environment.**
- **Apply organic herbicides to immature weed plants for best efficacy, as mature perennial weeds can grow back from established taproots or rhizomes. Applications of organic herbicides may need to be repeated.**
- **Bare ground and areas of sparse turf should be consistently overseeded with a rapidly germinating seed blend to discourage weed establishment. Perennial ryegrass has the greatest potential for rapid re-establishment.**
- **Examine the ability to alter traffic patterns in turf areas to prevent loss and encourage recovery on high traffic turf. High traffic areas may require conversion to another groundcover such as mulch or hardscape.**

Recommended – Insect and Disease Control Practices

- **White grubs are the insect pest of greatest concern for turf in New Jersey. White grubs are soil inhabiting pests that feed on plant roots during summer, fall, and spring. Products containing insect parasitic nematode species or milky disease-causing bacteria provide biological control options for white grubs, but these products have limitations.**

- **Use turfgrass seed that contains endophytes to produce turf with better tolerance to leaf- and crown-feeding insects. The seed of many new varieties of perennial ryegrass, tall fescue, and fine fescues contain endophytes. Seed containing endophytes should be stored under cool dry conditions because the endophytes in seed are lost (killed) when stored under hot, humid conditions for an extended period of time (several months).**
- **Turf diseases are often present in landscape turf, but the damage to the turf frequently do not warrant treatment, especially when a sound management plan is practiced.**
- **Select turfgrass species and varieties with improved tolerance to important and most damaging diseases. Examples of this approach include the use of seed blends (two or more varieties) of perennial ryegrass that have good tolerance to gray leaf spot or Kentucky bluegrass and fine fescues with enhanced resistance to summer patch (Murphy and Park, 2004; Bonos, et al., 2004; Murphy, 1996). Tall fescue should have good tolerance to brown patch disease (Park and Murphy, 2012).**
- **Several biological disease control products are registered for use in turf. These biocontrol products contain microorganisms (typically beneficial bacterial or fungi) that suppress the populations of disease-causing microorganisms. These products are most effective when used on a preventive basis in areas with a history of disease and when disease activity is low to moderate. Efficacy of these products is usually poor when used on a curative basis or where disease pressure is high. To be effective over long periods, biocontrol products usually need to be reapplied periodically to maintain populations of the beneficial microbes at disease suppressive levels.**
- **Compost teas should not be viewed as fungicides, but are more accurately described as soil or foliar inoculants intended to promote soil and plant health.**

NATIVE, EXOTIC, AND INVASIVE PLANTS

Promoting biodiversity and habitat for beneficial insects and wildlife is an important goal of organic land care practitioners. Incorporating native plants (plants indigenous to our region) and eliminating invasive, exotic plants can help achieve this important goal. The use of native plants helps reduce the need for irrigation, fertilizer, and pesticides as the plants are adapted to local environmental conditions. Invasive plants invade natural areas outcompeting native plants and reduce overall biodiversity. Control of invasive plants include physical, chemical, and biological controls and it will be necessary to research the specific plant to determine the most effective eradication method.

Recommended – Native, Exotic, and Invasive Plant Practices

- **Preserve and restore native plant species.**
- **Increase biodiversity by attracting beneficial insects such as pollinators and predators of pest species.**
- **Plants should be multi-functional such as providing food for wildlife and/or humans and habitat for native wildlife species.**
- **Deciduous trees and large evergreens should be placed for maximum energy efficiency. Shade trees should be planted where the sun will shade the structure in the summer months and will allow sunlight to heat it in the winter. Evergreens should be placed to provide a wind break from winter winds.**

Not Recommended

- **The planting of monocultures (plant communities made up of one type of species)**
- **The use of plants that are vulnerable to pests and diseases.**

- **The use of plants known to be invasive to natural areas (See below for list).**

Recommended – Invasive Plant Controls – Adapted from US Fish and Wildlife (2009)

- **Physical controls**
  - ✓ **Handpulling**
  - ✓ **Digging out the entire root**
  - ✓ **Mulching or smothering using an impenetrable barrier. It is helpful to first cut the plants down.**
  - ✓ **Pouring boiled water on plant roots.**
  - ✓ **Soil solarization by covering wet soil with plastic to trap heat and kill plants and seeds. Be aware that this will also kill beneficial microbes in the soil.**
  - ✓ **Weed burners or flame guns. Note that private property owners who would like to conduct prescribed burns on their properties must apply for a permit through the New Jersey State Forestry Services for the winter/spring prescribed burn season- http://www.state.nj.us/dep/parksandforests/fire/permits.html .**
  - ✓ **Cutting or mowing done several times throughout the growing season. This is most effective before plants go to seed.**
  - ✓ **Girdling a tree by cutting into the bark and cambium in a complete ring.**
- **Chemical controls**
  - ✓ **Use of EPA Minimum Risk (25b) products or Organic Materials Review Institute (OMRI)-approved herbicides by basal bark, cut-stump, bundle and cut, or foliar spray technique. Chemical applications are often most effective in combination with physical controls.**
- **Biological controls**
  - ✓ **Use of beneficial insects such as predators, parasitoids, or pathogens (fungi and viruses) that have been proven to be effective for control. Some insects are available for purchase but a USDA permit may be needed for interstate shipments.**
  - ✓ **Use of grazing animals such as sheep, goats, or cattle.**
- **Disposal**
  - ✓ **Proper disposal of invasive plants once removed is essential to prevent re-sprouting or seed germination. Plants should be bagged up and can be left to cook in the sun for at least a week. Then they can be disposed as trash.**
  - ✓ **Some plants can re-sprout easily from plant fragments including: Oriental Bittersweet, Japanese Knotweed, Phragmites, and Japanese honeysuckle. Every effort should be made to completely eliminate plant fragments from these species from the site.**

The following is a partial list of plants that are considered invasive, should not be utilized in the landscape and once identified, should be eradicated.

Not Recommended – Invasive Plants – From New Jersey Invasive Species Strike Team (2015)	
Trees	**Herbaceous Plants (perennial, bulb, or grass)**
***Acer platanoides* - Norway maple**	***Alliaria petiolata* - Garlic mustard**
***Ailanthus altissima* - Tree of heaven**	***Allium vineale* - Wild garlic**
***Paulownia tomentosa* - Princess tree**	***Buddleia davidii* - Butterfly bush**
***Pyrus calleryana*- Callery pear**	***Centaurea biebersteinii* - Spotted knapweed**
Shrubs	***Chelidonium majus* - Celandine**
***Berberis thunbergii* - Japanese barberry**	***Cirsium arvense* - Canada thistle**

Berberis vulgaris **- Common barberry**
Elaeagnus angustifolia **- Russian olive**
Elaeagnus umbellata Thunb. **- Autumn olive**
Euonymus alata **- Winged euonymus**
Ligustrum obtusifolium **- Border privet**
Ligustrum ovalifolium **- California privet**
Ligustrum sinense **- Chinese privet**
Ligustrum vulgare **- European privet**
Lonicera x bella Zabel **- Bell's honeysuckle**

Ivy/Vine

Euonymus fortune **- Winter creeper**
Glechoma hederacea **- Ground ivy**
Lonicera japonica **- Japanese honeysuckle**
Rosa multiflora **- Multiflora rose**

Datura stramonium **- Jimsonweed**
Heracleum mantegazzianum **- Giant hogweed**
Iris pseudacorus **- Yellow iris**
Lysimachia vulgaris **- Garden loosestrife**
Lythrum salicaria **- Purple loosestrife**
Microstegium vimineum **- Japanese stilt grass**
Miscanthus sinensis **- Chinese silver grass**
Ornithogalum umbellatum **- Star-of-Bethlehem**
Phragmites australis **- Common reed**

PLANTING AND PLANT CARE

Proper Plant Selection

The first and most important step in designing and establishing landscape plantings that can be successful using organic practices is proper plant selection. An initial assessment of light conditions, soil conditions, and water availability will assist in selecting appropriate plants.

Recommended – Site Conditions Assessment

- **Obtain a soil test of landscape beds as part of overall site assessment and to determine input requirements.**
- **Use a compass and visual survey of the site to gain a strong understanding of sun movement throughout the day and year.**
- **Evaluate impact of existing tree canopy on landscape, soil health and water drainage patterns**
- **Look for site features, such as fences or large blank walls that might create stressful conditions for landscape plants.**

Not Recommended

- **Site assessment based on a single visit without taking daily sun movement, seasonal changes, and tree canopy changes into account.**

Recommended – Water Conditions Assessment

- **Look at overall plant health and examine plant for vegetative signs of excessive water availability such as limp wilted leaves, yellowing or browning leaves, or blisters on the undersides of leaves.**
- **Look for vegetative signs of limited water availability such as limp wilted leaves, crisp wilted leaves, dry soil, or slowed growth.**
- **Determine plant water needs based on soil test and/or percolation test.**

Not Recommended

- **Irrigation design for a site without adjusting for micro-climates.**
- **Irrigation design prior to plant selection.**

Recommended – Soil Conditions Assessment
• **Test the soil for both basic characteristics (pH, soil type, micronutrients, etc.) and soil food web recommendations and choose plants based on soil test results.**
• **Test compost for nutrient composition and to evaluate plant fertility needs.**
Not Recommended
• **The assumption of soil conditions based on those of a neighboring property.**

Sourcing Plant Materials

Build a relationship with nurseries that carry a broad selection of native and site-adaptive plants. Use the staff knowledge to your advantage. Contact your local County Extension office for additional guidance.

Recommended – Sourcing Plant Material
• **Be specific with plant requests and use the scientific names of the plants.**
• **Pay attention to plant sizes and the requirements needed to help the plant thrive.**
• **Pay attention to water or fertility requirements in the landscape bed.**
Not Recommended
• **The use of plants with different water or fertilizer requirements in the same bed/area.**
• **The allowance of substitutions, unless the suggested plant meets the same site condition requirements as the initial plant selection.**
• **The use of common names or the omission of plant size when specifying plants for a project.**

Recommended – Use of Native and Site Adaptive Plants
• **Use plants that are native to the region or that are non-invasive and adapted to the site conditions present. A list of native plants sorted by county can be found here (Native Plant Society of New Jersey, 2013).**
• **Maintain a list of acceptable natives for reference when designing/selecting plants for a site.**
• **Use plants that will perform well over time to limit the need for excessive maintenance.**
Not Recommended
• **The use of non-native plants whose potential for developing invasive qualities is in question.**
• **The use of native or ornamental plants not adapted to the present site conditions.**
• **The installation of trees and shrubs that will become too large too quickly and will require regular replacement or excessive pruning.**

Planting Practices and Techniques for Plant Survival

Once the correct plant is selected, proper installation of the plant is essential to ensuring that the plant not only survives, but has the vigor to perform well over its life. Proper hole sizing, planting depth, and the physical connection between plant and soil is key to the plant's survival.

Recommended – Planting Practices – Adapted from Polanin, et al. (2003)
• **Dig a hole 2-3 times the size of the root ball/container of the plant.**
• **Scarify the sides of the hole to avoid "glazing" or hole walls that are hard for roots to penetrate.**
• **Use native soil from excavation to backfill holes.**
• **Ensure a proper connection between the plant and the soil with few or no large air pockets.**
• **Remove any synthetic material, including twine, metal, and plastic used in the growing or labeling of the plant material.**

Not Recommended

- **Forcing a plant into a hole that is too small.**
- **Installing a plant in a hole that is too deep, which can cause settling of the plant.**
- **Planting a specimen so that the top of the root zone or root flare is below existing grade.**
- **Compaction of the soil backfill surrounding the newly-installed plant via stomping or tamping.**

Watering Practices – Installation

Watering before, during, and after planting is essential for initial plant survival.

Recommended – Watering Practices

- **Water newly-installed plant material thoroughly to ensure good soil-to-root contact.**
- **Water frequently during the first two weeks after installation to ensure proper plant establishment.**
- **Once plant is established, monitor plant health and limit plant watering to times of significant need or drought stress.**

Not Recommended

- **Shallow, frequent watering that limits root depth and establishment.**
- **Irrigation only at the base of a plant, which might discourage lateral root development.**
- **Excessive watering of newly-installed plants.**
- **The use of the same watering schedule for both landscape plants and turf.**
- **The use of reflective white stone mulch around trees and shrubs, which could lead to heat stress of the plants.**

Mulching Practices

Recommended – Mulching Practices – Adapted from Smith-Fiola, 2000

- **Mulch new plantings with organic mulches that provide nutrients to the soil as they break down.**
- **Design planting beds so that mulch becomes less necessary as plant establishment occurs.**
- **Mulch should be no deeper than 3" in depth and kept away from root base.**
- **Replenish/refresh mulch only when needed for plant health and weed suppression.**

Not Recommended

- **The use of non-organic/non-synthetic (stone, rubber) mulches unless necessary to perform other site functions.**
- **Mulch in excess of 3 inches or piled against the root base of trees and shrubs.**
- **The use of dyed or synthetic mulch products, including synthetic weed mats.**
- **Mulching every season if it is not necessary for plant health or weed suppression.**

WATER

Water should be conserved in the landscape as much as possible and the infiltration of water into the soil should be promoted. Excessive irrigation can not only lead to unhealthy plants, but also to excess runoff that carries pollutants to local water bodies. Stormwater runoff from rain events should be reduced and infiltrated onsite. Green infrastructure is an approach to managing stormwater that mimics the natural hydrology of a site by infiltrating it into the ground using vegetation or porous surfaces, or by capturing it for later reuse. Rain gardens, bioswales, pervious pavements, and rainwater harvesting systems are all examples of green infrastructure. Green infrastructure techniques preserve the water

quality of nearby receiving waters, as well as conserve the local water supply, and should be utilized whenever possible in the landscape (Rowe and Bakacs, 2012).

Recommended – Watering Practices – General Conditions

- **Conserve water as much as possible.**
- **Irrigate early in the morning to prevent water loss due to evaporation and minimize leaf surface wetness that promotes disease.**
- **Use drip irrigation when possible in beds or mulched areas.**
- **Use plants that are already adapted to New Jersey's climate.**
- **Group plants according to their water needs and avoid exotic plants with increased water demands.**
- **Use rain barrels or cisterns to collect rainwater for irrigation purposes.**
- **Water only when necessary – during plant establishment or during times of drought.**
- **Set up irrigation systems properly. Encourage weather-sensing systems. Consider the use of timers and override systems that can detect precipitation.**
- **Be mindful of existing water bodies/wetlands, riparian buffers, wetland laws, buffer rules, stormwater rules, and local regulations and ordinances.**
- **Minimize runoff by disconnecting impervious surfaces including rooftops, driveways, and walkways. This can be achieved via:**
  - ✓ **Directing downspouts to lawn or garden areas.**
  - ✓ **Directing downspouts to a rain garden.**
  - ✓ **Directing downspouts to a collection vessel such as a rain barrel or cistern for rainwater harvesting.**
- **Once plants are established, water deeply and thoroughly less often.**
- **Mulch planting beds and around trees for retention of moisture.**
- **Check irrigation lines for leaks and breakages each season.**
- **Disconnect rainwater harvesting systems for the winter.**

Not Recommended

- **Wasteful watering of the sidewalk or driveway, or irrigation during precipitation events.**
- **Excessive watering to the point of runoff generation.**
- **The use of exotic plants with high water demands.**
- **Irrigation at night as this may promote fungal diseases.**

WEED MANAGEMENT

A weed is a plant growing where it is not wanted. Even turfgrass, when growing unintended in a mulched bed or patio area can be called a weed. Weeds compete with desired plants for space, water, nutrients and light and can disrupt the appearance and use of landscapes.

The acceptance levels for weeds among property owners can be as variable as their personalities, so it is important to establish a tolerance level (threshold) for weeds within a landscape. Keep in mind that thresholds may need to be specific to a particular weed. Dandelions, for example, are often an unacceptable component of lawns for some property owners; whereas they may have value as edible vegetation or herbal medicine to others. Similarly, some property owners find clover to be an attractive component of a lawn or planting bed while others do not. In a low-maintenance lawn, however, dwarf white clovers can play an important role in recycling nitrogen back into the system and encouraging

beneficial microbes in the soil. Clover can naturally break up compacted soils, encouraging improved conditions for turfgrass growth in the future (USDA-NRCS, 2003).

Recommended – General Weed Management Principles
• **Become familiar with weed characteristics, growth habits and life cycles. These factors play a major role in weed identification and control options.**
• **Prevent addition of weed seed or vegetative parts in composts, manures, topsoil, etc. Thoroughly read seed labels and purchase commercial turfgrass seed mixtures and blends with little or no weed seed.**
• **Prevent build-up of weed populations and do not allow weeds to produce seed or spread vegetatively. Reduce weed population through mechanical, biological, and only when necessary, chemical (organic) methods.**
• **Maintain a dense ground cover (turfgrass, landscape plants, or mulches) to reduce open areas and prevent germination and emergence of weeds. Where appropriate, an organic pre-emergent herbicide (corn gluten) can be used.**
• **Physically remove weeds via hand-pulling / hand tools. Periodic shallow cultivation of planting beds may be needed to control infestations when they occur.**
• **Improve site, soil health, and overall conditions through cultural management that improves health and vigor of desired landscape plants. Higher plant densities will help suppress weed encroachment.**

Weed Management in Planting Beds and other non-Turf Areas

Recommended – Weed Management in Planting Beds and other Non-Turf Areas
• **Increase plant density when feasible and maintain plant vigor to out-compete weeds.**
• **Use mulch to suppress weeds. Maintain mulched beds and cultivate to discourage weed establishment.**
• **Mechanical or hand-pulling of weeds is preferred. Burning and freezing tools are also available to kill weeds. Juvenile, tender seedlings are easiest to control.**
• **Please be aware that in New Jersey, a pesticide applicator license is needed even when applying organic herbicides. Be sure to follow the product label and wear protective gear. http://www.nj.gov/dep/enforcement/pcp/pcp-FAQs.htm#general4**
• **Organic herbicides are allowed but should be used sparingly in affected areas. Organic herbicides work best on small, juvenile weeds. Large, perennial weeds often require repeated applications. Weeds can grow back from taproots or rhizomes.**
• **Natural barriers and edges can be used to limit the spread of vegetation into unwanted areas.**
• **Target the problem plant (weed) and avoid negatively impacting nearby desirable plants.**
Not Recommended
• **Weed barrier fabrics or materials that inhibit or prevent the infiltration of water and soil gas exchange, for example those containing PVC.**
• **Overuse of salt and vinegar-based organic herbicides can yield a negative impact on soil chemistry.**
• **Runoff of organic herbicides from hardscapes into planted soil can reduce soil quality.**
• **Organic herbicide contact with non-target plants as most herbicides are non-selective and will damage plants in the area.**

- **No synthetic substances should be utilized for pest management except what is allowed under Section 205.601 of the USDA National Organic Program regulations.**
- **Non-synthetic substances that are not allowed in an organic land care program are listed in Section 205.602 of the USDA National Organic Program regulations and include ash from manure burning, arsenic, calcium chloride, and lead salts among others.**

PEST MANAGEMENT

Proper cultural practices should always be the first line of defense when combating pest and disease problems. Cultural practices such as fertilization, irrigation, sanitation, mulching, pruning, plant selection, planting site, pest resistant plants, and others will all help reduce the incidence of pest problems. In some cases, no action needs to be taken.

To help Organic Land Care managers determine if pest intervention is required, an approach called the Appropriate Response Process (ARP) is suggested. The chart listed below (Table 1), illustrates that the focus should be on the 5-10% damage threshold range. Research has concluded that a majority of people detect aesthetic injury at levels between 5-10%. Therefore, the general rule of thumb for decision-making guidelines in landscapes is that plants suffering from 5-10% damage warrant control measures. Note that the actual pest density is not determined, but the symptoms, responsible environmental factors, and future forecasts of the potential problems are specified.

Table 1: Plant Damage and Recommended Actions – Adapted from Ball, et al. (1999)

Plant Class Ranking	Recommended Action
1. Normal appearance. No injury symptoms.	**No action needed.**
2. Minimal (<5%) injury symptoms	**Determine if problem is a true health threat or merely aesthetic injury. Notify client of observation.**
3. 5% to 10% injury symptoms.	**Notify client of observation. Treatment may be warranted.**
4. Plant health is compromised by the pest.	**Intense multiple treatments are essential.**
5. Plant is in severe decline.	**Remove portion or whole plant.**

Table 2 below shows approximate insect and mite density thresholds for woody plants in the landscape for integrated pest management treatment. The pest if the type of pest causing damage. The damage is typical damage type seen from that type of pest. The sampling unit is the representative part of the plant that should be examined for infestation. The sampling time is the period of growth or part of the life cycle that sampling should be executed. Infested sampling units is the minimum number of sampling units that should be infested in order to consider treatment. The density per infested units gives the general number of pests per plant part that would need to be seen in order to treat. Let's look at aphids, for example. If there is leaf curl damage on 7 out of 10 growing shoots on the same plant at the beginning of flush growth and 5 wingless aphids can be seen on each of those 7 shoots, those aphids may need to be treated.

Table 2. Approximate insect and mite density thresholds for woody plants in the landscape. Adapted from Sadof and Moser (1997).

Pest	Damage	Sampling Unit	Sampling Time	Infested Sampling Units	Density per Infested Units
APHIDS	Leaf curl, shoot distortion, sooty mold	**10** growing shoots per plant	Beginning of flush growth	**7**	**5** wingless aphids
	Towards end of growth	Treatment not usually needed	Peak of flush growth		**50** wingless aphids
BAGWORMS	Defoliation	Each foot of tree height (inspect whole plant)	Before eggs hatch	**1**	**1** bag (hand remove) **10** bags (for sprays)
			After eggs hatch	**5**	**1** larva (hand remove) **10** larvae (for sprays)
BORERS					
on shrubs	Dieback	Base of shoots	All year	**1**	**2** active holes
young trees		Trunk			**2** active holes
mature trees		Trunk			**4** active holes
BARK BEETLES	Dieback	Square foot of trunk	All year	**1**	**5** active holes
ELM LEAF BEETLES	Skeletonization	4 branches	May	**2**	**2** egg masses
					20 young larvae
					15 older larvae
			July	**2**	**4** egg masses
					30 older larvae
LEAF NOTCHING WEEVILS	Leaf notching, girdling	**4** branches per linear foot	June/July	**4**	**10** new notches
PEAR SLUGS	Skeletonization	**4** branches	When larvae feed	**2**	**5 larvae**
PINE SAWFLIES	Defoliation	**10** branches	Straw stage	**4**	**1** larval cluster
HONEYLOCUST BUGS	Leaf distortion	**4** branch tips	After bud break	**2**	**5** nymphs
			Mid May	**2**	**10** bugs of any stage
JAPANESE BEETLES	Skeletonization	**4** branches	Middle of flight period	**2**	**4** beetles per leaf
LACE BUGS					
on shrubs	Leaf discoloration	**4** branches	When nymphs active	**2**	**5** leaves with nymphs
on trees				**4**	**10** leaves with nymphs
LEAF HOPPERS					
on red maples	Leaf distortion	**4**	June-July	**3**	**3** per shoot
SCALES	Shoot dieback & leaf discolor	**10** shoots	All year	**3**	**10** live scales per inch of shoot
SPIDER MITES	Leaf discoloration	Beat **4** branches	Mid active season		**24** mobile mites/beat over white paper

Recommended – Insect/Disease Pest Management Practices

- **Monitor the landscape and only apply control strategies when damage thresholds have been exceeded.**
- **Learn to recognize common beneficial insects typically found in the landscape. Conserve and encourage their numbers through landscape design.**
  - ✓ **Complex landscapes with high plant diversity are most attractive to beneficial insects as they provide food and pollen sources for all stages of the beneficial insect life cycles and encourage them to stay in the area.**
- **Approved organic pesticides should only be utilized as a last resort. Oils/soaps, pyrethrum, *Beauveria bassiana*, *Bacillus thuringiensis,* Spinosad, Neem oils, and entomopathogenic nematodes generally work best when pest densities are low and before significant symptoms occur.**
- **Use EPA-registered beneficial microbes that antagonize or are competitive with certain disease pathogens. To be effective, these materials will generally need to be applied preventatively in order to suppress the buildup of soil pathogens.**
- **Well timed, selective targeted applications of approved organic pesticides are preferred and are the most effective approach to reduce problem pests.**
  - ✓ **Learn the life cycles and behaviors of common pests in order to increase efficacy of treatments.**
  - ✓ **Be aware of which environmental conditions are favorable to disease pathogens of concern and use that information to determine when suppressive treatments should be applied.**
- **Develop a written recordkeeping system, use it during every monitoring visit over the entire growing season. Written records will improve monitoring efficiency, improve and direct decision-making.**
- **Enroll in Extension educational classes to remain current in preferred pest management practices.**

Not Recommended

- **Reliance on a single tactic pest management approach.**
- **Routinely applying pest management controls before monitoring of the landscape has been performed.**
- **The planting of monocultures due to the tendency to encourage pests and disease.**
- **The use of microbial organisms that have been genetically-engineered is not recommended.**
- **No synthetic substances should be utilized for pest management except what is allowed under Section 205.601 of the USDA National Organic Program regulations.**
- **Non-synthetic substances that are not allowed in an organic land care program are listed in Section 205.602 of the USDA National Organic Program regulations and include ash from manure burning, arsenic, calcium chloride, and lead salts among others.**

WILDLIFE CONTROL

One of the major keys to success in wildlife control is to identify the species causing the damage to the landscaping. Looking at scat, footprints, and the damage to plants can help identify the culprit. Table 3 shows typical urban wildlife and the types of damage they can cause. Once the species is identified, an appropriate control strategy must be chosen.

Table 3. Typical urban wildlife and the types of damage caused					
Plant Damage Type	Deer	Groundhog	Vole	Rabbit	Raccoon
Browse damage	X	X			
Trampled vegetation	X				
Girdling of woody plants			X	X	
Rolled up sod					X
Surface tunnels in turf or beds			X		

Recommended – Deer Control Practices

- **High-tensile fencing – Adapted from Grande and Katz (2010).**
  - ✓ **7 – 10 feet high**
  - ✓ **Fence posts should be 5-6 inches in diameter**
  - ✓ **Space posts 25-30 feet apart**
  - ✓ **Set posts 36-40 inches below grade**
- **Electric fencing – Adapted from Grande and Katz (1998).**
  - ✓ **42-inch electric net**
  - ✓ **9 live horizontal wires**
  - ✓ **Bait the hot lines with peanut butter – be sure to turn the fence off when applying bait!**
- **Repellents**
  - ✓ **Start using repellents before problems start.**
  - ✓ **Alternate the types of repellents used.**
  - ✓ **Use the correct formulation for the season/weather.**
- **Recommended repellents**
  - ✓ **Ammonium salts of fatty acids**
  - ✓ **Capsaicin-based animal repellents**
  - ✓ **Bars of heavy-smelling deodorant soap hung off trees and shrubs 30 inches above the ground can be used as an area repellent. One bar of soap covers a 1-yard radius.**
  - ✓ **Repellents made from plant materials.**
  - ✓ **Dried blood**

Not Recommended

The following materials are not recommended for use as a repellent:

- **Any product prohibited by state law**
- **Predator urine**
- **Diesel fuel and kerosene-based sprays**
- **Products containing sewage sludge (biosolids).**

Recommended – Small Animal Management Practices

- **New Jersey Trapping and Relocation regulations must be followed. Current regulations can be found on the NJ Division of Fish and Wildlife page.**
- **Only live traps are legal in New Jersey and the trap must be set in an appropriate location.**
- **The correct bait is the key to success. See recommendations below for each small animal. Control practices adapted from (Hygnstrom, et al., 1994).**
- **Vole Control Practices**

- ✓ **To exclude voles, use hardware cloth cylinders. Protect seedlings that are 0.25-inch mesh or smaller. Bury the bottom of the cylinder 6 inches deep.**
- ✓ **Habitat modification can include mowing or mulch removal.**
- ✓ **To trap voles, utilize snap-back traps set perpendicular to the tunnel and leave the traps unset for a few days so the voles get used to them being there.**
- ✓ **Bait traps with peanut butter, a mix of peanut butter and oatmeal, or small pieces of apples.**

- **Groundhog Control Practices**
  - ✓ **Woven-wire fencing can be installed at least 3-4 feet aboveground and excavated underground at least 1 foot down and outward.**
  - ✓ **Electric fencing can be used.**
  - ✓ **The following fumigants can be utilized: carbon dioxide or sulfur dioxide bombs**
  - ✓ **To trap groundhogs, utilize single catch traps located close to the burrow exit.**
  - ✓ **Bait traps with cantaloupe, apple slices, carrots with the tops, lettuce, cabbage, or fresh peas.**
- **Rabbit Control Practices**
  - ✓ **To exclude rabbits utilize a foot-high non-plastic fencing material with 1-inch or smaller mesh. Make sure to excavate 1 foot below the surface**
  - ✓ **Install tree guards made of 0.25-0.75 inch mesh hardware cloth 1-2 inches away from the tree**
  - ✓ **To trap rabbits, utilize single catch traps near the nest or along edges where cover meets open land.**
  - ✓ **Bait traps with apples, carrots, or greens during the warmer months and winter corn cobs, dried fruit, or dried alfalfa or clover hay during the cold season.**
- **Raccoon control practices**
  - ✓ **Manage garbage and put bungee cords on lids to prevent entry.**
  - ✓ **Electric fencing can be used.**
  - ✓ **To trap raccoons, utilize single catch traps or a large cage trap and put behind the trigger mechanism and also leading to the trap entrance to lure them.**
  - ✓ **Bait traps with fish-flavored cat food, fish, chicken, marshmallows, or white bread.**
- **Bird Control Practices**
  - ✓ **Utilize netting, mylar tape, or prune around the area needing protection.**

Not Recommended

The following materials are not recommended for use as a fumigant:

- **Cyanides**
- **Strychnine**
- **Phosgene bombs**
- **Gas-producing devices**

PRUNING

Ornamental Trees and Shrubs

Pruning is the removal of plant parts. The main objectives of pruning are to manage plant growth and development by considering plant structure and plant health. The biology, growth and development of each plant must be understood before applying the principles of pruning and training. The necessity for pruning can be reduced by selecting the right plant for the right location on the property. Through

proper selection and limited pruning, the natural characteristics of the plant are enhanced and its integrity maintained (Fogerty, 2013).

Recommended – Timing of Pruning Practices

- **Start pruning when plants are young.**
- **Know the plant and the best pruning time for both aesthetic and functional reasons.**
- **Delay spring pruning for plants that bleed excessively. Some examples include:**
  - ✓ ***Cornus* spp. (Dogwood)**
  - ✓ ***Betula* spp. (Birch)**
  - ✓ ***Ulmus* spp. (Elm)**
  - ✓ ***Acer* spp. (Maple)**
- **Prune spring-flowering plants after the flowers have faded. Some examples include:**
  - ✓ ***Cornus florida* (Flowering Dogwood)**
  - ✓ ***Cercis canadensis* (Eastern Redbud)**
  - ✓ ***Forsythia* spp. (Forsythia)**
  - ✓ ***Syringa vulgaris* (Common Lilac)**

***Note:* Early pruning of spring flowering plants may reduce floral display.**

- **Prune summer-flowering plants in the winter or early spring. Some examples include:**
  - ✓ ***Abelia x grandiflora* (Glossy Abelia)**
  - ✓ ***Callicarpa americana* (American Beautyberry)**
  - ✓ ***Magnolia virginiana* (Sweet Bay Magnolia)**
  - ✓ ***Stewartia pseudocamellia* (Japanese Stewartia)**
- **Broadleaf evergreens usually require little pruning, but most can be pruned before new growth starts in the spring. Some examples include:**
  - ✓ ***Rhododendron* spp. (Rhododendrons and Azaleas)**
  - ✓ ***Ilex* spp. (Holly)**
  - ✓ ***Buxus* spp. (Boxwood)**
  - ✓ ***Kalmia latifolia* (Mountain Laurel)**
- **Narrowleaf Evergreens (Conifers)**
  - ✓ **Needle-leaf Types (branches radiate from main stem) require little pruning and often will not develop new shoots on older wood. Some examples include:**
    - ***Pinus* spp. (Pine)**
    - ***Picea* spp. (Spruce)**
    - ***Abies* spp. (Fir)**
    - ***Cedrus* spp. (True Cedar)**
  - ✓ **Scale-like Types (branches arranged irregularly from main stem) are more tolerant of pruning and are often pruned more than once during the growing season. Some examples include:**
    - ***Thuja* spp. (Arborvitae)**
    - ***Juniperus* spp. (Juniper)**
  - ✓ **Flat leaves (Feather-like arrangement on stem) are very tolerant of pruning and shaping throughout the growing season. Some examples include:**
    - ***Taxus* spp. (Yew)**

Not Recommended

- **Late summer-early fall pruning is not recommended. Pruning will stimulate new growth which may not harden adequately before frost or freezing weather resulting in injury or death of this growth.**
- **Pruning plants when they are under stress or are forming new leaves is not recommended.**

HOW TO PRUNE

Recommended – General Pruning Practices – Adapted from Vodak (1993).

- **Consider the reason or purpose before pruning the plant.**
- **Remove any dead, diseased, crossing, or broken stems or branches**
- **Remove weak growth like watersprouts (strong upright shoots) and suckers (shoots from the root system) from trees**
- **Remove branches from the center of trees**
- **Make training cuts for shape or size**
- **Large branches of a tree over 1 ½ inches in diameter should be cut using the three-part cut, partial undercut 6-8 inches from attachment; another cut completely through branch 6-8 inches beyond the undercut; the final cut at the branch bark ridge**
- **Prune to an outer bud**
- **Plants that "bleed" after pruning can be pruned later in the Spring/Early Summer**
- **Sterilize tools between cuts of diseased plants with 10% bleach solution or 70% rubbing alcohol. Wipe off sap with a clean cloth before sterilizing in bleach or alcohol.**
- **Prune out limbs as needed on select species that have acute upright angles.**
- **Pruning cuts should be made just outside the branch bark collar on a slight angle at the same angle as the ridge.**
- **Larger trees may require cabling or bracing when pruning**
- **Make sure pruning tools are sharp and clean**
  - ✓ **Use the correct tool for the job**
    - **Hand pruner – ½ inch branches or less**
    - **Loppers – ½ - 1 ½ inch branches**
    - **Pruning Saw – Larger than 1 ½ inch branches**
    - **Bow saw – Best for large branches**

Not Recommended

- **Topping or dehorning of trees.**
- **The pruning of V-crotch limb attachments.**
- **The making of flush cuts with the branch or trunk.**
- **Pruning more than 1/3 of the plant at any one time.**

EMERGENCY TREATMENT

Sometimes issues may arise that require the use of a prohibited substance to provide emergency treatment. One example of an emergency treatment would be to save the life of a specimen tree. Under the US Department of Agriculture's National Organic Program, there are no provisions for the use of prohibited substances for emergency treatment unless there is a federal or state mandate for the removal of a particular pest or disease problem. In the case of a federal or state mandate, following the USDA NOP standards, the property could still be considered organically-managed (Section 205.672).

For More Information

Technical Assistance

Contact your local Cooperative Extension office. In New Jersey, county Extension offices can be found at http://njaes.rutgers.edu/ In other states: https://nifa.usda.gov/extension

Readings

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New Jersey Division of Fish and Wildlife - http://www.nj.gov/dep/fgw/

New Jersey Invasive Species Strike Team - http://www.njisst.org

Northeast Organic Farming Association Organic Land Care - http://www.organiclandcare.net

Organic Materials Review Institute - http://www.omri.org/

Rodale Institute - https://rodaleinstitute.org/

USDA National Organic Program Standards – http://www.ecfr.gov/cgi-bin/text-idx?rgn=div8&node=7:3.1.1.9.32.7.354.2

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5th Edition - January 2011

Standards for Organic Land Care

Practices for the Design and Maintenance of Ecological Landscapes

NOFA Organic Land Care Program | Northeast Organic Farming Association

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NOFA Organic Land Care Program
A program of the Northeast Organic Farming Association of Connecticut

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The NOFA Organic Land Care Program

Mission Statement

The Mission of the NOFA Organic Land Care Program is to extend the vision and principles of organic agriculture to the care of the landscapes that surround us in our daily lives.

Organic land care is a sustainable ecological landscaping system that promotes and enhances biodiversity, biological cycles, and soil biological activity. It is based on minimal use of off-site inputs and on management practices that restore, maintain, and enhance ecological harmony and beauty in urban and suburban landscapes and gardens. "Organic" means landscaping with no synthetic pesticides of any kind (insecticides, herbicides, fungicides, etc.) and with no synthetic fertilizers or soil amendments.

Basic Principles of Organic Land Care

(Adapted from the "Principles of Organic Agriculture," International Federation of Organic Agriculture Movements [IFOAM])

1. **Principle of health.** Organic land care should sustain and enhance the health of soil, water, air, plant, animal, human, and planet as one and indivisible.
2. **Principle of ecology.** Organic land care should be based on ecological systems and cycles and should work with them, emulate them, and help sustain them.
3. **Principle of care.** Organic land care should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.
4. **Principle of fairness.** Organic land care should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice, and stewardship of the shared world, both among people and in their relationships to other living beings.

These principles are closely interrelated.

Health is the maintenance of human physical and mental wellness, and social and ecological well-being.

Organic land care fosters healthy ecosystems, which include the smallest soil microorganisms, plants, and animals, including human beings. The sustained health of the planet depends on ecological diversity, resilience, and sustainability of ecosystems.

Organic land care practitioners strive to avoid pollution in establishing and caring for landscapes.

Ecology is the study of relationships among living things in a community. Organic land care uses ecological principles to sustain the health of plants and soils. Practices that enhance communities of living organisms and biological cycles are site specific.

In nature, ecosystems sustain themselves with no intervention. We try to mimic these systems in our managed landscapes. When inputs are needed, e.g., soil amendments, renewable materials from local sources are preferred.

Organically managed landscapes are designed to protect the diversity of the land and its surroundings, such as native plants and wildlife habitats.

"Right plant, right place," a key tenet of the Organic Land Care Program, refers to choosing plants for the environment, not altering the environment to fit a plant choice. Plants have evolved to grow in certain landscape niches and using this knowledge will allow the creation of resilient, low-input landscapes.

Plants that are selected, planted, and grown according to these principles thrive over long periods and better tolerate normal climatic cycles.

Care is the consideration of social and ecological impacts of the materials and techniques used in landscape creation and management.

"Do no harm" refers to land use decisions that have positive or neutral effects on the land. Organic land care protects and enhances the natural elements on a site. Before changes are made, a thorough site assessment must be conducted to discover the natural elements and how they interact with each other. If the assessment shows the site to be damaged or lacking in certain elements, restoration or remediation becomes part of the landscape plan. Studying existing nearby natural areas is the best way of approaching site restoration.

Fairness implies stewardship of the earth and all its creatures. An organic land care employer demonstrates strong ethical practices, including fair distribution of assets and benefits. Our businesses respect nature, family needs, and personal values. Also, business goals must be sustainable, i.e. economically sound, socially acceptable, and environmentally benign.

Each company sets work hours beyond which additional work is voluntary and paid in accordance with applicable laws. Employees must receive adequate compensation to meet their needs and satisfaction from their work. Working conditions must be safe and respectful. The work schedule should allow for at least one day off in seven, adequate rest and meal breaks, and use of sanitary facilities.

Personal safety equipment must be provided with the appropriate training. Explicit information is a requirement whenever hazardous materials or dangerous equipment may be used or stored in the work environment.

Fairness extends to the employer, who should expect a good work ethic of his employees. This includes adherence to all agreed-upon company policies, reasonable care of company property, and respect for clients and vendors.

Employers are encouraged to go beyond the minimal employer-employee relationship by increasing participation and responsibility of employees in the business whenever possible. Wages and benefits should reflect the increased responsibility.

Client relations should be consistent with honest and ethical business practices, a fair price for materials and services provided. Projects should be completed to the client's reasonable satisfaction.

Vendors of the company should be treated honestly and ethically. Payments should be made within the agreed-upon terms.

This business philosophy is a guide, not a mandate. Business owners are free to define honest and ethical social conduct, as befits their beliefs and conditions. In any case, all federal, state, and local laws must be complied with.

Purpose of the Standards

The purpose of the *NOFA Standards for Organic Land Care* is to:

- Specify the requirements for accreditation for organic land care
- Present the fundamentals of organic land care
- Specify practices that accredited land care professionals will pledge to abide by in providing organic land care services.

The intent of the Standards is not to provide all of the information needed for successful organic land care. More detailed information on organic land care is provided in the NOFA Organic Land Care Accreditation Course and at *www.organiclandcare.net*.

The NOFA Organic Land Care Program has developed these Standards as part of the process of educating land care professionals about the meaning of the word "organic" and to present our vision of how these principles can be applied to the landscaping profession. Through an education and accreditation program, we hope to make available to the public landscaping services that will meet or exceed the standards presented here. We also hope to educate the public about the meaning of "organic" and the benefits of this option for care of the land around homes, neighborhoods, and communities.

Definition of Key Terms in the Standards

Principles

Many of the sections within the Standards contain a list of fundamental land care principles. These principles form the basis for identifying preferred, allowed, and prohibited practices and materials. While judgments regarding specific practices and materials depend on our current state of knowledge, we expect that the underlying principles will endure well into the future and may serve as a guide when the practitioner encounters a situation not covered in the Standards.

Preferred

Practices and materials the NOFA Organic Land Care Program finds to be ecologically appropriate and in accord with the goals of organic land care.

Allowed

Practices and materials that are acceptable when needed, but should, where possible, be reduced in favor of the preferred alternatives.

Prohibited

Practices and materials that are not acceptable in organic land care.

A Note About Genetically Modified Organisms

Genetically Modified Organisms are developed from a variety of methods including:

- Cell fusion
- Microencapsulation
- Macroencapsulation
- Recombinant DNA

Organisms developed by these methods are prohibited in organic land care.

Traditional breeding methods that are acceptable include:

- Conjugation
- Fermentation
- Hybridization
- In-vitro fertilization
- Tissue culture

Emergency Non-Organic Rescue Treatment

There may be rare occasions when the organic land care professional and the client, who have previously agreed on organic land care, will decide to use extraordinary measures that are prohibited under the Standards.

An example might be to save the life of a tree of great value from a pest that cannot be adequately

controlled using organic methods. The professional must inform the client prior to any emergency non-organic rescue treatment about the need for this treatment. Emergency non-organic rescue treatments must be rare, must only be undertaken as a last resort, and must be approved by the client.

NOFA Organic Land Care Standards and the National Organic Program

The National Organic Program (NOP) is a marketing program housed within the USDA Agricultural Marketing Service that has developed national organic standards and established an organic certification program to assure consumers that agricultural products marketed as organic meet consistent, uniform standards. The now familiar green and black "USDA Organic" emblems appear on foods certified under this program. The *NOFA Standards for Organic Land Care* came originally from the CT and Mass NOFA agricultural standards, and were developed before the NOP was in effect. On some issues the Standards have been modified to come closer to the NOP (including resolving differences about pest management materials), but on other issues we have chosen to differ. In some ways we are more lenient, and in some ways we are stricter.

Some specific differences:

- CT NOFA agricultural standards did not allow use of Chilean nitrate fertilizer, and we kept this prohibition in the Standards. The NOP allows use of Chilean nitrate up to a certain percentage of the nitrogen applied.
- Emergency Non-Organic Rescue Treatment: There is no such provision in the NOP.
- In these Standards, we use the categories Preferred, Allowed, and Prohibited. The NOP categorizes materials as Allowed or Prohibited, but has restrictions on the use of many materials that are allowed. For example, materials for management of crop pests, weeds, and diseases are allowed only if a series of non-chemical methods have been found to be insufficient and if the materials are included in the organic system plan filed by the grower.

The NOP was developed for a very different purpose than were these Standards. The purpose of the NOP was to set legally enforceable standards that would be used by accredited organic certifiers to determine which agricultural products could bear the word "organic." The purpose of the *NOFA Standards for Organic Land Care* is to provide the educational basis of a voluntary program for land care professionals to apply the practice of organic land care to landscapes where people live. These Standards include principles, background information, and some how-to information that are not an element of the NOP standards.

The NOP was developed to set standards for organic agricultural production. In general, agricultural systems require more frequent and intensive intervention in order to provide a regular yield of marketable products than is needed in organic land care. Successful organic land care must satisfy the needs and desires of the client, but there are often much greater opportunities to work toward a sustainable, diverse ecological system than in agriculture, and we try to present those opportunities in these Standards.

For more information on the National Organic Program, see *www.ams.usda.gov/AMSv1.0/nop.*

Accreditation by the NOFA Organic Land Care Program to Provide Organic Land Care

The NOFA Organic Land Care Program operates an accreditation program (through CT NOFA) for organic land care professionals. Professionals take an approved 5-day accreditation course, pass an exam, and pledge to provide organic land care according to the Standards for their clients who ask for organic services. There are currently over 500

accredited professionals in 18 states. An accreditation manager oversees the program. Accreditation provides access to continuing education courses, referrals, networking, newsletters, publicity, media interviews, business listing in an annual homeowner publication, and an on-line searchable database.

Accredited Organic Land Care Professionals are allowed to use a NOFA-approved logo on their printed marketing materials for the year in which they are accredited. For example, the logo might appear on business cards, on brochures, in yellow pages and newspaper advertisements, on uniforms, and on company vehicles.

Accreditation Requirements

The following steps are required to become a NOFA Accredited Organic Land Care Professional (AOLCP):

- Complete the NOFA Organic Land Care 5-Day Accreditation Course
- Demonstrate knowledge of and skills in organic land care by earning a passing grade on the Accreditation Examination
- Sign a pledge to follow the tenets set out in the Standards for all clients who request organic land care
- Complete the Application Form
- Pay the Accreditation Fee

Maintaining Accreditation

Accreditation will be for a period of one year and is renewable annually. To remain accredited, an AOLCP must obtain four approved continuing education credits (CECs) and pay a re-accreditation fee each year. A list of approved CECs is maintained on the NOFA Organic Land Care Program website at *www.organiclandcare.net*. Potential credit opportunities can be submitted at any time to the Accreditation Manager. The NOFA Organic Land Care Program CEC review committee determines which opportunities are in keeping with the principles of organic land care and are thus eligible for credits.

Accreditation may be withdrawn if the Accreditation Manager, with the approval of the CT NOFA board, determines that any land care professional has misled clients about organic practices or failed to adhere to the Standards in providing services to clients requesting organic land care.

There are provisions for renewing a lapsed accreditation. Please refer to the NOFA Organic Land Care Program website, *www.organiclandcare.net*, for more information.

Disclaimer

The NOFA Organic Land Care Program works to foster professional competency in the area of organic landscaping and protect the public interest in responsible use of land care products and land resources. We publicize the list of AOLCPs so that people interested in having their properties managed organically can more easily find trained professionals. AOLCPs have satisfied the accreditation requirements listed above, but neither the NOFA Organic Land Care Program nor CT NOFA makes any further claims to the quality or cost of work performed by an AOLCP, nor are they responsible for any damages incurred in procuring or using AOLCP services.

Split Businesses

In cases where a business offers both organic and non-organic land care, it is crucial that clients understand clearly what type of land care services they are receiving. Printed business materials and advertising that are directed at the public must clearly distinguish the different arms of the business. *The NOFA logo must not be displayed on vehicles or equipment used to administer non-organic treatments.*

Any application equipment used for organic treatments must not also be used for non-organic treatments. Any materials used in organic land care practices must be stored separately from non-organic materials to prevent cross-contamination.

Standards Review and Revision Procedures

The Standards were researched and written in 2000-2001 by a multi-state volunteer group of practicing land care professionals, scientists, and concerned citizens, with assistance from technical advisors. The Standards—and especially the preferred/allowed/prohibited practices and materials—are intended to be reviewed periodically by practitioners and the NOFA Organic Land Care Program Standards Review Committee and amended as appropriate. The current revision is the fifth revision of the Standards.

Suggestions for changes to these Standards are welcome. Land care professionals, scientists, extension educators, government officials, and others are invited to submit suggestions in writing to the NOFA Organic Land Care Program Manager. New materials, new products, and new information on practices will be considered at the time of Standards revision.

Site Analysis, Design, and Management

Site Analysis, using the principles in these Standards as a guide, is the observation of the key elements of a site, coupled with an understanding of how these elements affect the relationship between organisms (people, plants, animals, microscopic soil life) and the site. Site Analysis is the primary discipline used to determine appropriate land use—including plant selection and placement, construction and placement of hardscape elements, and in some cases, site modification to create particular ecosystems.

Design is the creative application of these principles in the landscape. It employs the disciplines of ecology and sustainability to create landscapes that can be managed organically.

Management refers to the holistic care of landscapes before, during, and after installation. It utilizes recognized organic methods and materials, and also innovation and experimentation, so long as they conform to the principles set forth in these Standards. One of the goals of organic management is the gradual decrease of inputs as the landscape is guided toward sustainability.

Preferred

- Site analysis that includes: special attention to variation in microclimates; evaluation of sunlight availability and degrees of shade, soil characteristics (see Soil Testing, page 17), air circulation, water flows, and temperature variations; and observations of plants and animals, current land use, and features of the surrounding landscape
- Understanding not only the site delimited by the property lines but the bioregion in which it is located
- Use of native plants whose characteristics are ecologically appropriate to the site
- Leaving established ecosystems intact (except where invasive or harmful plants exist—see Native, Exotic, and Invasive Plants, page 37)
- Producing food (vegetable gardens, edible landscapes)
- Restoring, protecting, enhancing, and creating ecologically appropriate wildlife habitat (e.g., riparian buffers)
- Establishing buffers to protect organic sites from neighboring non-organic sites
- Designing landscapes that enhance the principles of ecology and sustainability (e.g., reducing the amount of space devoted to lawns)

Allowed

- Modifying existing habitats, within the guidelines of these Standards, where a new landscape design is desired
- Use of non-native plants whose characteristics are ecologically appropriate to the site

Prohibited

- Breaking local, state, or federal laws regarding wetlands and buffer zones
- Using plants that are inappropriate to the site or that require extraordinary inputs and efforts to keep them alive
- Modifying a site in a way that results in considerable harm to the environment
- Use of invasive plants
- Designing and managing a site in ways that violate these Standards

Inland Wetlands and Watercourses

Inland wetlands may be transitional areas between open water and dry land. Or they may be isolated areas away from open water. They are found in uplands, on the top of hills, the side of hills, in valleys, and along watercourses such as rivers, streams, and ponds or lakes. Wetlands form in areas dictated by landscape position in relation to the underlying soil and bedrock and regional drainage patterns. The formation and development of wetlands may also be influenced by wildlife activity, e.g., beavers.

Numerous ecological functions and values are attributed to wetlands: water quality and water quantity, flood control, habitat and biodiversity, groundwater recharge, storm water runoff, reduction of soil erosion, aesthetics, and production of natural products such as timber, fish, cranberries, and wild rice.

Inland wetlands include semi-aquatic areas and also terrestrial areas that are subject to a high, or fluctuating, water table for periods each year that are sufficiently long to cause soils to develop hydric properties and support vegetation that is adapted to life in saturated or poorly drained soil. The specific types of wetlands vary considerably around the United States, from riparian wetlands along rivers to isolated depressions surrounded by dry land, from acid or calcareous bogs to wetlands dominated by shrubs, and from wet meadows to hardwood swamps, inland marshes, and vernal pools.

Care must be taken during land management and landscaping to avoid stream channel degradation, sedimentation, and backyard wetland damage due to filling, excavating, dumping yard waste, or mowing up to the edges of wetlands or ponds.

Most states now have strong inland-wetland protection laws. State laws vary but usually require accurate and detailed identification and delineation of wetland boundaries by a credentialed professional. In Connecticut, the law stipulates that this process be performed by a soil scientist. Laws also regulate certain types of activities in wetlands and also in upland review areas adjacent to wetlands. Such activities may include landscaping, as well as paving, building, etc. Of particular concern is the construction or removal of dams, which may change stream flow and velocity and result either in downstream flooding or the deprivation of water to downstream wetlands. Permits are usually required for any activity within wetlands or upland review areas. Possible exceptions may include simple landscape maintenance that does not require machinery. The Army Corps of Engineers also has jurisdiction over wetlands and watercourses in the United States, and certain types of projects may require an ACOE permit.

Principles

- We must learn about the different types of wetlands that may occur in the bioregion where we live and work and their functions and values.
- We must become familiar with, and develop an understanding of, the local, state, and federal regulations that govern inland wetlands and watercourses. All wetlands work must be done in compliance with these regulations.
- We must make every effort to avoid negatively impacting wetlands and strive to protect, maintain, or improve inland wetlands occurring on the properties we manage.

Preferred

- Becoming conversant in and complying with inland-wetland regulations and where to apply for permits or receive guidance (town commissions or county or regional boards)

- Consulting with a professional to identify all wetlands and watercourses on a site
- Protecting wetlands during landscaping by following best management practices, which are usually available from state departments of environmental protection
- Advising the client of inland-wetland regulations to help him or her avoid violations, which can result in costly fines and expensive remediation projects
- Helping the client work with a wetlands agency to develop a reasonable plan within the law, one that includes prudent alternatives and provides for mitigation actions to restore or replace any wetland areas that might be impacted by the proposed activity
- Adopting landscaping practices that enrich or benefit wetlands—e.g., increasing native plant buffer plantings around wetlands, ponds, and riparian buffer zones; removing invasive species; building water infiltration gardens; preventing soil erosion and sediment from settling into wetland areas; and stabilizing stream banks

Allowed

- Making site changes to address safety concerns
- Reasonable use of the home grounds by the homeowner in the areas close to the residence, i.e., normal outdoor living areas attached to the home, reasonable recreation areas, access pathways, and garden materials storage
- Creation of vehicle or emergency access across wetlands or watercourses

Prohibited

- Draining or filling of wetland areas
- Any activity in a designated wetland or upland review area without a permit
- Removal of existing vegetation from wetlands or wetland buffers, except invasive species that will be replaced with appropriate natives
- Altering a stream channel by piping, straightening, or otherwise disturbing the natural flow of the watercourse
- Garden waste disposal in a wetland
- Spreading fertilizer or fresh manure in a wetland or upland review area

Water Use and Water Quality

Unprecedented fresh water shortages, declining stream levels, and degraded water quality are serious and growing problems in the United States, as they are in much of the world. According to a report by the U.S. Government Accounting Office (2003), 36 states project that they will face water supply shortages by 2015. Cities and communities that already face tightening fresh water supplies have arrived at their predicament due largely to *one single uncontrolled and excessive water demand: landscape irrigation.* An estimated 50% of United States urban water demand—half of all water going to cities, towns, and suburbs—is pumped onto landscapes, principally lawns, according to the U.S. Environmental Protection Agency.

Today, even "water-rich" Massachusetts, which receives over 40 inches of precipitation annually, faces a long-term water supply deficit despite the fact that its population has been largely stable for over 20 years. Over 75% of Massachusetts's major river basins have been classified by the state as being under medium to high stress, meaning they suffer from reduced streamflows, degraded water quality, and damaged natural habitats, according to the MA Department of Environmental Protection (see map at *www.mass.gov/dep/water/resources/stresmap.html*). Water use during the summer lawn-watering season as much as doubles in some suburban towns, suggesting that the growing number of automatic irrigation systems, along with the unprecedented number of new private landscape irrigation wells, which increasingly dominate new developments, towns, and suburbs, are the primary cause of this river stress. Each automatic landscape irrigation system and private irrigation well commonly pumps hundreds and sometimes thousands of gallons of water a day.

At such excessive rates of water use and abuse in New England and across the United States, is it any wonder why even the most water-plentiful regions in America fear they will one day run out of water?

Principles

- Conservation of both water supply and water quality should be factored into all site design, construction, and management practices.

- All sources of water, including but not limited to municipal water, private ground or surface water, rainwater, and gray water, are valuable and should be conserved in both supply and quality.

- Do no harm that would alter or disturb natural onsite water flows, ponds, groundwater, or other natural water features. Existing natural water features (wetlands, streams, ponds) on or near a property should be identified, and the course of their flow and movement should be left unimpeded and protected from disturbance. All water in its free-flowing state acts in the service of local ecosystems whether or not it is visible to the human eye.

- Know and respect your watershed. Seeming water abundance is never a justification or license to take or use water for nonessential purposes. Lawn and landscape irrigation are nonessential water uses. They should be limited to temporary needs (such as establishment of new plantings) or exceptional situations (such as athletic turf), and should operate as efficiently as possible.

Preferred

- "Right plant, right place"—selecting native and noninvasive exotic landscape plants and lawn grasses that will thrive under local temperature and climate patterns

- Planting at times of year when rainfall is plentiful and the need for irrigation is low

- Rainfall-only irrigation for lawns and landscapes after turf and plant establishment. Native plants and noninvasive exotic plants and lawn grasses, once they have been established, should not need supplemental irrigation.

- Allowing lawns to go through natural dormancy cycles (i.e., allowing grass to go brown in summer). It is normal for cool-season lawn grasses to go dormant when temperatures rise and water becomes less plentiful in summer. They green up again when temperatures cool and rainfall becomes more abundant. Watering lawns in summer not only depletes an increasingly precious resource, it places undue stress on the grass plants (see Lawns and Lawn Alternatives, page 31).

- Using only *proven* water conservation practices and technologies backed up by credible evaluations and rating systems. Exercise caution when considering the water-saving claims of manufacturers, product vendors, and trade groups. Demand verification by independent third-party labs.

- Pervious surfaces that allow water to pass through to the soil underneath rather than run off. Many types of permeable materials are available for terraces, sidewalks, walkways, and driveways.

- Directing runoff (such as from roofs) to pervious areas, such as natural infiltration areas and vegetable gardens

- Restoring and maintaining natural buffers along watercourses and wetlands in accordance with local, state, and federal laws

- Preventing contamination of stormwater with cleaners, solvents, waste materials, and other pollutants. See "Environmental Best Management Practices Guide for Small Businesses" in the Bibliography, page 62. See EPA's *WaterSense Labeled New Home Irrigation Audit Checklist* for acceptable design and installation criteria for irrigation systems, also in the Bibliography.

Allowed

- Temporary hose irrigation for the establishment of turf and landscape plants

- During particularly dry periods, manual watering with a hose to sustain garden vegetables and fruits and to keep important landscape plants from dying, as allowed by local watering ordinances

- Limited permanent irrigation systems, with the following restrictions:

    - All permanent irrigation systems must meet water efficiency standards, e.g., be leak-free, have high distribution uniformity (DU), and meet the criteria for acceptable irrigation system design (new and renovated systems) and maintenance (all systems) according to the US EPA WaterSense® Program's *Final Specifications for Single-Family New Homes,* as described in the *Resource Manual for Building WaterSense Labeled New Homes, Section III. B., Irrigation Systems (4.2)* (see *www.epa.gov/watersense/docs/newhome_builder_resource_manual508.pdf*) and the *WaterSense Labeled New Home Irrigation Audit Checklist* (see *www.epa.gov/watersense/docs/home_irr-audit-checklist508.pdf*).

    - Property owners with automatic irrigation systems must be taught how to set the controllers and reprogram them to account for changes in seasonal temperature and rainfall patterns and plant demands.

    - A working rain shut-off valve must be installed on automatic irrigation systems. Functioning must be checked at least annually.

- "Smart" weather-based irrigation controllers (WBIC) may only be used under the following conditions: The irrigation system must meet water efficiency standards, e.g., be leak-free, have high distribution uniformity (DU), and meet the criteria for acceptable irrigation system design (new and renovated systems) and maintenance (all systems) according to the US EPA WaterSense® Program's *Final Specifications for Single-Family New Homes,* as described in the *Resource Manual for Building WaterSense Labeled New Homes, Section III. B., Irrigation Systems (4.2)* (see *www.epa.gov/watersense/docs/newhome_builder_resource_manual508.pdf*) and the *WaterSense Labeled New Home Irrigation Audit Checklist* (see *www.epa.gov/watersense/docs/home_irr-audit-checklist508.pdf*).

- To prevent runoff, irrigation system run times must not exceed a site's soil water-holding capacity and plant needs.

- Moisture sensors are only beneficial for saving water when they are properly installed and maintained according to the manufacturer's directions and used with a well-designed automatic irrigation system.

- Minimal use of petroleum- and chemical-based plastics—such as pipes, barrels, and liners. Contact with water and/or sunlight causes plastics to degrade and release plasticizers, endocrine-disrupting chemicals, and other nonorganic materials that can leach into water and soil and enter the soil food web. When plastics must be used, downsize the area and volume of material whenever possible.

- Rainwater harvesting, under the following conditions:

  - Rainwater collected for irrigation shall not be stored or harvested in volumes larger than are needed to irrigate vegetables, fruits, and nut trees, and essential landscape plants. Water collected from rainwater shall not be hoarded or stored in excess.

  - Rain water applied to the landscape shall be in accordance with all local drought and water conservation watering rules and restrictions, even if they only apply to potable (municipal) water.

  - Rainwater shall not be applied to non-essential areas, such as lawns.

  - Rainwater collection systems should be properly maintained to prevent mosquito breeding and water contamination.

- Use of gray water or reclaimed water for irrigation of non-edible plants, as permitted by law (check local and state health codes)

- Limited impervious surfaces, where necessary. Impervious surfaces include driveway blacktop, building structures, soil compaction, and loss of vegetative cover. They cause precipitation to run off to storm drains and streams, thereby reducing the amount of rain water that can percolate through the soil to recharge groundwater.

Prohibited

- Irrigation practices that waste water, such as causing water to run-off onto hardscape (e.g., sidewalk, driveway, nonvegetation areas), puddle, or foster disease or fungal growth on lawns and plants

- Use of broken or leaking irrigation systems. Broken systems include improperly wired or installed systems and improperly scheduled irrigation runs (e.g., irrigation during rain, for excessive run times, etc.).

- Automatic lawn and landscape irrigation systems that are not adjusted as needed to account for changes in seasonal

temperature and rainfall patterns and plant demands

- Any misuse of water that causes flooding or erosion problems (e.g., improperly designed or maintained irrigation systems, water features, or rainwater harvesting systems)
- Gray water or other reclaimed water that does not meet local, state, and federal water quality and public health and safety standards
- Addition of synthetic chemicals of any kind to the water used on an organically managed landscape or property
- Draining or filling of wetland areas
- Synthetic turf, plants, or mulches. Synthetic materials, such as recycled tires, may contain lead, cadmium, and other hazardous compounds that can contaminate surface or groundwater.

Energy Use and Climate Change

Awareness is growing of the dramatic impact on both the local and global scale of the persistent, heavy use of fossil fuels. In addition to pollution, environmental degradation due to drilling and mining, and the geo-political ramifications of depending on these sources of energy, there is now the specter of climate change on the horizon and all that that implies.

The land care profession is a part of the self-styled "green" industry, but the color refers to chlorophyll, not to sustainable energy use. Most land care businesses use copious quantities of petroleum for transportation and for powering equipment. Less obvious is the "embodied" energy found in landscaping materials. Embodied energy is the energy used to create a product and move it to the point of sale or use. The production of synthetic fertilizers requires huge amounts of energy, and trucking the heavy bags requires yet more. Synthetic nitrogen fertilizer is particularly damaging, contributing to CO_2 emissions in its production and transportation, creating the greenhouse gas NO_2 in its use, and disrupting the global nitrogen cycle. In addition to the energy used to make and transport synthetic pesticides, many of the formulations and "inert" ingredients are composed of compounds derived from petroleum. Even tap water embodies energy, whether it is pumped from the ground or delivered under pressure through an intricate system of pipes—after being treated with chemicals that also embody energy.

It is completely impractical for most land care businesses to go cold turkey and stop depending on fossil fuel energy entirely, but there are ways to significantly reduce its use. Gas-powered equipment can be eliminated or employed more judiciously, local materials can be preferred to those collected or manufactured hundreds of miles away, compost made on site can be applied instead of synthetic fertilizers.

The organic land care professional needs to operate a successful business while focusing on larger issues. These two concerns are not incompatible. Increased energy efficiency and the use of local materials can do more than help save the planet; they can also improve the bottom line.

Principles

- Energy use and climate change are critical issues at this time in history, and landscaping and land use patterns have a major impact on climate.
- Organic land care practitioners consider the embodied energy of the materials and resources used in their work to minimize the total energy used to make, deliver, and dispose of materials.
- Organic land care practitioners should strive to minimize or eliminate the use of fossil fuel–powered equipment and seek to reduce energy use through the design of their offices and workshops and the scheduling of jobs.
- Landscape plantings can be designed to reduce the amount of energy required to heat and cool houses and other structures. Shade trees can be planted to block the summer sun; evergreens can be sited to deflect prevailing winter winds.

Preferred

- Locally produced materials and plants
- Use of on-site or local materials for design, construction, and maintenance
- Striving for a closed system on a property—for example, creating and using compost made from materials found on site
- Using manual tools and equipment

- Keeping equipment and tools maintained and in good working condition
- Emphasizing the cultivation of edibles in landscape designs to reduce food transportation costs
- Use of native plants in the planting design. If selected with the soil, moisture, climate, and exposure conditions in mind, native plants will generally perform better and require less maintenance and thus fewer energy inputs than fussy exotics.
- Eliminating tilling in order to preserve carbon sequestered in soil. Tilling, by increasing the amount of oxygen in the soil, speeds the oxidation of organic matter, releasing CO_2 into the atmosphere.
- Designing site plantings to improve the heating and cooling efficiency of structures and outdoor recreational spaces
- Reducing the use of power tools by designing landscapes that require less management (e.g., planting slow-growing plants below house windows to reduce the need for shearing and foregoing fertilizer on lawns to reduce the need for mowing and watering)
- Considering maintenance energy requirements as well as installation energy requirements in all designs

Allowed

- Using exotic plants for their carbon sequestration potential, as long as they aren't prohibited in other sections of these Standards
- Operating vehicles and power equipment (mowers, leaf blowers etc.) that meet the strictest current efficiency standards
- Planting or maintaining lawns in landscapes where attention has been given to other landscape ecology functions
- Materials from outside the immediate local area, if necessary to establish a new garden on a difficult site or rehabilitate a degraded landscape before transitioning to a management regime based on local materials

Prohibited

- Clear cutting
- Synthetic fertilizers and pesticides
- Buying materials, including fertilizers and soil amendments, without first checking to see if there is a closer source at little or no additional expense for the same material
- Idling vehicles and equipment

Soil Health

The foundation of organic land care is knowledge of and proper care for the soil. Soil tests, along with site analysis, allow the land care professional to select and implement practices that maintain or increase soil life and vitality and thereby enable the soil to support a vigorous plant community. A healthy soil is free of crusts, compaction, pesticides and other toxins, salt buildup, and excessive erosion, and contains sufficient organic matter and nutrients, in proper balance, to support a large and active population of native organisms.

The community of organisms that inhabits the soil is known as the soil food web. The soil food web consists of such familiar earth dwellers as worms and insects but also the countless microscopic creatures, bacteria, and fungi that inhabit every spoonful of soil. The benefits of a healthy soil food web are many. It forms protective layers around roots to keep pathogens at bay, helps plants obtain nutrients from the soil, breaks down toxic compounds that inhibit plant growth, improves disease suppression, and builds soil structure, making it easier for roots to grow and obtain nutrients and water.

In natural systems, organic matter—provided by decaying roots and stems and, in forested areas, the autumn leaf drop—cycles in place. A thriving microbial community digests and breaks down this organic matter, releasing nutrients back into the soil. The organically managed landscape retains and recycles organic matter, to the extent that the client's needs and the situation permit. On-site composting is a means to this end, as is shredding or chipping organic material on a property and allowing it to compost in place. By closing the nutrient cycle in this way, the need for external inputs is minimized.

Organic soil amendments may be needed to help balance a soil's chemistry, stimulate its biology, and restore its physical composition. Such amendments may also be required to support the growth of a typical lawn, which has extraordinary nutrient needs because it is maintained in an unnatural way—relentlessly mowed and kept green as long as possible.

In an organically managed landscape, soil fertility is enhanced by feeding the soil, not the plant. Carbon and nitrogen are applied to the soil in the form of manure, compost, blended organic fertilizers, and cover crops, and the soil food web breaks these organic materials down into the nutrients that plants need. Horticultural methods that short-cut this natural process by supplying synthetic nitrogen, phosphorus, and potassium (NPK) directly to plants lead to damaged soils and weak root systems, making the plants more susceptible to insects, disease, and drought. Repeated, excessive application of synthetic fertilizers may also inhibit the development of mycorrhizae—symbiotic fungi growing on or around plant roots that help to gather nutrients beyond the range of the roots themselves. Eventually the soil structure collapses and the soil becomes infertile. To revive dead, compacted soil, it may be necessary to apply compost to reintroduce soil life.

A carefully managed soil-building program that increases soil organic matter and humus gives many benefits. It recycles nutrients, improves water retention, balances minerals, and buffers pH. In addition to compost and manure, other amendments, such as root stimulants, rock dust, and beneficial microbes, may be indicated based on soil test results.

Principles

- There are two approaches to matching soils and plants:

    1. We can maximize the diversity of soils and plants and minimize the need to alter the soil by leaving the soil alone as much as possible and choosing appropriate plants for that soil, site, and microclimate; or

2. We (or the client) can decide what plants are desired and alter the soil and site to make them suitable for the desired plants.

- The first choice is the more desirable because it minimizes our effects on the environment, and thus the potential for harm from our interventions. In either case, we must avoid practices that impair soil health and the health, diversity, and functioning of soil organisms.

- Organic land care follows a holistic approach to plant health, nourishing soil life instead of feeding plants directly. This is accomplished by increasing organic matter in the soil, balancing nutrients and pH, and increasing soil life through the judicious use of biologically active materials such as compost and compost tea.

- To reduce our ecological footprint, we emphasize the cycling of nutrients on site, supplemented as needed by local, renewable, sustainably harvested materials, and limit our use of materials that are mined or transported from far away to those that are necessary and not obtainable in any other way.

- Soil tests are essential to gain specific information about the soil, and must be performed before any soil alterations can usefully be made.

- We must minimize or eliminate any risk of contamination of soil or water with toxic substances or excessive nutrients, whether they are added directly, as with fertilizers, or simply allowed to come into contact with the soil. We utilize natural remediation methods, where possible, to cleanse the soil of contaminants.

Soil Testing

Soil testing provides essential information about soil texture and structure; the levels of minerals, nutrients, organic matter, and other essential components; and the presence of soil organisms. Core samples are taken to determine the depth, structure, and texture of the topsoil layer and basic characteristics of the subsoil layer. A standard soil test is used to determine soil pH (acidity/alkalinity); the percentage of organic matter in the soil; and any nutrient or mineral deficiencies, excesses, or imbalances. A more comprehensive soil bioassay can evaluate the presence and balance of soil organisms such as fungi, bacteria, nematodes, and protozoa.

Taking soil samples and preparing them for shipment to a lab is not difficult and does not require special tools. Each lab (see Appendix III, page 70) provides complete instructions and specifications that must be followed to obtain accurate results. It is important to note that a soil test will yield meaningful results only when a representative sample is collected and prepared for each area of interest (the vegetable garden, the lawn, the perennial bed, around a tree, etc.). There is time and effort involved in this process, and lab fees to pay as well, but the knowledge gained is invaluable to you and your client.

Do not be tempted to purchase a soil test kit from a garden center or home improvement store. Such kits typically show pH and nutrient levels through colorimetric reactions (placing a soil sample into a solution causes the solution to turn color), and their results are only as accurate as one's visual acuity and the print quality on the reference card. Homeowner-grade pH meters are also highly suspect because their readout is analog and calibration against standard buffer solutions is not possible. Recently introduced digital pH meters, such as the Hanna® pHep 5, can be both accurate and precise, but only if the person doing the testing has been trained in their proper use.

Soil testing isn't just a good idea, it is a requirement of proper land management. Neither

experience, intuition, nor received knowledge, as valuable as they may be, provides sufficient basis for determining the need to apply amendments or fertilizer, or the amount required to correct a perceived deficiency or imbalance. The only way to *know* what a soil requires is to test it. The only way to determine *how* to correct a problem with a soil is to test it. Throwing fertilizer around without benefit of a soil test is malpractice—by any standard.

Preferred

- Performing an initial soil test, then retesting every three years thereafter
- Obtaining separate soil samples from each type of microclimate (sun/shade, wet/dry, etc.) to ensure accurate representation of all soil conditions on a site
- Sending samples to a professional or government soil testing lab for analysis and organic recommendations, and for a soil bioassay, if desired (see Appendix III, page 70, for a list of soil testing laboratories)
- In cases where the soil test laboratory recommends non-organic amendments or fertilizers, adjusting those recommendations to meet the requirements of these Standards
- Keeping records for each site, including name and location, date of initial test, and preexisting conditions, and a copy of the soil test results. Also maintain a record of any applications and a summary of any changes observed.

Allowed

- Applying amendments after planting, following soil test results
- Measuring soil pH using a digital pH meter calibrated against standard buffer solutions. Individuals performing such tests must be trained in the appropriate collection of soil samples and calibration and use of the meter, as well as the standard testing protocol.

Prohibited

- Using a homeowner-grade colorimetric soil test kit or analog pH meter to determine application of soil amendments or fertilizers
- Using tools and containers for soil testing that retain remnants of other matter. Any contaminants may taint the results. Tools and containers must be *clean*.
- Amending the soil or fertilizing with nitrogen, phosphorus, or potassium without the guidance of a soil test
- Following soil test recommendations that are prohibited in these Standards

Toxic Elements in Soil

Many elements occur naturally in soil as inorganic ions (charged species) and at least 18 of them are known to be plant nutrients. Of these elements, approximately half are required by plants in very small quantities and are described as trace or micronutrients. Human activity can adversely affect soil, either by the incorporation of toxic elements such as mercury, lead, and cadmium or by increasing the proportion of necessary trace elements such as copper or zinc to toxic levels. Modes of incorporation into soil can include the use of pressure-treated wood, sanding or scraping of paint containing lead on nearby structures, use of dirty fill, past use of pesticides containing lead or arsenic, application of industrial or domestic sludge (also called sewage sludge or biosolids), smokestack emissions, and past use of leaded fuels. Testing the soil for heavy metals is strongly encouraged on potentially contaminated sites before growing food or creating play areas for children.

Toxic elements, once introduced to the soil, have a tendency to persist. Preventing the contamination

of soils is critical because remediation of polluted soil can be both costly and time consuming.

If there is reason to believe a site has been contaminated, proper management begins with a soil test to determine the level and type of contamination, followed by consultation with a specialist trained in management and remediation of toxic elements in soil. Once the test results are known and fully understood, the proposed remediation plan must comply with all pertinent federal, state, and local statutes.

Preferred

- Limiting soil disturbance at sites suspected or known to be contaminated (such as those bordering heavily-traveled roads, near gas stations, and in industrial areas) to reduce human exposure
- Maintaining thick turf, dense evergreen groundcover, or impenetrable vegetation on contaminated sites to prevent children from digging and to reduce tracking of contaminated soil into buildings
- Working in collaboration with a phytoremediation or mycoremediation specialist to determine how to use specific plants or fungi to absorb toxic elements from a contaminated site. Consult with local authorities to make sure that the plant or fungal material is disposed of properly.

Allowed

- Disturbance of contaminated sites, provided no edible and/or berrying plants are installed, and there is no migration of contaminants to adjacent sites
- Covering contaminated soil with sod or with plastic sheeting followed by a layer of organic mulch or gravel
- When planting on a contaminated site, sealing the site with plastic sheeting, then adding an appropriate amount of compost or soil for the plants to grow in

Prohibited

- Installation of edible and/or berrying plants
- Removing contaminated soils, except for regulated disposal
- Allowing runoff from disturbed contaminated sites to reach uncontaminated areas

Materials in Contact with Soil or Plants

Building materials, masonry, edgings, landscape fabrics, and other materials that come in contact with soil or plants should be free of harmful substances such as toxic metals, pesticides, and toxic chemicals. Pressure-treated wood products that contain chromated copper arsenate (CCA) are of special concern. These products are no longer sold for residential use, but if they have been used in the past, toxic residues may still be present. Studies have shown that high amounts of CCA, which is extremely toxic, can be released from the wood in most soils found in the Northeast.

Preferred

- Untreated, rot-resistant wood, such as cedar, white oak, or black locust, from sustainably harvested sources
- Wood alternatives such as recycled plastic and plastic and wood fiber composites, provided they do not contain polyvinyl chloride (PVC)
- Masonry (stone, bricks, etc.)
- Non-galvanized or stainless steel
- If pressure-treated wood is present, testing the soil for arsenic, chromium, and copper before planting food crops or disturbing the soil

Allowed

- If chemically treated wood already exists on a site and cannot be removed or the client

is unwilling to remove it, coating the wood with paints or stains formulated for such use, such as polyurethane, acrylic, and spar varnish. Re-coat as required.

- Newspaper printed with black ink, used under a layer of mulch to suppress weeds
- Plastic and nonwoven geotextile fabrics that do not contain polyvinyl chloride (PVC)
- Synthetic burlaps, if removed completely at time of planting

Prohibited

- All types of chemically treated wood, burlap, stakes, and twine
- Chemically treated paper and cellulose mulches
- Newspaper printed with color inks and inserts printed on glossy paper
- Plastic and nonwoven geotextile fabrics that contain polyvinyl chloride (PVC)
- Synthetic burlaps
- Creosote- or tar-treated wood (such as railroad ties)
- Petroleum-based wound dressings
- Galvanized steel
- Mulch made from ground-up rubber tires

Fertilizers and Soil Amendments

Fertilizers and soil amendments are tools that enable us to modify existing soil conditions. The "feed the soil" principle is used to benefit plant health, not artificially stimulate plant growth. Unnecessary applications of any fertilizer or soil amendment—including those listed as Preferred or Allowed in these Standards—can cause nutrients to build up to excessive levels in the soil. At such levels, nutrients may enter local water resources. Nitrogen and phosphorus are the nutrients most involved in eutrophication of water bodies (nitrogen in oceans, phosphorus in lakes and ponds), and are thus of major concern as pollutants. Nitrogen can also be a hazard to human health when it pollutes drinking water supplies.

The availability of mineral elements depends on environmental factors specific to each site. Good stewardship of the environment requires that soil tests be performed to obtain an accurate picture of the soil chemistry on a particular property. A bioassay provides valuable information about the living components of the soil. If the land care professional determines, on the basis of the test results, that a soil requires amendment, it is preferred to use renewable materials that are locally and sustainably produced. Many nutrient amendments are mined or harvested from natural sources that are not renewable and transported over long distances. We do not want to deplete these resources for our short-term benefit.

Preferred

- Local or on-site nutrient sources
- Compost in the amounts specified below
- Compost teas
- Cover crops and green manures

Allowed

- Organic fertilizers with ingredients that meet the NOFA OLC Standards for Organic Land Care. Baystate Organic Certifiers maintains a list of products in the Northeast that have been carefully reviewed and found to be consistent with these Standards. To submit a product for review, please contact Baystate directly at *www.baystateorganic.org*.

Prohibited

- Exceeding the amounts of nitrogen, phosphorus, and potassium recommended by a soil test
- Synthetically derived ingredients. *Note:* Blended fertilizers may contain a mixture of organic and synthetic materials. If synthetic materials are present, the fertilizer is prohibited for use in organic land care.
- Sewage sludge
- Allowing fertilizers to remain on sidewalks or pavement (typically after being applied by a rotary spreader). Fertilizers left on pavement wash into storm sewers and then into waterways. Any spillage must be swept up or vacuumed and reused.

Compost

Compost has many advantages over topsoil or mulch alone. It improves soil structure, reduces runoff and compaction, enhances biodiversity, increases water and nutrient retention, increases microbial activity, supplies nutrients, increases root growth, helps prevent and suppress plant diseases, detoxifies certain pesticides, and inactivates or kills potential human pathogens. Additional benefits for the land care professional include: improved establishment of turf, ornamentals, and shade trees; improved foliage color; improved plant performance in marginal or poor soils; and reduced

and often eliminated need for fertilizers, pesticides, and irrigation.

Composting is the managed, rapid decomposition and stabilization of raw, clean organic waste to a humus-like finished product. High-quality compost is well decomposed and is highly aerobic due to regular aeration. It is high in beneficial soil organisms such as actinobacteria, fungi, nitrogen-fixing bacteria, aerobic bacteria, and many others. On the other hand, it generally contains low and variable amounts of nutrients. Organic fertilizers may be required to meet some plant nutrient requirements.

A commonly accepted recipe for compost is to use 3 parts by volume carbon-rich brown material (such as wood chips, sawdust, leaves, or shredded paper) and 1 part nitrogen-rich green material (such as grass clippings, kitchen waste, green plant material, or manure). For more on compost making, see the Bibliography, page 63.

Characteristics of well-decomposed or finished compost

Appearance: Few recognizable components of the initial raw materials. Color resembles dark topsoil. Structure is light and crumbly. Finished compost does not release steam when disturbed.

Odor: An "earthy aroma" with no offensive odors such as ethanol, ammonia, or sulfur.

Temperature: Not hot to the touch.

Weed seeds: No weeds growing on or around the pile. Proper composting at high temperatures kills weed seeds.

Moisture content: Between 30% and 50%. Above 60%, compost tends to clump and not spread evenly, is heavy and difficult to handle, and can be anaerobic. Below 20%, it produces excessive dust, will tend to wash away, and favors excessive growth of actinobacteria.

Carbon-to-nitrogen (C:N) ratio: Approximately 15:1, from raw materials with an initial C:N ratio of between 25:1 and 40:1.

pH: Finished compost has a pH of between 6 and 7 (typically around 6.8), a range that is favorable for most plants. Extremes in pH may result in reduced availability of some plant nutrients and/or toxicity problems.

Additional methods of evaluating compost quality: Laboratory testing and recommendations from other land care professionals. Commercial composters should have state certification or a permit, as appropriate. A simple test to determine if compost is mature is to put 3 cups of compost in a sealed plastic bag and let it sit overnight at room temperature. If the bag expands, the compost is not finished. Another test is to use the compost to germinate watercress (*Nasturtium officinale*) seeds. If the seeds fail to germinate, or the seedlings are weak, spindly, or distorted, then the compost is not finished. (Note that watercress is listed as potentially invasive and should not be planted in the field.) Garden cress (*Lepidium sativum*) is also a good indicator plant for compost maturity. Red clover (*Trifolium pratense*) is the best indicator of herbicide contamination.

Organic matter that is composted improperly may go anaerobic (become putrefied). The most common indication of anaerobic decomposition are offensive odors from the production of ethanol, ammonia, or hydrogen sulfides. Check with your compost supplier for evidence of proper quality control to avoid this problem. *Note:* Under specific conditions, anaerobic compost may be used to create proper growing media for wetland plants.

Caution: Herbicide Contamination of Compost

In the past, organic farmers and land care professionals have not had to be too concerned about herbicide residues in compost because most herbicides break down rapidly in the composting process. However, clopyralid and picloram, which break down very slowly in composting, have been found to contaminate compost to the point where sensitive plants are damaged. As a result of these problems, the primary clopyralid product, Confront, is no longer registered for use on residential lawns. However, it is still labeled for use on commercial lawns and golf courses. Herbicides containing

clopyralid and the similar compound picloram also continue to be used agriculturally and may be applied to cereals, hay fields, and pastures. They pass quickly through grazing animals, so compost made from feed stocks, including animal bedding and waste, may also be contaminated. Be aware of these hazards, discuss them with your compost suppliers, and ask them if they have conducted bioassays on any potentially contaminated materials. See articles: *www.mindfully.org/ Pesticide/Clopyralid-Composting-Dow.htm* and *www.puyallup.wsu.edu/ soilmgmt/Clopyralid.htm* For more information, see the magazine *BioCycle*. Review articles are posted on their website at: *www.jgpress.com/BCArticles/ 2001/070132.html*

Analytical techniques associated with herbicide and pesticide residues continue to evolve, as does our understanding of their degradation pathways. Once in the environment, herbicides are chemically and/or biologically transformed into new chemical entities that no longer kill weeds. However, these breakdown products should not automatically be considered biologically benign. 2,4-dichloro-phenoxyacetic acid (2,4-D) cleaves to produce 2,4-dichlorophenol as its initial degradation product; this halogenated aromatic compound is significantly more toxic than the parent herbicide. When in doubt about including potentially contaminated raw materials into a mix for composting, consider not only the actual herbicide, but also its known or potential degradation products as well.

Preferred

- Composting yard waste properly on site and using the compost in beds or gardens. Locate compost piles away from rivers, streams, and other bodies of water to prevent the runoff of nutrients seeping from the piles.
- Using compost made locally from local materials to reduce transport of bulk materials
- Using compost that is well decomposed
- Monitoring phosphorus levels with soil tests to prevent the build up of excess phosphorus due to repeated compost applications over time (see Phosphorus, page 27, for information on phosphorus pollution)
- Incorporating compost into the soil prior to planting, where soil amendment is needed. Compost may be applied to the soil surface as a 1–2 inch layer (approximately 3–6 cubic yards per 1,000 square feet), then incorporated to a depth of 4–6 inches. A 2-inch layer is appropriate for very sandy soils or soils that are low in organic matter. For more fertile soils, use less. Make sure compost is thoroughly mixed with the soil.
- Top dressing/surface application, as follows:
  - On turf: ¼ inch or less, no more than two times per year, for no more than three years, unless a soil test shows organic matter remains below 4% and phosphorus is below "medium"
  - Around perennials: 2 inches or less
  - Around shrubs and shade trees: 3 inches or less
- Radial trenching or vertical mulching to alleviate compaction around woody plants. Mix equal parts of compost and excavated soil to backfill the trench.

Allowed

- Any compost that appears to be adequately decomposed; does not contain sewage sludge, industrial toxic wastes, large stones, trash, or other prohibited materials; and is made from at least two different raw materials
- Sheet composting (surface application of organic material to compost in place) to establish gardens and beds. Note restrictions under Prohibited, below, on sheet composting of manure where human food crops will be grown.

- Anaerobic compost for growing wetland plants or restoring wetland soils

Prohibited

- Sewage sludge (biosolids), municipal solid waste, and paper mill by-products as raw materials of compost. Current EPA standards are not adequate to protect the public from contamination of biosolids from toxic elements, industrial toxins, pharmaceuticals, and radioactive materials.
- Compost containing excessive amounts of plastic, undesirable objects, or offensive odors
- Compost containing large amounts of viable weed seed
- Planting human food crops within 120 days of harvest in sheet composting systems that use animal manure. For other restrictions on the use of animal manure, see Manure, page 25.
- Using more than the amounts specified under Preferred, above
- Over-application of compost. Repeated applications over time may exceed the limits on nitrogen and phosphorus in the soil.
- Anaerobic compost as a soil amendment

Compost Tea

Compost tea is attracting increasing attention as an inoculant to enhance or restore soil and leaf surface microflora. There is some research to show that compost tea has a role in deterring disease, although the results are highly variable. Recent research conducted by Dr. Clive Edwards of Ohio State University has shown strong and consistent effects of worm compost and tea made from worm compost on plant resistance to insects, mites, and plant pathogens in laboratory studies. Under current laws, however, it cannot be claimed that compost tea suppresses or controls diseases or pests because it is not registered as a pesticide by the U.S. Environmental Protection Agency.

Although compost tea is sometimes made by simply fermenting compost in water, it is now more commonly made in a brewer or extractor, which creates aerobic conditions to yield great quantities of bacteria, yeasts, and fungi in ratios designed for very specific purposes and soil conditions. A range of organic adjuvants, including worm castings, kelp, and/or fish hydrolysate may be added as food sources, and yucca extract, saponin, rock dust, humic acid, and fulvic acid, alone or in combination, may be added to create teas for specific uses. Compost teas may be made through aerobic or anaerobic processes, using different methods designed to produce various results. References to reviews of both aerated and non-aerated compost teas and their effects on plant disease are provided in the Bibliography, page 63.

According to Soil Foodweb, Inc., perennials, annuals, and turf require a compost tea made from compost in which fungi and bacteria are balanced, or that is slightly higher in bacteria. Compost of this sort can be created by starting with a mixture of 25% animal manure or worm castings (see Manure, page 25, for composting requirements), 50% green material (household waste, leaves, and grass clippings), and 25% woody materials (wood chips, bark, sawdust, and mushroom substrates). For shade trees and shrubs, Soil Foodweb, Inc. recommends a compost tea made from compost that is high in fungi. A fungi-dominated compost can be created with an initial mixture of 50% green material, 45% woody materials resistant to rapid decay, and 5% manure or worm castings.

Caution: There are a lot of variables involved in creating high-quality compost tea. It is therefore important to understand the process thoroughly before attempting to make or use compost tea. There have been reports of *Escherichia coli* and other potential human pathogens multiplying in compost tea, particularly when molasses is used as a food source. It is very important to prevent any

possible contamination of compost tea with human pathogens.

Preferred

- Constituent materials preferred by these Standards
- Using aerated compost tea within 6 hours of brewing. Extracted tea can be used for a longer period.
- Using compost tea that contains less than 120 colony-forming units of *Escherichia coli* per 100 milliliters
- Brewing compost tea in which the biology has been adjusted for a specific use
- Applying compost tea as a soil drench, root dip, or foliar application to improve the health and vigor of lawns and landscape plants

Allowed

- General purpose compost tea, in which the biology has not been adjusted for a specific use

Prohibited

- Compost tea made with materials prohibited by these Standards
- Compost tea with more than 120 colony-forming units of *Escherichia coli* per 100 milliliters

Manure

Manure is animal excrement that is used as a plant nutrient and soil amendment. A manure pile that has not been composted aerobically is considered raw manure. Raw manure is rarely used in land care because it is difficult to handle and apply, is highly odiferous, and often contains large numbers of weed seeds. It may also contain human pathogens, pesticides, antibiotics, and growth hormones. Composting raw manure aerobically and at high temperature eliminates these problems.

Preferred

- Composting manure aerobically until it has the characteristics of finished, well-decomposed compost, as defined under Compost (page 22)

Allowed

- Using an in-vessel or aerated static pile composting system, as specified in the standards issued under the National Organic Program (see: *www.ams.usda.gov/nop*)
- Using raw manure, dehydrated manure, or manure slurry, if incorporated into the soil and applied more than 120 days before harvest of any crop for human consumption

Prohibited

- Applying raw manure in fall or winter without an actively growing groundcover
- Raw manure applied on snow or frozen ground
- Raw manure applied on sandy, fast-draining soils in the absence of a groundcover
- Raw manure applied where human contact is probable, even if it is incorporated into the soil
- Over-application of manure. The amount allowed per year is determined by limits on nitrogen and phosphorus in the soil.

Nitrogen

Nitrogen is an essential plant nutrient because it is required to create amino acids and proteins, genetic material, chlorophyll, and other important biochemical molecules. Nitrogen is the most

abundant gas in the atmosphere (78%), but the gaseous form (N_2) is inert and unavailable for use by animals and most plants. Turning N_2 into available nitrogen, or "fixing" it, requires breaking the bond between the nitrogen atoms, which requires energy. Under natural conditions nitrogen is fixed by lightning strikes through the atmosphere and by the work of a few species of symbiotic bacteria and some free-living bacteria and fungi in the soil or water. The amount of new, naturally "fixed" nitrogen being produced at any time is quite small compared to the amount already fixed and cycling through an ecosystem.

Human activities have almost doubled the amount of fixed nitrogen entering the global cycle through the industrial production of fertilizer, selective cultivation of nitrogen-fixing plants, and the burning of fossil fuels. (See "Human Alteration of the Global Nitrogen Cycle: Causes and Consequences" at *www.epa.gov/owow/watershed/wacademy/acad2000/nitroabstr.html)* These activities have affected natural systems by increasing greenhouse gases in the atmosphere, depleting the ozone layer, increasing acid rain, creating smog, and changing ecosystem balances by favoring nitrogen-tolerant plants over other species while creating deficiencies in other nutrients (calcium, potassium, and magnesium). Nitrates in drinking water have also been linked to human health problems.

Plant and animal nitrogen sources also contain phosphorus; therefore, their use should be limited by the requirements for phosphorus as determined by a soil test.

The NOFA Organic Land Care Program has decided to prohibit the use of sodium nitrate (also known as Chilean nitrate). This decision is at odds with the standards issued under the National Organic Program in the United States. However, other standards for organic agriculture around the world, including those in the European Union and Canada, prohibit the use of sodium nitrate. The administrator of the U.S. National Organic Program recently requested that the National Organic Standards Board re-evaluate the use of sodium nitrate in organic agriculture in the United States. See the memorandum here: *www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5086746&acct=nopgeninfo*

Preferred

- Compost
- Cover crops and green manures
- Lawn clippings
- Compost teas
- Minimizing the need for nitrogen in lawns by leaving grass clippings, planting low-maintenance varieties, and including legumes in the lawn mix
- Alfalfa meal
- Feather meal and other low-phosphorus organic materials

Allowed

- Blood meal. *Caution:* Blood meal may contain pathogens. Take precautions to avoid direct human contact.
- Vegetable meal
- Fish hydrolysate, emulsion, and meal. *Caution:* May contain mercury, PCBs, or other contaminants. Be aware when choosing to use fish products that massive over-fishing is causing severe ecological damage in oceans.
- No more than 1 pound of soluble nitrogen per 1,000 square feet per application, with a maximum of 3 pounds of soluble nitrogen per 1,000 square feet per year. Rates of nitrogen application must be further reduced after 2 years of organic management. *Note:* In sandy soils with high leaching rates, particularly those along or near the ocean, the allowable amounts of water-soluble nitrogen should be decreased to reduce the potential for contamination of down-slope water bodies.

Prohibited

- Applying more nitrogen than is needed based on soil testing
- Natural sodium nitrate, also known as Chilean nitrate. This is a place where these Standards differ from those of the National Organic Program. *Note:* Fertilizer approved under the National Organic Program by the Organic Materials Review Institute (OMRI) may contain Chilean nitrate. Fertilizer approved by Baystate Organic for organic landscaping will not contain Chilean nitrate.
- Application of nitrogen fertilizer to lawns when grass is not growing actively enough to use it rapidly, generally between October 15 and April 1 in Connecticut and Massachusetts
- Allowing fertilizers to remain on sidewalks or pavement (typically after being applied by a rotary spreader). Fertilizers left on pavement wash into storm sewers and then into waterways. Any spillage must be swept up or vacuumed and reused.
- Leather meal or its by-products
- Sewage sludge
- Synthetically derived nitrates, urea, ammonia (e.g., ammonium sulfate)

Phosphorus

Phosphorus, in the form of phosphate, is an essential nutrient for every living organism. It enters soils in natural systems by rock weathering. Leaching and runoff remove it from soils and carry it through aquatic systems to lakes and oceans, where it settles into deep water sediments. These large "sinks" of phosphorus can only be returned to the phosphorus cycle by upwelling of deep waters or geological uplift of marine sedimentary rocks.

Because of the length of time involved in cycling phosphorus out of "sinks," phosphorus is, for all practical purposes, a nonrenewable resource. Humans get phosphorus from very limited sources around the world by mining phosphorus rock and guano (excrement of bats, birds, and seals). Most of this phosphorus is turned into fertilizers and applied to soils, and a great deal of it then leaches into aquatic ecosystems. In ponds and lakes, excess phosphorus can substantially increase plant productivity and lead to eutrophic conditions, causing increased phytoplankton and bacteria growth, loss of dissolved oxygen, and loss of animal life, especially in lakes.

Recent studies have indicated that global supplies of phosphorus are running low, and remaining supplies are high in the toxic element cadmium. Current estimates are that world production of phosphorus will peak around the year 2030, and that phosphorus will become increasingly expensive and difficult to obtain after the peak. There is no substitute for phosphorus in modern agriculture, and even organic agriculture uses rock phosphate, greensand, and other mined phosphorus fertilizers. It is essential to avoid wasting phosphorus by over-applying it to soil, and it is important to retain phosphorus by composting plant and animal materials and using the compost on site. Efficient use and cycling will also reduce eutrophication of lakes from excess phosphorus.

If a standard soil test gives a rating of medium or above for phosphorus, then no additional phosphorus should be applied. If other nutrients are needed, use organic fertilizers or composts that are low in phosphorus.

Preferred

- Compost
- Cover crops and green manures
- Properly composted animal manure
- Alfalfa meal

Allowed

- Rock phosphates

- Steamed or precipitated bone meal. *Caution:* Bone meal may contain pathogens. Take precautions to avoid direct human contact.
- Greensand

Prohibited

- Applying more phosphorus than is needed based on soil testing
- Mono-ammonium and di-ammonium phosphate
- Single and triple superphosphate
- Other synthetically derived phosphates

Potassium

Preferred

- Composts and compost teas
- Alfalfa meal

Allowed

- Greensand
- Seaweed
- Sulfate of potash (potassium sulfate)
- Sulfate of potash, magnesium (such as Sul-Po-Mag®)
- Rock or quarry dust
- Clean wood ashes

Prohibited

- Applying more potassium than is needed based on soil testing
- Muriate of potash (potassium chloride)
- Synthetically derived potassium
- Applying wood ashes from the combustion of painted or treated wood, wood composites, coal, household trash, or glossy (colored) paper

Calcium

Allowed

- Aragonite
- Calcitic limestone (calcium carbonate)
- Agricultural gypsum (calcium sulfate)
- Kelp meal
- Dolomitic limestone

Prohibited

- Burned or quick lime (calcium oxide)
- Hydrated or slaked lime
- Synthetically derived calcium

Sulfur

Allowed

- Sulfur (elemental)
- Epsom salt (magnesium sulfate)
- Agricultural gypsum (calcium sulfate)
- Sulfate of potash (potassium sulfate)
- Sulfate of potash, magnesium (such as Sul-Po-Mag®)

Prohibited

- Synthetically derived sulfates
- Ironite® (contains high levels of lead and arsenic)

Magnesium

Allowed

- Dolomitic limestone
- Epsom salt (magnesium sulfate)
- Greensand
- Sulfate of potash, magnesium (such as Sul-Po-Mag®)

Prohibited

- Burned or quick lime (magnesium oxide)
- Synthetically derived magnesium

Micronutrient Sources

Preferred

- Manage soils to release micronutrients already present (e.g., manganese, zinc, boron, copper, iron, molybdenum, chlorine)
- Compost

Allowed

- Rock powders such as Azomite®
- Kelp
- Fish hydrolysate, emulsion, or meal. *Caution:* May contain mercury, PCBs, or other contaminants. Be aware when choosing to use fish products that massive over-fishing is causing severe ecological damage in oceans.

Prohibited

- Synthetically derived micronutrients
- Copper sulfate
- Iron chloride
- Chelated iron
- Ironite® (contains high levels of lead and arsenic)

Blended Fertilizers

Allowed

- Products containing only preferred and/or allowed mineral nutrients applied according to these Standards

Prohibited

- Products containing any prohibited materials, including "transitional" or "bridge" products

Materials Used to Adjust pH

Preferred

- Compost
- Compost tea
- Leaf mold

  Note: These organic materials will have a moderating effect on soil pH, but only over time and multiple applications. Inorganic materials such as limestone and wood ashes will elevate soil pH much more rapidly.

Allowed

- Aragonite
- Calcitic limestone (calcium carbonate)
- Dolomitic limestone
- Wood ash
- Granulated sulfur (decreases pH)

Prohibited

- Aluminum sulfate
- Synthetically derived products
- Iron Sulfate
- Ironite® (contains high levels of lead and arsenic)

Soil Conditioners

Preferred

- Composts and compost teas
- Cover crops and green manures
- Leaf mold
- Grass clippings

Allowed

- Biochar made from plant residues. *Note:* There are many different materials and techniques used to make biochar, and thus characteristics and behavior of biochar vary widely.
- Humates and fulvic acids
- Greensand
- Gypsum
- Mulches
- Organic rock powders
- Sugar sources (molasses, glucose, sucrose)
- Peat moss. *Note:* Although peat moss is widely used as a soil conditioner, we do not recommend it because the harvesting of peat moss destroys increasingly rare bog habitats.

Prohibited

- Synthetically derived products
- Anything containing sludge or biosolids

Microorganisms and Inoculants

Allowed

- Non-GMO (genetically modified organism) microbial inoculants
- Biodynamic preparations
- Compost teas
- Soil biostimulants. *Caution:* Beware of false claims and synthetic ingredients.

Prohibited

- GMO (genetically modified organism) microbial inoculants

Potting Mixes

Preferred

- Compost- or soil-based potting mixes free of prohibited substances

Allowed

- Compost-free mixes that do not contain prohibited substances
- Yucca extracts used as wetting agents
- Addition of beneficial fungi and/or bacteria to the mix
- Peat moss. *Note:* Although peat moss is widely used in potting mixes, we do not recommend it because the harvesting of peat moss destroys increasingly rare bog habitats.

Prohibited

- Synthetically derived products
- Synthetic rooting or wetting agents

Lawns and Lawn Alternatives

Lawn is an area of land covered with closely cropped plants, usually grasses. Most lawn grasses used today in the Northeast are sun-loving, sod-forming, cool-season species of European descent. Their genetic predisposition is to grow tall, produce flowers and seed, and become dormant during the heat and relative dryness of summer. Typical lawn maintenance—namely, continuous mowing close to the ground, which prevents grass plants from flowering and producing seed, and forcing the plants to stay green and growing throughout the warm season by fertilizing and watering them—is contrary to their natural habits. Pushed in this way beyond their genetic limits, grass plants are under constant stress, requiring yet more inputs to keep them healthy.

The energy and resources required to maintain a weed-free, summer-green, grass carpet cause a great deal of collateral environmental damage. The manufacture and use of machinery for installing and maintaining lawns requires huge amounts of energy and creates air, water, soil, and noise pollution. The manufacture, transportation, and application of pesticides and fertilizers demands yet more energy and releases pollutants into the environment at every stage. Because water travels easily over shorn grasses, lawns increase surface-water runoff and subsequent soil erosion. Limiting broad stretches of the cultivated landscape to a handful of grass species and varieties reduces biodiversity. As this partial list makes clear, the ecological sustainability of our national obsession with high-maintenance lawns must be questioned, and their use curtailed.

There are many low-maintenance lawn alternatives. In sunny areas, low-growing native grasses and grass-like species that are drought-tolerant, nutrient efficient, and disease resistant can be used. Incorporating certain leguminous (nitrogen-fixing) broadleaf plants such as clovers and trefoil with these native grasses adds diversity and durability and provides a supply of natural nitrogen to the lawn. For sunny areas that will not be mowed frequently, mixtures of native grasses and/or wildflowers can be planted as a meadow garden. The "no mow" grass mixes, composed of grasses that are naturally compact and require infrequent, if not zero, mowing, are another alternative. In areas of moist or dry shade there are native, low-maintenance grasses and other plants that will thrive where other grasses fail. In areas too shady for any grass to grow, shade-tolerant, low-maintenance perennials, shrubs, and trees can add beauty and increase the biodiversity of the landscape. Special attention should be given to plants that are native to the region to increase local biodiversity. In marginal areas of the landscape, just allowing the lawn that already exists (free of invasive species) to grow "wild" will provide an economical, ecological, and sustainable alternative to the high-maintenance lawn, and provide food and cover for wildlife.

Principles

- Lawns are good for recreation, athletics, pathways (provided foot traffic is light), and as separations between different land uses. Lawn areas can be visually appealing, but they can also be a high-maintenance component of an organic landscape. Limiting the size of lawns to what is absolutely necessary reduces maintenance costs and is better for the environment.

- Where lawns are necessary or desired, the ecological footprint should be kept as small as possible by choosing grass varieties and cultural methods that reduce the need for irrigation, fertilizer, pesticides (including organic pesticides), and energy-consuming machinery to a minimum. The demands of some specialized situations (high-profile lawns and athletic fields) can be met organically, but may require the use of more inputs and more time than are

required in most residential and commercial landscapes.

New Lawn Installation

Proper installation of a new lawn is essential for its long-term beauty and health, and reduces the need for excessive inputs. Soil testing is the first step (see Soil Testing, page 17). Installation of a new lawn is best undertaken in late summer or early fall, and can be accomplished in several ways. One of the key elements of a successful new lawn is properly prepared soil. Choose a soil type that is close to neutral pH and has a balanced fungal to bacterial ratio. After a proper seedbed is prepared (see Planting Bed Preparation, page 42), soil amendments, as specified by the soil test results, are incorporated into the seedbed. Then an appropriate mix of seeds can be sown by hand, or using a spreader or seed driller, or in conjunction with a fiber mulch that is pressurized and sprayed onto the soil (hydroseeding). Care should be taken to identify all ingredients in a hydroseeding mixture to ensure they are approved for organic use.

Be careful to choose a seed mixture that is adapted to, and tolerant of, the particular growing conditions of the site. There are many insect- and/or disease-resistant, sun- or shade-tolerant species and cultivars to choose from. Endophytically enhanced grass seed protects the grass from surface-feeding insects but should not be used where the grass may be used as food or feed for ruminant animals, as it will sicken them. Always use several different species and cultivars in the mix to enhance diversity and increase the chances of success.

Ensure good seed-to-soil contact by lightly rolling or dragging the seed into the soil. Use a mulch that is as weed-free as possible, such as sterilized straw, to enhance germination and control erosion. The seedbed should be watered frequently but shallowly. The ideal situation is to maintain a "uniformly moist" seedbed during germination and establishment. Watering should increase in duration but decrease in frequency once the root system has become established. After several mowings and in the absence of hot, dry weather, watering should gradually be decreased. Watering should be eliminated when not necessary.

Sodding is a form of lawn establishment that provides instant coverage and looks impressive right away. Unfortunately, most sod is composed of high-maintenance grass species that have been given large amounts of synthetic inputs and water to meet the demand for cheap sod. At least one New England sod grower uses sewage sludge as a growing medium and soil amendment. Sod can be so dependent on synthetic chemicals and devoid of organic matter that it may not have the ability to assimilate organic forms of nutrients. The use of humates, compost, compost teas, fish hydrolysates, carbohydrates, microbial inoculants, biostimulants, root stimulants, and/or soil flocculants is sometimes necessary to detoxify the sod, reestablish the biology in the root zone, and break down the thick thatch layer that is sometimes present. As a result, a sodded lawn often costs several times more and requires greater inputs than a lawn properly installed and maintained from seed.

Lawn Renovation

Lawn renovation is the process of rejuvenating a partially damaged lawn. It is also useful for filling in bare spots. Lawns may require rejuvenation to repair insect, disease, or drought damage; recover from soil compaction; or improve vigor and appearance. By adding different varieties of grass, we can improve wear tolerance, decrease disease susceptibility, and increase a lawn's adaptability to its site. All these changes can alter the dominant cultural regime from high maintenance to low maintenance.

The soil should be tested beforehand (see Soil Testing, page 17) to determine the types and quantity of nutrients that are needed (if any) and the soil pH. If thatch is more than ½ inch thick, the lawn can be de-thatched mechanically. If time allows and thatch is not excessive, the lawn can be de-thatched naturally by increasing the number of

microorganisms that break down thatch and boosting their vigor by adding carbohydrates such as sugar, molasses, or dextrose via compost and compost tea. Proper pH (in the range of 6.5 to 6.8) is very important to the development of a healthy lawn and to the vitality of these microbes.

If thatch is over 1 inch thick, mechanical removal with a vertical slicing machine (also known as a vertical mower, not a power rake) is necessary. Where thatch is light to moderate, the use of a core-aerating machine may be sufficient. Excessively thick or tough thatch can be reduced by using a core aeration machine in conjunction with a vertical slicing machine. Thatch should be reduced to 1/8 inch–1/4 inch before amending the soil or overseeding. The duff material that comes to the surface during de-thatching should be removed and composted, as long as no persistent herbicides have been applied. If persistent herbicides have been applied in the past, compost the duff separately and return it to the lawn. See Herbicide Contamination of Compost, page 22.

Pernicious weeds should be eradicated by hand pulling, smothering, stripping, or the use of organic herbicides (see Lawn Maintenance, below). Bare soil should be lightly cultivated or filled with a compost/topsoil mix prior to seeding. To seed bare spots after corn gluten has been applied, mix grass seed with a 50/50 mix of compost and topsoil and apply at a minimum thickness of 2 inches, then mulch and water.

Renovation is often the first step in converting a conventionally maintained lawn to organic management. It may be three years before a functioning organic turf ecosystem is fully established. Until the process of building up soil organic matter and soil biology and encouraging the grass plants to develop healthy root systems has been completed, lawn or turf may be susceptible to more weed infestation and insect damage than the client is used to. The land care professional needs to prepare the client for the challenges of the transition period and counsel patience if he or she starts to have second thoughts.

Lawn Maintenance

The ongoing sustainability of a properly installed lawn is dependent upon proper maintenance. For high-maintenance lawns, fertility levels and soil pH should be maintained by the judicious use of soil amendments and fertilizers, as determined by soil testing. The quantity of inputs can be decreased, and the number of nitrogen-fixing bacteria in the soil increased, by returning grass clippings to the lawn, mulching shredded leaves into the lawn in the fall, using nitrogen-fixing plants in the lawn mix, and applying compost that is high in bacteria. (See Compost Tea, page 24, for the recipe for making bacterial compost.)

Mow using a well-maintained mower with a sharp blade. No more than one-third of the grass blade should be removed at one time, and the grass should be allowed to grow to a height of 3 inches or taller. The taller the grass is allowed to grow, the larger and deeper the root systems can grow and the more effective the turf will be in crowding out competition from weeds. The grass clippings should, if at all possible, be left in place. As they decay, they release nutrients back to the soil; over the course of a growing season, the nitrogen contained in the clippings equals one fertilizer application. When there is a history of using persistent herbicides on a lawn, the grass clippings must remain in place or be composted separately and returned to the lawn. The residues of such herbicides do not break down readily in composting and are a hazard to many broad-leaved plants. (See Herbicide Contamination of Compost, page 22, for more information.)

When needed, nutrients can be added to a lawn in several ways: by applying organic matter (typically in the form of compost); by returning grass clippings and shredded autumn leaves to the soil; by using a blended organic fertilizer; by including plants in the lawn that fix nitrogen; or by applying individual nutrients. When applying compost, spread it evenly in a thin layer approximately ¼ inch thick. Compost can be added to a lawn in both spring and early fall.

On healthy, established turf, systematic watering is generally not needed and is not recommended. Water is a precious resource requiring large amounts of energy and infrastructure to deliver, and must be conserved. Lawns watered regardless of need eventually become dependent on it. If watering an established lawn becomes necessary, it should be watered deeply (to a depth of 6 inches or more) and infrequently. The soil needs to dry out partially between waterings to allow gas exchange between the soil and the atmosphere. Too much water will fill the pore spaces in the soil, suffocating roots and soil life and increasing the likelihood of disease. Watering should be timed and the saturation depth checked to determine how long to water a particular area. Do not water to the point of runoff (see Water Use and Water Quality, page 10).

Proper management of insects and diseases begins with a five-step process that does not include the use of pesticides:

1. Identify the pest
2. Learn about the pest's biology
3. Determine tolerance levels
4. Modify habitat to deter pests
5. Monitor pests

Only if the pest remains above tolerance levels after these five steps have been followed is the application of pesticides to be considered: Pesticides—even organic ones—can kill beneficial life forms. It is very important to accurately identify the pest and know its life cycle and how it damages the grass plant. A healthy soil harbors copious amounts of active microorganisms and humus, which remedy imbalances that can prevent a pest outbreak. Many times a pest is not present in numbers high enough to warrant control. Other times a natural control (a predator, antagonist, etc.) may be present, preventing serious damage without requiring intervention from the land care professional. Do not initiate a pest control measure unless damage exceeds economic and/or esthetic thresholds. Consult cooperative extension publications for thresholds. As a long-term response, cultural methods such as planting resistant cultivars or endophytically enhanced varieties, or improving air circulation should be implemented. If immediate control becomes necessary, use only organically approved pesticides. Before applying a pesticide, read and understand the label instructions and warnings and follow all applicable laws (see Pest and Disease Management, page 51).

Weeds are tolerated in an organic lawn to varying degrees (determined by the client). Many so-called weeds are actually beneficial to the lawn ecosystem. It wasn't until the advent of selective herbicides that a lawn consisted only of grasses. Before then, a lawn consisted of any and all plants that lived under the mower blade. In most cases it is time to return to that mindset. If weed control is deemed necessary, there are several products on the market approved for organic use. For pre-emergent weed control, corn gluten meal is the material of choice. It is applied in the spring, before weeds emerge, usually between forsythia and lilac bloom. Corn gluten meal is high in protein and thus contains approximately 10% organic nitrogen. This nitrogen needs to be figured into the total allowable amount of nitrogen applied per year (see Nitrogen, page 25). Weeds that already exist in a lawn can be controlled organically through the use of non-selective herbicides made from ethanoic and acetic acids or potassium salts of fatty acids. When using a non-selective herbicide, spot spray weeds, being careful to avoid any unnecessary overspray or drift onto desirable lawn or plants; the overspray will kill or deface any living green tissue on contact. Care should also be taken not to get any spray on the body. As with any pesticide, read and understand the label before use and follow all applicable laws.

Preferred

- Reducing the size of lawn areas to what is absolutely necessary
- Lawn seed mixtures consisting of low-maintenance grasses, broadleaf plants, and/or legume varieties appropriate for the site

- Lawn alternatives, such as "no-mow" lawns, native grasses and wildflowers, native or low-maintenance perennials, herbs, shrubs, and trees
- Allowing lawn to grow unmowed
- Covering high-traffic recreation and pedestrian areas with mulch, sand, etc., instead of turfgrass. *Note:* Recycled rubber tire mulch is prohibited in these Standards, and for playgrounds, there are Child Safety standards and Americans with Disabilities Act standards to consult.
- Disease- and/or insect-resistant grass cultivars
- Mowing to maintain a height of 3 inches or more
- Irrigation by natural rainfall only
- Seeding or overseeding in fall to minimize the amount of water needed for germination and the establishment of young grass plants
- Leaving grass clippings on the lawn
- Returning shredded leaves to the lawn in the fall
- Having soil tested to determine nutritional needs prior to the application of amendments or fertilizers
- Thatch removal using thatch-reducing soil amendments

Allowed

- Mowing at less than 3 inches in height, but not less than 2 inches, except for sports turf
- Irrigation to establish grass (see Water Use and Water Quality, page 10)
- Removing grass clippings and/or leaves, if composted and used on site. If persistent herbicides have been used in the past, compost clippings separately and use resulting compost on the lawn only.
- Blended organic fertilizers, as recommended by soil testing
- Soil conditioners and biostimulants
- Application of minor amounts of organic rock powders that do not contain nitrogen, phosphorus, or potassium, without first testing the soil
- Conventionally grown sod, in conjunction with a detoxifying program
- Mechanical thatch removal when thatch is more than ½ inch thick
- Maintenance of existing lawns, with little or no inputs, in wetlands or riparian areas
- Cultivars bred to remain green under low nitrogen use
- Core aeration when adding soil amendments
- Corn gluten meal. One application per year of 20 pounds per 1,000 square feet. *Note:* This application provides 2 lbs. of nitrogen per 1000 square feet, whereas these Standards allow just 1 lb. of nitrogen per 1000 square feet per application. Extra precautions against run-off are required and additional nitrogen fertilization must be reduced accordingly. See Nitrogen, page 25, for annual nitrogen limits.
- Herbicides allowed under the National Organic Program

Prohibited

- Planting lawn within a wetland or riparian border
- Genetically modified organisms (e.g., Roundup-Ready® grass seed)
- Monoculture stands of a single species of turfgrass

- Cultivars of turfgrass that are known to be disease- and/or insect-prone
- Species and cultivars of turfgrass with high nutrient and watering requirements
- Synthetic pesticides, synthetic fertilizers, and synthetic soil conditioners
- Biosolids (also known as sewage sludge)
- Endophytically enhanced grasses where the grass may be grazed by livestock or wildlife
- Mowing less than 2 inches in height, except for sports turf
- Excessive irrigation, resulting in runoff, compaction, and/or disease
- Installation or use of improperly adjusted irrigation systems (see Water Use and Water Quality, page 10)
- Application of nitrogen, phosphorus, or potassium without soil testing
- Bringing grass clippings from lawns to which persistent herbicides have been applied to composting facilities (see Herbicide Contamination of Compost, page 22)

Native, Exotic, and Invasive Plants

Native plants evolved in harmony with their environment over the course of millennia. During this evolution, they adapted to their habitat in relation to other species of plants and to insects, animals, and other organisms to create an intricate web of life. The web has rewoven itself repeatedly over thousands of years in response to disturbance, such as glaciation, and to management by Native Americans.

The colonization of North America has had a profound impact on this web of life. The burgeoning human population and associated development have altered the landscape and reduced natural areas to a handful of fragmented parcels. Meanwhile, humans have introduced, either intentionally or inadvertently, a large variety of exotic plants, some of which have spread rapidly and become pests in natural or minimally managed habitats such as woodlands, grasslands, and sea shores.

Not all non-native plants are invasive. In fact, most are not. Many ornamental plants and the majority of our fruits and vegetables are not native to the United States and are not invasive. The qualities that cause certain plants to be called invasive are defined in different ways. Here are the criteria used by the Connecticut Invasive Plant Working Group:

- The ability to establish new plants and grow rapidly under a wide variety of site conditions
- A high reproductive rate
- The ability to disperse over wide distances, often by the spreading of vegetative fragments as well as seeds
- The lack of the natural controls on growth and reproduction that would be found where the invader is native.

The Massachusetts Invasive Plant Advisory Group defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems." Invasive plants may also create significant changes in the composition, structure, and ecology of the natural environment, including changes in soil chemistry, biology, and structure.

In addition to their ability to compete for sunlight, water, and nutrients, invasive plants may have few or no natural enemies to keep their populations in balance with the rest of the local ecosystem. With no check on their growth or spread, invasive plants are able to form monocultures where no other plant grows, disrupting the food chain upon which insects, birds, and other animals depend.

Invasive plants also have a severe economic impact. According to researchers at Cornell University, invasive plants in the United States cause environmental damage amounting to as much as $120 billion per year.

Regional, state, and federal governments or agencies are now in the process of developing "banned" and "watch" lists. In some states, banned plants may be illegal to move, sell, purchase, transplant, cultivate, or distribute. We have provided current lists of banned plants for Connecticut and Massachusetts in Appendix IV, page 72; lists for other states can be found online. In states that do not have legislation to ban invasive plants, many invasive species are still commonly available from wholesale and retail nurseries, and invasive species are still being sold via the Internet. Land care professionals need to become familiar with the lists of invasive and potentially invasive plants in their state and be sure that they are not purchasing these plants or installing them in the landscapes that they manage.

Approximately 85 percent of the invasive woody plant species in the United States were introduced for landscape or ornamental use. Studies have shown that it can take up to 20 years from first introduction for a plant to become invasive and begin to cause problems in the natural landscape. Therefore, the precautionary principle should be applied when deciding which plants to use in an organic landscape: A plant whose invasive potential is unknown should not be planted.

The importation of exotic plants poses additional risks. Exotic species of insects, fungi, and other organisms can come along for the ride unnoticed, then attack native plants. Because native plants did not evolve with these pests and pathogens, they often have no defense against them. There are numerous examples of the devastation these stowaways can wreak, including chestnut blight, Dutch elm disease, and hemlock woolly adelgid. It is illegal to import plants into the United States without a permit from the U.S. Department of Agriculture. Land care professionals should also use caution when purchasing plants from other parts of the United States.

What is Native?

There is a great deal of debate surrounding the definition of "native." Generally, a plant is considered to be native if it was growing in the area prior to the arrival of Europeans. Beyond that, land care professionals may have to make their own decisions about where they are willing to draw their "native" circle. If the property is located in the western part of Massachusetts, for example, you might consider a plant native if it naturally grows in the Berkshire region, in New England, or anywhere in the Eastern United States. For guidance on this subject, we suggest you seek out an expert. The Northeast, and many other parts of the United States, have native plant organizations that can help landscapers figure out what is native to their local region. The New England Wildflower Society (*www.newfs.org*) is a good place to start, and their website has a listing of native plant societies in the United States and Canada.

The Cultivar Debate

There is currently a debate among scientists as to whether all cultivars of certain invasive species are themselves invasive. A general definition of "cultivar" is a variety of plant not normally found in wild populations that has been selected for some feature that distinguishes it from the species and that is propagated by horticultural techniques.

Long-term studies are being conducted to determine whether there are any cultivars of invasive species, such as Burning Bush (*Euonymus alata*) and Japanese Barberry (*Berberis thunbergii*), that are barren (unable to produce viable seeds). Research thus far has shown that even cultivars that are currently being marketed as sterile do indeed produce viable seeds. It has yet to be seen whether a truly sterile cultivar can be developed. For this reason, we have decided to prohibit cultivars of invasive species from organic land care.

Principles

- Native plants have special value in the landscape because they help to maintain or restore the original web of life that evolved in a particular place—the animals, microbes, and associated plants that belong to the soils and climate of that site.

- As human beings have traveled the Earth, they have transported many species of plants and other organisms with them, either deliberately or inadvertently. We may choose to use these exotics in our landscapes, but we need to be aware that there is a risk that they may escape from cultivation and crowd out native species or do other harm to the native web of life in ways we cannot foresee.

- Invasive organisms are exotic plants, animals, and microbes that have been shown to spread to natural areas and disrupt the local web of life. We should avoid spreading invasive organisms as part of the general principle, "do no harm."

Appropriate Plant Choices

Preferred

- Native species, ideally specimens that were organically propagated by a local nursery from plants that were originally found within the local bioregion
- Cultivars of species native to the local bioregion
- Plants that perform multiple functions (food for humans or for wildlife, shade to reduce the need for cooling buildings, wind breaks, etc.)

Allowed

- Plants native to other parts of North America and not known to be invasive in the place where they will be planted
- Non-native, noninvasive plant species appropriate to the ecology and microclimate in which they will be planted

Prohibited

- All plants considered to be invasive or potentially invasive in a given state or region. For lists of plants that are considered to be invasive by Connecticut and Massachusetts state governments, see Appendix IV, page 72. The National Invasive Species Information Center *www.invasivespeciesinfo.gov/unitedstates/main.shtml* provides links to other state lists and invasive plant working groups.
- All cultivars derived from species considered to be invasive, including hybrids between invasive and non-invasive species
- Removing, destroying, or collecting seed from native plants in the wild, along the roadside, or on public or private land without prior permission. Rescuing native plants that will be destroyed by development is encouraged, but it is important to get permission from the land owner and local government officials.

Treatment of Existing Invasive Plants

It is strongly recommended that invasive and potentially invasive plants (as listed in Appendix IV, page 72) be removed from all sites under management. Land care professionals must first be sure to correctly identify a plant as invasive and then determine the best way to remove and dispose of it. For example, certain invasive plants may be pulled or dug, but extreme care must be exercised to prevent further propagation from root or stem fragments or other propagules. Disturbance of the soil by digging may also bring invasive plant seeds to the surface. Best organic removal methods are still being studied. The land care professional needs to learn about the biology of the invasives he is battling and research control strategies.

When removal of an invasive plant is not possible or the client refuses to allow it, the plant should, if at all feasible, be pruned immediately after the first flowers begin to fade to reduce or prevent the formation of seed. All flower parts should be removed and composted in a manner that will keep the seed from maturing. It is critical to understand the life cycle and seed dispersal mechanism of a species in order to use this method effectively.

After invasive plants are removed, it is important to fill the void with mulch or a cover crop so that seeds brought to the surface during the removal process will be less likely to sprout, and also to replant with native species as soon as possible to prevent re-colonization by invasive plants.

Preferred

- Hand pulling
- Hand-powered mechanical means (e.g., Weed Wrench, a tool designed specifically for removing invasive woody plants)
- Repeatedly cutting down woody plants with hand tools after each flush of growth to

draw down root energy reserves, eventually causing death by starvation

- Pouring boiling water directly over roots
- Mowing with a push reel mower
- Smothering with a thick layer (more than 4 inches) of weed-free mulch, paper mulch under a thick layer of organic mulch, or a temporary covering of PVC-free plastic sheeting
- Girdling
- Animal grazing/browsing
- Biological control of invasive plants, using carefully selected natural insect enemies or pathogens
- Covering the soil disturbed in the process of removal to prevent seeds of invasives from germinating
- Protecting surrounding native habitat during invasive removal

Allowed

- Motorized equipment
- Pruning spent flowers to prevent seed formation, if the client won't allow removal of the plant
- Solarization, which involves covering a low-growing invasive plant with clear plastic sheeting. Thanks to the greenhouse effect, the temperature under the plastic rises high enough to "cook" the plants. This technique can also kill beneficial microorganisms in the soil; after the plastic is removed, the area may benefit from applications of compost or compost tea.
- Flame weeders
- Prescribed burning (the land care professional *must* be trained and *must* request approval in advance from the local fire department)
- Organically approved herbicides. *Caution:* Although approved for use in organically managed landscapes, these herbicides are pesticides and must be handled with great care. The applicator must have a pesticide applicator's license and follow all pesticide laws, including all worker protection safety requirements.

Prohibited

- Synthetic herbicides (such as those containing glyphosate, better known under the trade names Roundup and Rodeo)

Preventing the Spread of Invasives

As stewards of the environment, land care professionals must do everything possible to avoid spreading invasive plants. Unfortunately, it is very easy to spread invasives inadvertently. It can also be difficult to identify invasive species, so it is wise to take precautionary measures. There are two common means of spreading invasives unintentionally: on landscaping equipment and by dumping cut materials.

Landscaping equipment, including shovels, lawn mowers, and excavators, all have the potential to spread invasive plants. Seeds, root and stem pieces, and other propagules can all be transported on blades or other equipment parts and in tire grooves. Transporting invasive plants is obviously bad for the environment, but it could also be a liability risk for the land care professional. This is why it is very important to clean equipment thoroughly before leaving a property. If water is used to clean equipment, it is imperative that the washing be done over a permeable managed surface such as a lawn, and not over an impervious surface such as a driveway, where wash water can run off into storm water sewers or local water bodies.

Some states have laws specifying that cut invasive plant material must be kept on site. This is recommended wherever possible. Unfortunately, most compost piles do not get hot enough to kill

invasive plants. Because many invasive plants are capable of growing and spreading even after they have been removed from the soil, it is important to kill as much of the plant as possible before composting.

Preferred

- Thoroughly drying roots and other plant parts away from contact with the ground to prevent re-rooting. Plant material killed through desiccation can be composted or disposed of with other brush.

Allowed

- Bagging invasive plant material and delivering it to a trash-burning facility, or a composting facility equipped to handle invasive species, after checking that such disposal is permitted by law

- Covering areas where invasive plants have dropped seed with old natural-fiber rugs or cardboard, followed by 6 inches of wood chips, to prevent germination. These areas should be monitored for signs of shoots pushing up through the mulch.

- In sunny areas, piling plants together and covering them tightly with a dark-colored tarp to heat in the sun. Edges of the pile should be monitored for signs of re-sprouting.

Prohibited

- Leaving invasive plant material where it can take root and re-establish itself

- Dumping invasive plant material or soil contaminated with invasive roots or seeds on another site

- Incomplete containment of invasive plant material during cleanup or transport. Every seed, every piece of stem or rhizome that escapes is another potential infestation.

Planting

Planting Bed Preparation

Planting beds are prepared differently when an organic approach is used. The well-being of the soil always comes first. The kinds of plants grown, the site conditions, and the desired outcome dictate the method or methods of preparation. If a soil test indicates the need for amendments, they should be incorporated into the soil whenever possible. A soil bioassay may indicate what plants will do well with the existing soil biology or ways to adjust the soil biology to suit the desired plants.

Although many variations exist, there are two basic approaches to preparing the soil in a planting bed. The first is to not amend the native soil at all. This requires great care in selecting plants that match the soil types and site conditions on a property. Foregoing the conventional amendment process requires fewer inputs and is less expensive, but requires more knowledge. The second approach is to amend the existing soil with compost or organically approved minerals and nutrients. This approach may result in more lush growth, and may require additional inputs to maintain that growth. Highly amended soil may be too rich for some plants, making them prone to problems and requiring higher maintenance. Excessive nitrogen and phosphorus may also cause pollution.

Specimen trees and shrubs should generally be planted in soil that has not been amended. The native soil should be loosened well beyond the sides of the root ball but no deeper than the height of the root ball. If amendments are to be used, it is best to amend the surrounding soil as well as the planting area in order to provide sufficient growing area for the roots. Plant roots have a tendency to stay in the richly amended soil rather than spread into the less hospitable surrounding soil, resulting in a constricted root system and loss of vigor due to excessive root competition in a confined area.

In rare circumstances the soil may be so poor or contaminated that the best approach is to replace the soil prior to planting. For soils contaminated with toxic elements, refer to Toxic Elements in Soil on page 18. Contaminated soil must be disposed of in accordance with all state and local laws. Imported soil may contain hazards of its own, such as weed seeds, invasive plant material, and pollutants. Be aware that there is ecological damage created when topsoil is mined.

Whether the soil is amended or not, choosing the right plant for the right place will yield consistently good results and will help to ensure the long-term health and sustainability of any planting.

Preferred

- Preserving desirable existing native vegetation whenever possible
- Choosing plants that match existing site conditions
- Using soil found on site, as available and appropriate
- Manually removing (stripping) unwanted vegetation and roots in areas to be planted
- Composting unwanted vegetation on site
- Smothering unwanted vegetation with old natural-fiber rugs, layers of cardboard, or organic matter
- Using amendments per soil test recommendations
- Incorporating amendments into the soil
- Mulching with organic matter (e.g., shredded leaves or compost—see Mulches on page 49)

Allowed

- Altering site conditions to accommodate a plant's cultural requirements

- Rototilling to remove unwanted vegetation
- Solarizing unwanted vegetation with clear plastic sheeting (plastic should be removed and reused)
- Flame burning or scalding unwanted vegetation
- Herbicides allowed under the National Organic Program
- Composting debris off site
- Using soil imported from off site
- Mulching with bark or inorganic products (see Mulches, page 49)

Prohibited

- Adding nitrogen, phosphorus, or potassium without a soil test
- Leaving amendments on the surface. The nutrients in exposed amendments may be leached away in runoff.
- Disturbing protected areas such as riparian and wetland areas (obey all applicable laws)
- Using soil amendments or fertilizers that are inconsistent with these Standards (see Fertilizers and Soil Amendments, page 21)
- Synthetic herbicides, fertilizers, wetting agents and water-retaining polymers

Cover Crops, Green Manures, and Crop Rotations

Cover crops and green manures help maintain soil organic matter, add nitrogen, reduce leaching of soluble nutrients, make insoluble nutrients more available to the next crop, prevent erosion, interrupt disease and pest life cycles, and suppress weeds. They are particularly useful in temporarily covering bare soil. When a green manure or cover crop is turned under, its organic matter and nutrients feed the soil biota, which in turn feed the next crop. Although cover crops and green manures cannot be rotated with perennial crops, benefits accrue from cover crops planted prior to perennial crops or between rows or plants.

A few guidelines: Wait one to two weeks after turning under a green manure before planting. This delay allows residues to break down and release their nutrients. If rye or other non-legumes have become too mature before being turned under, they may temporarily bind soil nitrogen and take longer to break down. Nitrogen is wasted when a lush, succulent legume is turned under more than two weeks before planting another crop. Legumes should never be turned under in the fall because they may release soluble nitrogen, which is vulnerable to leaching. Finally, minimize the length of time the soil is bare.

Where a crop of vegetables or annual herbs is removed and not allowed to recycle on site, crop rotation can bolster the health of the soil. Growing the same plants repeatedly on the same piece of ground invites disease and depletion of nutrients in the soil. A crop rotation plan is strongly recommended. When selecting cover crops or green manures, alternate light and heavy feeders, legumes and non-legumes. It is also best to follow a crop with a cover crop or green manure that has different or complementary nutritional needs. Avoid growing two successive crops that are from the same plant family or are subject to the same pests or diseases.

Seeds, Transplants, and Nursery Stock

Every effort should be made to find sources of organically grown seeds and plants or to produce them oneself. Growers of plants sold as "Certified Organic" should follow the standards issued under the National Organic Program.

Preferred

- Purchasing all shrubs, trees, seedlings, plugs, rootstocks, and other propagative forms of plants from certified organic sources
- Organically grown seeds
- Nontoxic seed treatments such as hot water soaks and legume inoculants

Allowed

- Conventionally grown shrubs, trees, seedlings, plugs, rootstocks, and other propagative forms of plants and untreated seeds
- Pelletization (of seeds) that does not use prohibited materials

Prohibited

- Fungicide-treated seeds
- Genetically modified seeds and plants
- Synthetic rooting or wetting agents
- Planting commercially propagated rare, endangered, or threatened plants (to preserve the genetic integrity of wild populations of these plants)
- Collecting plants or their seeds from the wild, along the roadside, or on public or private land without prior permission. Rescuing native plants that will be destroyed by development is encouraged, but it is important to get permission from the land owner and local government officials.

Pruning

Our first thought should be to "do no harm." Organic land care practitioners are expected to care about what they do and possess the knowledge, proper tools, and necessary licenses and/or certifications to do the job. Because plants are living systems, it is important to know how these systems work and how to work within them. Since living systems use gradual processes to grow, our practices should avoid methods that yield quick results or drastic changes. Poor pruning practices can result in a weak, unsightly plant or even cause death. Many of the old pruning practices have been shown to be harmful. Therefore, education in proper pruning methods is very important.

Plants should be encouraged to grow as their genetics dictate, not as we determine. Whenever possible, leave the shaping and shearing to Disney! Leaves are the "food factories" of a plant. All food produced by a plant is manufactured in the leaves. The more leaves, the more potential to make food. The plant knows best how many leaves it needs and in what spatial arrangements. Our job is to disturb this process as little as possible when pruning—especially with older, less vigorous plants.

The optimum time to prune living wood is when the plant's energy reserves are high. For most plants this is in late winter, before buds begin to swell. Pruning in late fall or early to midwinter can result in dieback and disease or insect problems because the dormant plant cannot seal off the wound created by the pruning cut. If pruning is necessary during the growing season, wait at least two weeks after the leaves have matured to allow the plant to make and store energy. When removing woody tissue, it is important to make a clean, smooth pruning cut in the proper location. The swollen area where a branch is joined to the plant at a crotch is called the branch bark collar. All pruning should be done just outside this collar, leaving a short stub. Do not tip prune or "top" a plant. This practice only leads to disfigurement and weak plants. Much of the plant's energy for growth is stored in the tips and buds (symplast) and should be preserved as much as possible during pruning. When size reduction is necessary, it is healthier for the plant to remove an entire branch back to the main trunk or leader (drop crotch pruning) than it is to prune back the tips.

In many states (CT included) you must be licensed to prune woody plants for hire.

Preferred

- Removing deadwood, diseased wood, and crossing and intersecting wood as soon as it is noticed
- Pruning living tissue when energy reserves are high
- Corrective pruning for mechanical stability done when plants are young and wood is less than 3 inches in diameter
- Using drop crotch pruning methods
- For size reduction, removing no more than one-third of the branches back to the trunk or main leader over a period of several seasons
- Pruning at the proper time to ensure proper bud formation
- Rejuvenating a multi-stemmed plant by removing one-third of the oldest wood to the ground over a 3-year period
- Disinfecting pruning tools after their use on diseased wood, or removing diseased wood during the dormant season (see Diseases, page 54, for ways of disinfecting tools)
- Disposing of pruning debris by composting on site

Allowed

- Corrective pruning to improve mechanical stability when wood is larger than 3 inches in diameter
- Rejuvenating a multi-stemmed plant by removal of all stems at one time
- Removing pruning debris to an off-site recycling facility
- Shearing

Prohibited

- Any practice that results in, or contributes to, a decline in the health of a desirable plant
- Topping
- Removing excessive symplast tissue (tips and buds)
- Leaving portions of branches during size reduction
- Using tree gaffs (climbing spikes) while pruning, except for emergency rescue

Weeds

A weed has been defined as a plant out of place, one whose desirable attributes have yet, perhaps, to be discovered. It is important to distinguish between weeds in the yard and invasive plants causing havoc in natural ecosystems (see Native, Exotic, and Invasive Plant Species, page 37 for information on invasive plants).

The key to weed control is timing. Careful observation of weed populations and weed seedling emergence patterns after disturbance will help the land care professional develop an appropriate weed control program. Staying on top of weed problems through regular monitoring and prompt removal prevents the formation of large weed populations.

Preferred

- Avoiding conditions that favor weeds: compacted soils, overtillage, overwatering, and excessive or ill-timed nitrogen applications
- Adjusting soil chemistry and/or biology to favor desired plants over weeds
- Covering the ground with desired plants that out-compete weeds
- For weeds in beds containing woody and/or perennial plants, hand weeding, spot spraying with organic herbicides, smothering with mulch, or cultivating by hand
- Mulches to suppress weeds (see Mulches, page 49)
- Installing permanent vertical edging or hand edging between lawn and garden to prevent grass from creeping into beds
- Overseeding with cover crops such as annual ryegrass to fill bare spots in lawns, or white clover or buckwheat to cover bare soil in vegetable gardens
- Shallow cultivation to avoid bringing more weed seeds to the surface
- Boiling water poured slowly and directly over weed roots
- Maintaining lawns at a height of 3 inches or more (see Lawn Maintenance, page 33)

Allowed

- Plastic sheeting, including landscape fabric, that does not contain polyvinyl chloride (PVC)
- Paper mulch beneath an organic mulch
- Flame weeders
- Hot water weed burners
- Vinegar or salt, but only in cracks in walkways and terraces
- Corn gluten meal. One application per year of 20 pounds per 1,000 square feet. *Note:* This application provides 2 lbs. of nitrogen per 1000 square feet, whereas these Standards allow just 1 lb. of nitrogen per 1000 square feet per application. Extra precautions against run-off are required and additional nitrogen fertilization must be reduced accordingly. See Nitrogen, page 25, for annual nitrogen limits.
- Herbicides allowed under the National Organic Program
- Mechanical cultivation

Prohibited

- All synthetic herbicides, arsenates, and caustic acids or salts
- Synthetic growth regulators
- Diesel products
- Petroleum distillates

- Micronutrients in toxic quantities
- Synthetic transpiration suppressants

Issue of Special Concern: Poison Ivy

Poison ivy fruit is an important food for birds. For this reason, poison ivy should be left unmolested whenever feasible. The following procedures are suggested for removing it from an area where humans or domestic animals will have contact with it.

Do not burn

Hand pulling:

- Use non-absorbent gloves that completely cover the arm from fingers to shoulder
- Wear rubber boots
- Before handling poison ivy, apply a protective lotion designed to block urushiol. Urushiol is the oil that causes skin irritation.
- For large jobs, don a Tyvek suit and tape the cuffs to your gloves. Dispose of contaminated suit in a plastic bag.
- Gather plants in bags and dispose of entire collection in the trash. Take care to protect anyone who may come in contact with the trash.
- Be sure to dig out the entire root system to prevent resprouting. Repeated weeding may be needed.
- Wash gloves and boots completely with naptha-based soap or urushiol-removing cleanser before removing them to dry
- If poison ivy comes in contact with your skin, wash within ten minutes with water or a wet wipe, or wash within eight hours with a product that is formulated to remove urushiol. Such products can also be used to help minimize the spread of rashes.

Grazing:

- Sheep and goats will browse poison ivy without harm to themselves. Repeated grazing is necessary to eradicate the plant.

Mulches

Mulch is a layer of material—either organic or inorganic—applied to the soil surface. The natural state of soils in this bioregion is to be covered with plant material—whether alive, dead, or both. This layer performs many functions that are vital to plant and soil health. Organic mulches mimic this natural cover by adding organic matter, humus, and nutrients to the soil; providing a substrate for beneficial microorganisms; retaining moisture; controlling erosion; moderating soil temperature fluctuations; and helping to suppress weeds. Inorganic mulches are less desirable because they do not contribute to soil or plant health and are usually more ecologically harmful to produce and transport, but they can sometimes be reused and do not need to be replenished as often as organic mulches.

The proper application of mulch is very important. Too much mulch can inhibit the movement of air and moisture into and out of the soil. Mulch piled up against the trunks of plants can cause the bark to rot, leaving the cambium layer under the bark vulnerable to damage. Dormant buds at the base of the trunk can be forced to sprout into surface roots (adventitious roots) that have no alternative but to grow in the mulch layer where there is little or no food or protection. Lastly, rodents can cause serious damage to trunks by tunneling through the mulch and feeding on the bases of plants. This damage is most common in winter.

It is important to note that mulches that are high in carbon, such as undecomposed leaves and fresh wood chips, can also be detrimental to plants. The microbes that break down carbonaceous materials are able to out-compete plants for nitrogen, and when these microbes are active in large numbers they effectively tie up the available nitrogen in the soil. As decomposition slows, the microbes die off and release the nitrogen in their bodies back into the soil, but in the short term, plant growth, especially of seedlings and annual transplants, may be stunted.

Preferred

- Mulching bare ground as soon as possible to prevent the elements from damaging the soil
- Mulching seeded areas to prevent erosion
- Limiting the mulch layer to 3–4 inches around woody plants and keeping the mulch a minimum of 4 inches away from trunks
- Limiting the mulch layer to 2–3 inches around herbaceous plants and keeping the mulch away from their crowns
- Replenishing mulch to maintain but not exceed the above depths
- Applying a winter mulch (e.g., evergreen boughs) after the ground has frozen to ensure that root systems remain dormant through winter
- Anchoring engineered mulch blankets on slopes having a 3 percent grade or greater with pegs and twine, netting, or mats. Check mulch blankets and anchoring devices for prohibited materials before use.
- Covering bare soil with a cover crop (e.g., annual or perennial rye, hairy vetch, winter rye, oats)
- Compost, partially decayed leaves, partially decayed wood chips
- Sawdust (only for acid-loving plants). Like undecomposed leaves and fresh wood chips, sawdust may temporarily tie up soil nitrogen.
- Buffering materials (e.g., compost) to prevent "shocking" of soil microorganisms when using mulch materials that are at the extreme ends of the pH scale

- A layer of composted leaves or compost to prevent bark mulch from coming in contact with the soil

Allowed

- Un-composted leaves
- Bark. *Note:* Bark, especially pine bark, contains high amounts of indigestible fats, waxes, and lignans. Because they are very slow to break down, bark mulches do not feed the soil the way other organic mulches do.
- Buckwheat hulls and cocoa bean hulls
- Newsprint containing black ink only
- Stone and gravel (mined substances)
- Plastic and polyethylene mulches that are free of PVC
- Weed barrier fabrics, when used beneath washed gravel or stone
- Mulch layer exceeding 4 inches in total depth, when used to smother undesirable or invasive plants
- Corrugated cardboard

Prohibited

- Mulch layers exceeding 4 inches in total depth, except when used to smother undesirable or invasive plants
- Mulch blankets and anchoring materials containing substances prohibited by these Standards (see Materials in Contact with Soil or Plants, page 19)
- Genetically modified cover crop seed
- Newspaper printed with color inks and inserts printed on glossy paper
- Weed-barrier fabrics beneath organic mulch. Soil and organic matter clog the pores of the fabric and prevent air and water from penetrating to the soil below.
- Dyed mulch, which may contain demolition debris contaminated with lead paint, pressure-treated wood, or other toxic substances
- Mulch made from ground-up rubber tires

Pest and Disease Management

The most effective way to prevent and limit pest problems is to grow healthy plants—by putting the right plant in the right place and building healthy soil. Not all pest outbreaks are harmful to the long-term survival or health of a plant. An outbreak can be a temporary phenomenon quickly eliminated by natural enemies or plant defenses without human intervention, and the plants recover. Client education may be needed on this issue.

Pest control requires a pest management plan, which should include regular monitoring of plant health and pest density. (For information on damage thresholds, consult publications from your cooperative extension office or agricultural experiment station.) When selecting a pest control method, it is important to seek the most specific control for the pest in order to avoid harming beneficial organisms.

All laws must be followed in the application of any material used as a pesticide (including biological products and botanical pesticides). State certification as a pesticide applicator is required for any commercial application of pesticides. Check with your state government regarding the need for specific licenses in specific situations.

Commercial application of materials for pest management is illegal unless the materials are registered by the Environmental Protection Agency (except for the 25b materials discussed below) and the state government, and labeled for the plant to be treated and the site. *The label is the law.* Label restrictions on crop or plant species, application rates, and requirements for worker protection must be followed. If you are an employer who uses pesticides of any kind, including organic pesticides, make sure you are in compliance with requirements for worker protection (such as use of protective clothing, reentry intervals, decontamination, and emergency medical assistance). More information on the Worker Protection Standard is available from the U.S. Environmental Protection Agency (EPA) at *www.epa.gov/oecaagct/htc.html*. In addition, state law may require pesticide application signs and neighbor notification.

An increasing number of pest management products that are classified as "minimum risk pesticides" and are thus exempt from EPA registration have come onto the market in recent years. These are often referred to as "25b" pesticides, after the section of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) that created this exemption from Federal registration. The criteria for exemption from registration are that all active and inert ingredients are on the respective EPA lists of materials considered to be non-toxic and that the label meets certain specific requirements. Note that manufacturers of 25b materials are not currently required to demonstrate the efficacy of their materials against pests, so let the buyer beware.

Although 25b pesticides are exempt from Federal registration, state registration may still be required in many states. In addition, the rules for commercial application of these products are the same as those for registered pesticides, and a person who applies them for hire must be a certified applicator. EPA-registered or 25b products labeled for home use may also be used by a professional in a residential setting as long as the label does not specifically prohibit professional use.

You can find out whether a product is registered in your state by contacting the responsible state regulatory official (a list of state pesticide control officials can be found on the Association of American Pest Control Officials website *aapco.ceris.purdue.edu/htm/control.htm*). An additional source is Kelly Solutions, which keeps a database of registered pesticides for 36 states (*www.kellysolutions.com*), but the final word always comes from the responsible state official.

Note: Pesticides allowed for use in these Standards are all either EPA-registered or 25b pesticides (exempt from EPA registration) and contain no

synthetic inert ingredients unless they are in the 205.601 (m) list of allowed synthetic inerts on the National List of Allowed and Prohibited Substances of the National Organic Program.

Principles

- Insects and other arthropods, fungi, and even snails and slugs are essential to sustaining the web of life on Earth. Human beings choose to protect their plants and other resources from competition or damage from these organisms, and thus consider them to be "pests."

- The best way to manage pests is to prevent the pests from reaching damaging levels. By using his knowledge of the pest, the plant, and the local ecosystem; of the natural enemies that limit pest populations; and of the biological and cultural methods that can be used to prevent conditions favorable to disease, the land care professional can foster an ecosystem in which pest outbreaks are uncommon.

- Pesticides, including pesticides allowed in organic land care, should be used only as a last resort, after habitat modification and non-chemical methods have failed.

- If pesticides are to be used, the criteria for choosing the best pesticide option should be:

    1. Minimize known or suspected effects on human health

    2. Minimize known or suspected effects on the environment

    3. Minimize persistence in the environment of the applied material and its breakdown products

    4. Maximize the effectiveness of the material so that the amount and the number of applications can be kept to a minimum. For example, using pesticide in a bait is preferable to broadcasting it into the environment.

- It is an underlying assumption in organic land care that carefully chosen, naturally occurring materials are best able to satisfy the above criteria and are least likely to have unanticipated negative effects in the long run.

Insects and Other Arthropods

Preferred

- Planting species and varieties that are resistant to pests or tolerant of their damage

- Careful inspection of nursery stock to detect and remove any infestation before planting

- Diversifying plant species and varieties to avoid monocultures

- Conservation or improvement of habitat for natural enemies of pests (such as planting flowers that provide pollen and nectar to beneficial insects)

- Making the environment unsuitable for the pest (such as using wood chips as a barrier to the movement of ticks)

- Removal and proper disposal or composting of infested plant parts

- Timely planting of annual plants with attention to pest life cycles

Allowed

- Mechanical measures, such as traps, nets, hand picking, and vacuuming

- Pheromones and other attractants used to monitor or trap pests or disrupt mating

- Releasing predators or parasites such as lacewings (eggs or larvae), parasitic wasps, or insect-attacking nematodes

- Releasing insect or arthropod pathogens such as Milky Spore® bacteria or *Beauveria bassiana,* provided they are not genetically engineered
- Insecticides whose active ingredients are extracted from naturally occurring microbes, such as Bt (*Bacillus thuringiensis*) or spinosad
- Insecticidal soaps. *Note:* Insecticidal soaps can damage some plants. Apply with care.
- Spray oils derived from plant or animal sources
- Narrow-range, or superior, horticultural spray oils derived from petroleum. These oils can be used during both the dormant and growing seasons.
- Botanical insecticides, such as pyrethrum or neem. *Note:* These are broad-spectrum poisons that are hazardous to humans, wildlife, soil organisms, and beneficial insects. They should be used with discretion and not on a regular basis
- Products based on extracts from food-grade materials such as hot peppers or garlic and on plant essential oils, including clove oil (eugenol), floral extracts (2-phenethyl propionate), thyme oil (thymol), rosemary oil, and wintergreen oil
- Boric acid for ant control. *Note:* Boric acid may not be used in direct contact with food crops.
- Diatomaceous earth, if labeled for use in your state. *Caution:* Protection is needed against breathing the dust.
- Elemental sulfur and lime sulfur
- Sucrose octanoate esters
- Common glue (casein) to seal pruned rose canes against borer damage

Prohibited

- Any synthetic insecticide not listed above, including neonicotinoids, synthetic insect growth regulators, pyrethroids, carbamates, organophosphates, and piperonyl butoxide (used as an insecticide synergist)
- All soil fumigants
- Nicotine, nicotine sulfate, and tobacco dust
- Sodium fluoaluminate
- Mothballs
- All other persistent poisons, such as arsenic
- Genetically engineered organisms or materials derived from them
- Any pesticide formulated with inert ingredients that are prohibited under the National Organic Program

Snails & Slugs

In most landscapes, snails and slugs can be tolerated and cause only cosmetic plant damage. When present in large numbers in a bed of newly planted seedlings, however, they can weaken or kill the plants.

Preferred

- Modification of the environment to make the habitat drier and to eliminate protected hiding places
- Planting plants that slugs and snails do not eat
- Slug-attacking nematodes (if they become available—a species is currently in use in Britain)
- Copper or zinc strips or mesh used as barriers
- Traps

- Predation by chickens or ducks

Allowed

- Slug baits with ferric (iron) phosphate as the active ingredient
- Diatomaceous earth, if labeled in your state for use against snails and slugs in the landscape. *Caution:* Protection is needed against breathing the dust.
- Barriers of sawdust or wood ash

Prohibited

- Slug or snail bait containing synthetic molluscicides such as metaldehyde

Diseases

Plant pathogens include fungi, bacteria, viruses, nematodes, and phytoplasmas. These organisms can be dispersed by wind and water, insects, mites, and other organisms; by contaminated tools and equipment; and by human activities such as planting, pruning, and cultivating. Pathogens, which are usually present in the environment, often infect stressed or weakened plants. As a consequence, the key to disease management is prevention by maintaining plant and soil health. Client education is another important component of disease management, since not all plant diseases require or warrant aggressive strategies for control. For example, foliar leaf spots are generally considered cosmetic diseases. Unlike blights or dieback diseases, which often have significant implications for plant health, most leaf spots are nothing more than unsightly.

It is strongly recommended that a plant health care plan be prepared for each property. The plan should include regular scouting to detect and identify diseases as early as possible. Scouting during peak periods should be done at least twice a month for trees and shrubs and, if possible, once a week for turf. In time, trends develop and "hot spots" of disease activity emerge. These hot spots are often consistent from year to year and are usually associated with microclimates in a landscape. Plotting these areas on a map is useful for future reference. It is also helpful to consult with fellow organic land care professionals and extension service, experiment station, and university personnel to keep informed about what others are seeing in the field and obtain results of disease forecasting or other prediction models.

Preferred

- Building and maintaining healthy, fertile soil (see Soil Health, page 16). Nutrient deficiencies and toxicities can weaken plants and make them more vulnerable to primary pathogens and also to secondary pathogens and/or opportunistic pests.
- Maintaining a soil pH that favors healthy growth (usually 6.4–7.0)
- Planting disease-resistant species and cultivars, when available
- Avoiding monocultures. If a disease takes hold, all of the plants in a stand are likely to suffer. A diverse landscape spreads risk and creates an ecosystem that can help keep pathogens under control.
- Carefully checking all nursery stock—roots as well as leaves and stems—for signs of disease before purchase
- Using adequate spacing to promote good air circulation and overall plant health
- Developing a plant health care plan to scout for diseases in the landscape
- Using the following sanitation practices. *Note:* Infected plant debris should be properly composted or removed from the site. If in doubt, infected material should not be composted.
    - Pruning dead, dying, damaged, or diseased branches

- Removing infected leaves, twigs, branches, needles, and cones around the base of trees and shrubs in the fall to remove reservoirs of overwintering inoculum
- Removing infected grass clippings from the lawn
- Eliminating infected hosts and replanting with disease-resistant cultivars
- Crop rotation for annual plants

Allowed

- EPA-registered beneficial microbes that antagonize or compete with specific pathogens
- Potassium bicarbonate
- Insecticidal soaps. *Note:* Insecticidal soaps can damage some plants. Apply with care.
- Plant-derived anti-desiccants and anti-transpirants
- Plant- or microbe-derived products formulated to enhance plant growth and improve soil health
- Plant-based oils, including those derived from garlic, neem, jojoba, cottonseed, and thyme
- Other plant extracts, such as saponins from *Chenopodium quinoa*
- Hydrogen peroxide
- Copper sulfate and fixed copper products—copper hydroxide, copper oxide, copper oxychloride. *Note:* Because copper accumulates in the soil, these products must be used sparingly. They must not be used as herbicides.
- Sulfur
- Lime sulfur
- Hydrated lime
- Neem products
- Narrow-range, or superior, horticultural spray oils derived from petroleum. These oils can be used during both the dormant and growing seasons.
- Peracetic acid, tetracycline (oxytetracycline calcium complex), and streptomycin—for use only to control fire blight in apples, pears, mountain ash, and other members of the rose family (*Rosaceae*)
- Ethanol, isopropanol (active ingredient in rubbing alcohol), hydrogen peroxide, and peracetic acid—used as disinfectants for pruning tools and other equipment. *Note:* Although the chlorine-containing materials calcium hypochlorite, chlorine dioxide, and sodium hypochlorite, at a concentration of 500 ppm (1 teaspoon of household bleach to 2 cups of water), are also allowed, they must be further diluted before disposal to below 5 ppm. This means diluting the 2 cups of bleach mix with an additional 12 gallons of water. In many cases this may be impractical.

Prohibited

- All synthetic chemical fungicides other than those listed above
- Petrochemical-based anti-desiccants

Wildlife Management

Native animals of all kinds are essential to a healthy ecosystem. Priority must be given to protecting, maintaining, and improving critical habitats for wildlife, with the goals of increasing biodiversity and the stability of local ecosystems. In addition, humans often like to have some wildlife around purely for its aesthetic value. We must recognize, however, that wildlife can come into conflict with human beings in various ways: by injuring valued plants or crops, increasing the exposure of humans to pathogens (e.g., tick-borne diseases), or coming too close to humans (e.g., bears searching for bird seed). Some species may exceed not only the level of human tolerance (cultural carrying capacity) but also the capacity of the local environment to sustain their numbers (biological carrying capacity). Damage caused by wildlife may even be serious enough to degrade the ecosystem, causing erosion or pollution or a loss of biodiversity. Such conflicts between wildlife and humans may require diversion, the application of repellents, exclusion, or other management strategies. Management also requires the education of clients about wildlife behavior and actions that can be taken to reduce conflict, such as keeping compost covered and eliminating bird feeders.

Care must be taken to accurately identify the species that is causing damage (through identification of tracks, scat, behavior, and the type of damage) before determining a management strategy. It is wise to work with the client or community to identify an acceptable population threshold in the area before taking action to control the animals. State and local laws pertaining to live trapping, hunting, and removal of animals must be observed at all times.

Principles

- Humans and wildlife are parts of the same interdependent web of life.
- We must protect, maintain, and improve critical habitats for wildlife.
- Where management of wildlife is needed, we should make all possible efforts to respect the animals, minimize suffering, and educate the local human community.

Preferred

- Identifying landscape features that are important to biodiversity and wildlife and protecting or enhancing those features, particularly with respect to endangered and wetland species
- Improving or maintaining habitats identified as important for wildlife conservation in the local region. Check your State's Wildlife Action Plan at *www.wildlifeactionplans.org* for this information.
- Using plants that are avoided by wildlife, particularly deer. Native plants are recommended.
- Modifying habitat to prevent nesting or feeding by wildlife in areas used by humans
- Tree wraps (made of materials that are not prohibited in the Standards) to prevent girdling and other wildlife damage
- Fencing in selected areas, leaving corridors for wildlife to move safely
- Repellents based on plant materials or soap
- Human hair placed around the perimeter of an area containing plants favored by wildlife
- Mechanical or visual scaring devices
- Diversion plantings (planting favored plants in wildlife corridors to draw animals away from human landscapes)
- Barrier hedgerows composed of non-invasive species
- Netting

- Locating plants favored by wildlife in areas where humans are highly active and visible
- Educating the client in methods of preventing conflicts with wildlife (e.g., don't leave food on the ground, don't feed the dog outside, cover the compost pile if it contains kitchen scraps, remove bird feeders, keep domestic cats indoors)

Allowed

- Repellents based on ammonium salts of fatty acids, such as Hinder® deer repellent
- Capsaicin-based animal repellents, such as Miller's Hot Sauce® animal repellent
- Dried blood or animal renderings used as a repellent. *Caution:* These materials must come only from American cattle to avoid the risk of infectious diseases. Take precautions to avoid direct human contact. These materials may contain pathogens.
- Trapping in accordance with state laws and best management practices published by the Association of Fish & Wildlife Agencies (*www.fishwildlife.org*)
- Hunting in accordance with state laws
- Rodenticides with Vitamin D3 as the active ingredient
- Dogs used in a fenced, confined area or under direct supervision (as when trained dogs are used, under supervision, to discourage Canada geese)
- Carbon monoxide or sulfur dioxide smoke bombs, when used for underground rodent control

Prohibited

- Any products prohibited by state laws
- Traps that cause slow death or injury (those that violate the best management practices published by the Association of Fish and Wildlife Agencies, *www.fishwildlife.org*)
- Rodenticides with an active ingredient other than Vitamin D3
- Predator urine. Prohibited due to inhumane conditions of urine collection.
- Diesel fuel and kerosene-based sprays
- Cyanides, strychnine, phosgene bombs, and other gas-producing devices
- Products containing sewage sludge, such as Milorganite®

Disposal Guidelines For Plant Residues and Other Landscaping Materials

Organic land care professionals should comply with local town or city regulations regarding the disposal of any nondegradable materials such as pressure-treated lumber, concrete, asphalt, and other building debris. Dumpster rental may be required. Disposal of degradable materials, such as stumps, logs, and brush may also be regulated locally or by state statute. Invasive plant parts must be disposed of appropriately to prevent spread (see Native, Exotic, and Invasive Plants, page 37).

Preferred

- On-site composting of degradable materials
- Grinding stumps and brush to chips for reuse on site

Allowed

- Composting off site
- Removing stumps and brush to an off-site composting facility
- Other disposal methods, such as burning, as permitted under local ordinances and state laws

Prohibited

- Dumping off site in unauthorized areas
- Disposal of invasive plant material in ways that could lead to the spread of such plants

Appendix I: Sources of More Information

Baystate Organic Certifiers. USDA National Organic Program accredited certifying agent. Maintains the NOFA Organic Land Care approved materials list for organic landscaping. 1220 Cedarwood Circle, N. Dighton, MA 02764, 774-872-5544; *www.baystateorganic.org*

Bio-Integral Resource Center (BIRC). Non-toxic and least toxic integrated pest management solutions to urban and agricultural pest problems. Publications include: *The IPM Practitioner* and *Common Sense Pest Control Quarterly.* BIRC, P.O. Box 7414, Berkeley, CA 94707; 510-524-2567; *www.birc.org*

Connecticut Agricultural Experiment Station. Publications, soil testing, identification of pests and plant diseases. CAES, P.O Box 1106, 123 Huntington St., New Haven, CT 06504. General Information and Main Laboratories: 203-974-8500; Insect inquiries: 203-974-8600; Plant inquiries: 203 974-8601; Soil testing: 203 974-8521(New Haven) or 860-683-4977 (Windsor). *www.caes.state.ct.us*

Ecological Landscaping Association. Professional membership organization with educational workshops, forums, annual Eco-Marketplace. 841 Worcester Rd. #326, Natick, MA 01760, 617-436-5838; *www.ecolandscaping.org*

National Sustainable Agriculture Information Service (ATTRA). Provides information about sustainable agriculture. Publications include: list of soil testing labs, composting, compost teas, sustainable lawn care. ATTRA – Sustainable Agriculture Information Service, P.O. Box 3838, Butte, MT 59702; 800-346-9140, English; 800-411-3222, Español; *www.attra.org*

Neighborhood Network. Citizen membership organization with educational forums and annual organic turf and tree trade show. Publishes resource journal of vendors from annual organic trade show. Neighborhood Network, 7180 Republican Airport, East Farmingdale, NY, 11735; 631-963-5454; *www.longislandnn.org*

New England Wild Flower Society. Membership organization offering education, certification programs, and information about the use of native plants in the landscape. Operates Nasami Farm which grows and sells native plants. 180 Hemenway Road, Framingham, MA 01701; 508-877-7630; *www.newfs.org*

Northeast Organic Farming Association. This is a regional organic farming organization, with chapters in 7 states (CT, MA, NH, NJ, NY, RI, VT). The Connecticut chapter of NOFA houses the NOFA Organic Land Care Program. *www.nofa.org*

Northeast Organic Farming Association Organic Land Care Program. PO Box 164, Stevenson, CT 06491; 203-888-5146; info@organiclandcare.net; *www.organiclandcare.net*

Organic Materials Review Institute. Provides organic growers, manufacturers and suppliers with and independent review of products intended for use in certified organic production according to National Organic Program regulations. *www.omri.org*

University of Connecticut, Cooperative Extension System, College of Agriculture and Natural Resources, 1376 Storrs Road, University of Connecticut, Unit 4134, Storrs, CT 06269; 860-486-9228; *www.cag.uconn.edu/ces/ces/index.html*

University of Massachusetts Cooperative Extension Service. 101 University Dr., Suite C1, Amherst MA 01003, 413-545-4800; *www.umassextension.org*

USDA Natural Resources Conservation Service.
Connecticut office: 344 Merrow Road, Tolland, CT 06084; 860-871-4011;
www.ct.nrcs.usda.gov

USDA Natural Resources Conservation Service.
Massachusetts office: 451 West Street, Amherst, MA 01002; 413-253-4350;
www.ma.nrcs.usda.gov

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Appendix III: Soil Testing Labs

Here is a partial listing of soil testing labs in the Northeast. The National Sustainable Agriculture Information Service also maintains a list of "Alternative Soil Testing Laboratories" across the country. Contact ATTRA at P.O. Box 3657, Fayetteville AR 72702, 800 346-9140, or online at *www.attra.org/attra-pub/soil-lab.html*.

Commercial Labs

Agri Analysis, Inc.
280 Newport Road
Leola, PA 17546
1-800-464-6019
717-656-9326
www.agrianalysis.com

Agri-Balance Organic Consultants
P.O. Box 3083
Sag Harbor, NY 11963
516 725-5725
516 725-2110 fax
Contact: Elizabeth and Crow Miller

Cook's Consulting
RD #2, Box 13
Lowville, NY 13367
315 376-3002
Contact: Peg Cook
pegcook@northnet.org

Harrington's Organic Land Care
Soil Testing Laboratory
70 Highland Park Drive
Bloomfield, CT 06002
860-243-8733
860-882-0271 fax
sales@harringtonsorganic.com
www.harringtonsorganic.com

Soil Foodweb New York
555 Hallock Avenue, Ste 7,
Port Jefferson Station, NY 11776
631-474-8848
631-474-8847 fax
soilfoodwebny@aol.com
www.soilfoodweb.com

Woods End Research Laboratory, Inc.
290 Belgrade Rd.
P.O. Box 297
Mt. Vernon, ME 04352
207 293-2457
Contact: Dr. William Brinton
compost@woodsend.org
www.woodsend.org

State University and Agricultural Experiment Station Labs

Agricultural Analytical Services Laboratory
Penn State University
Tower Road
University Park, PA 16802
814-863-0841
814-863-4540 fax
aaslab@psu.edu
www.aasl.psu.edu/Default.htm

Connecticut Agricultural Experiment
Station Slate Laboratory
123 Huntington Street
P.O. Box 1106
New Haven, CT 06504
203-974-8521
203-974-8502 fax
Gregory.Bugbee@ct.gov
www.ct.gov/caes/cwp/view.asp?a=2836&q=378206

Connecticut Agricultural Experiment Station
Valley Laboratory
153 Cook Hill Road
Box 248
Windsor, CT 06095-0248
860-683-4977
860-683-4987 fax
www.ct.gov/caes/cwp/view.asp?a=2836&q=378206

Cornell Nutrient Analysis Lab
804 Bradfield Hall
Cornell University
Ithaca, NY 14853
607-255-4540
cnal.cals.cornell.edu

Rutgers Soil Testing Laboratory
Rutgers, The State University of New Jersey
57 US Highway 1
New Brunswick, NJ 08901-8554
732-932-9295
soiltest@njaes.rutgers.edu
njaes.rutgers.edu/soiltestinglab

Soil Nutrient Analysis Laboratory
6 Sherman Place, U-102
University of Connecticut
Storrs, CT 06269-5102
860-486-4274
860-486-4562 fax
soiltest@uconn.edu
soiltest.uconn.edu

University of Delaware Soil Testing Program
152 Townsend Hall
531 S. College Avenue
Newark, DE 19717-1303
(302) 831-1392
(302) 831-0605 fax
11462@udel.edu
ag.udel.edu/other_websites/dstp

University of Maine Soil
Testing Service Analytical Lab
5722 Deering Hall
Orono, ME 04469-5722
Contact: Sue Erich – Lab Director
207-581-2997
207-581-3597 fax
anlab.umesci.maine.edu

University of Massachusetts Soil Testing Lab
West Experiment Station
682 North Pleasant Street
University of Massachusetts
Amherst, MA 01003-8021
413 545-2311
soiltest@umext.umass.edu
www.umass.edu/plsoils/soiltest

University of New Hampshire
Cooperative Extension
Soil Testing Program
Spaulding Life Science Center, Room G28
38 Academic Way
Durham, NH 03824
603-862-3200
soil.testing@unh.edu
extension.unh.edu/agric/agpdts/soiltest.htm

The University of Vermont
Agricultural and Environmental Testing Lab
219 Hills Building, UVM
Burlington, VT 05405
802-656-0285
www.uvm.edu/pss/ag_testing

Appendix IV: Lists of Invasive Species

Invasive Plant Species from the Invasive Plant Atlas of New England

Source: *nbii-nin.ciesin.columbia.edu/ipane/ipanespecies/current_inv.htm*

Note that the IPANE list does not have official status. However, there are laws in effect in Connecticut, Massachusetts, and other states banning the purchase, sale, transplanting, cultivation, or distribution of certain invasive species.

Species banned in Massachusetts as of January 2009 are marked with ^. See also the additional list of species banned in Massachusetts but not on the IPANE list below.

Source: Massachusetts Department of Agricultural Resources. *www.mass.gov/agr/farmproducts/prohibitedplantlist.htm*

Species banned in Connecticut as of September 2010 are marked with *. An additional species banned in Connecticut is also listed below.

Source: Connecticut Invasive Plant Working Group. *www.hort.uconn.edu/cipwg/pdfs/invplantsCT09sciname.pdf*

	Scientific Name	**Common Name**
	Acer ginnala Maxim.	Amur maple
^	*Acer platanoides L.*	Norway maple
^*	*Acer pseudoplatanus L.*	Sycamore maple
^*	*Aegopodium podagraria L.*	Goutweed
^*	*Ailanthus altissima (Mill.) Swingle*	Tree of heaven
	Aira caryophyllea L.	Silver hairgrass
^*	*Alliaria petiolata (Bieb.) Cavara & Grande*	Garlic mustard
	Allium vineale L.	Wild garlic
	Alnus glutinosa (L.) Gaertner	European black alder
*	*Amorpha fruticosa L.*	False indigo
^	*Ampelopsis brevipedunculata (Maxim.) Trautv.*	Porcelainberry
^*	*Anthriscus sylvestris (L.) Hoffm.*	Wild chervil
^*	*Arthraxon hispidus (Thunb.) Makino*	Hairy jointgrass
^	*Berberis thunbergii DC.*	Japanese barberry

IPANE Invasive Plants, continued

^*	*Berberis vulgaris L.*	Common barberry
*	*Bromus tectorum L.*	Drooping brome-grass
*	*Butomus umbellatus L.*	Flowering rush
^*	*Cabomba caroliniana A. Gray*	Fanwort
*	*Callitriche stagnalis Scop.*	Pond water-starwort
^*	*Cardamine impatiens L.*	Narrowleaf bittercress
^*	*Carex kobomugi Ohwi*	Japanese sedge
^*	*Celastrus orbiculatus Thunb.*	Oriental bittersweet
^*	*Centaurea biebersteinii DC.*	Spotted knapweed
	Chelidonium majus L.	Celandine
*	*Cirsium arvense (L.) Scop.*	Canada thistle
	Cirsium palustre (L.) Scop.	Marsh thistle
^*	*Cynanchum louiseae Kartesz & Gandhi*	Black swallow-wort
^*	*Cynanchum rossicum (Kleo.) Barbarich*	Pale swallow-wort
	Cytisus scoparius (L.) Link	Scotch broom
*	*Datura stramonium L.*	Jimsonweed
^*	*Egeria densa Planchon*	Brazilian waterweed
^	*Eichhornia crassipes (Mart.) Solms*	Water hyacinth
*	*Elaeagnus angustifolia L.*	Russian olive
^*	*Elaeagnus umbellata Thunb.*	Autumn olive
*	*Elsholtzia ciliata (Thunb.) Hylander*	Crested late-summer mint
^	*Epilobium hirsutum L.*	Hairy willow-herb
^	*Euonymus alata (Thunb.) Sieb.*	Winged euonymus
^*	*Euphorbia cyparissias L.*	Cypress spurge
^*	*Euphorbia esula L.*	Leafy spurge
^	*Frangula alnus Mill.*	Glossy buckthorn
*	*Froelichia gracilis (Hook.) Moq.*	Slender snake cotton
	Geranium thunbergii Sieb. & Zucc. Ex Lindl. & Paxton	Thunberg's geranium
^	*Glaucium flavum Crantz*	Yellow hornpoppy
*	*Glechoma hederacea L.*	Ground ivy
^*	*Glyceria maxima (Hartman) Holmburg*	Reed mannagrass
^*	*Heracleum mantegazzianum Sommier & Levier*	Giant hogweed
^*	*Hesperis matronalis L.*	Dame's rocket
^*	*Humulus japonicus Sieb. & Zucc.*	Japanese hops

IPANE Invasive Plants, continued

^*	*Hydrilla verticillata (L. f.) Royle*	Hydrilla
	Hydrocharis morsus-ranae L.	European frogbit
	Hypericum prolificum L.	Shrubby St. Johnswort
*	*Impatiens glandulifera Royle*	Ornamental jewelweed
^*	*Iris pseudacorus L.*	Yellow iris
*	*Kochia scoparia (L.) Schrader*	Common kochia
^*	*Lepidium latifolium L.*	Perennial pepperweed
^*	*Ligustrum obtusifolium Sieb. & Zucc.*	Border privet
	Ligustrum ovalifolium Hassk.	California privet
	Ligustrum sinense Lour.	Chinese privet
	Ligustrum vulgare L.	European privet
^*	*Lonicera x bella Zabel*	Bell's honeysuckle
^*	*Lonicera japonica Thunb.*	Japanese honeysuckle
^*	*Lonicera maackii (Rupr.) Herder*	Amur honeysuckle
^*	*Lonicera morrowii A. Gray*	Morrow's honeysuckle
^*	*Lonicera tatarica L.*	Tatarian honeysuckle
*	*Lonicera xylosteum L.*	Dwarf honeysuckle
	Luzula luzuloides (Lam.) Dandy & Wilmott	Oakforest woodrush
*	*Lychnis flos-cuculi L.*	Ragged robin
^	*Lysimachia nummularia L.*	Moneywort
*	*Lysimachia vulgaris L.*	Garden loosestrife
^*	*Lythrum salicaria L.*	Purple loosestrife
*	*Marsilea quadrifolia L.*	European waterclover
^*	*Microstegium vimineum (Trin.) A. Camus*	Japanese stilt grass
	Miscanthus sinensis Anderss.	Eulalia
^*	*Myosotis scorpioides L.*	Forget-me-not
^*	*Myriophyllum aquaticum (Vell.) Verdc.*	Parrotfeather
^*	*Myriophyllum heterophyllum Michx.*	Variable-leaf watermilfoil
^*	*Myriophyllum spicatum L.*	Eurasian watermilfoil
^*	*Najas minor Allioni*	Brittle water-nymph
^*	*Nymphoides peltata (Gmel.) Kuntze*	Yellow floating heart
*	*Onopordum acanthium L.*	Scotch thistle
	Ornithogalum umbellatum L.	Star-of-Bethlehem
*	*Paulownia tomentosa (Thunb.) Sieb. & Zucc.*	Princess tree

IPANE Invasive Plants, continued

^	*Phalaris arundinacea L.*	Reed canary grass
^*	*Phragmites australis (Cav.) Trin. Ex Steud.*	Common reed
	Pistia stratiotes L.	Water lettuce
*	*Poa compressa L.*	Canada bluegrass
*	*Polygonum caespitosum Blume*	Bristled knotweed
^*	*Polygonum cuspidatum Sieb. & Zucc.*	Japanese knotweed
^*	*Polygonum perfoliatum L.*	Mile-a-minute vine
*	*Polygonum sachalinense F. Schmidt ex Maxim.*	Giant knotweed
*	*Populus alba L.*	White poplar
^*	*Potamogeton crispus L.*	Curly-leaved pondweed
^*	*Pueraria montana var. lobata (Willd.)*	Kudzu
^*	*Ranunculus ficaria L.*	Fig buttercup
^	*Ranunculus repens L.*	Creeping buttercup
^*	*Rhamnus cathartica L.*	Common buckthorn
^	*Robinia pseudoacacia L.*	Black locust
*	*Rorippa microphylla (Boenn. Ex Reichenb.) Hyl. Ex A.& D. Löve*	Onerow yellowcress
*	*Rorippa nasturtium-aquaticum (L.) Hayek*	Watercress
^*	*Rosa multiflora Thunb. Ex Murr.*	Multiflora rose
	Rosa rugosa Thunb.	Rugosa rose
^*	*Rubus phoenicolasius Maxim.*	Wineberry
*	*Rumex acetosella L.*	Sheep sorrel
^*	*Salvinia molesta Mitchell Complex*	Salvinia
^*	*Senecio jacobaea L.*	Tansy ragwort
*	*Silphium perfoliatum L.*	Cup plant
*	*Solanum dulcamara L.*	Bittersweet nightshade
^*	*Trapa natans L.*	Water chestnut
^*	*Tussilago farfara L.*	Coltsfoot
*	*Valeriana officinalis L.*	Garden heliotrope
	Veronica beccabunga L.	European speedwell

Additional Plants Banned in Massachusetts

Scientific Name	**Common Name**
Aeginetia spp.	Aeginetia
Ageratina adenophora	Crofton weed
Alectra spp.	Alectra
Alternanthera sessilis	Sessile joyweed
Asphodelus fistulosus	Onion weed
Avena sterilis	Animated oat
Azolla pinnata	Mosquito fern
Carthamus oxyacanthus; C. oxycantha	Wild safflower; Jeweled distaff thistle
Caulerpa taxifolia	Caulerpa
Chrysopogon aciculatus	Pilipiliula
Commelina benghalensis	Benghal dayflower
Crupina vulgaris	Common crupina
Cuscuta spp.	Dodder
Digitaria abyssinica; D. scalarum	African couch grass
Digitaria velutina	Velvet fingergrass
Drymaria arenarioides	Alfombrilla
Emex australis	Three-cornered jack
Emex spinosa	Devil's thorn
Festuca filiformis	Hair fescue; Fineleaf sheep fescue
Galega officinalis	Goatsrue
Homeria spp.	Cape tulip
Hygrophila polysperma	Miramar weed
Imperata brasiliensis	Brazilian satintail
Ipomoea aquatica **(PERMIT REQUIRED—contact MDAR)**	Chinese waterspinach
Ischaemum rugosum	Murain-grass
Lagarosiphon major	Oxygen weed
Leptochloa chinensis	Asian sprangletop
Limnophila sessiliflora	Ambulia
Lycium ferrocissimum	African boxthorn
Melaleuca quinquenervia	Melaleuca

Additional Plants Banned in Massachusetts, continued

Melastoma malabathricum	Malabar melastome
Mikania cordata	Mile-a-minute; Heartleaf hempvine
Mikania micrantha	Mile-a-minute; Bittervine
Mimosa diplotricha; M. invisa	Giant false sensitive plant; False sensitive plant
Mimosa pigra	Catclaw mimosa
Miscanthus sacchariflorus	Plume grass; Amur silvergrass
Monochoria hastata	Monochoria
Monochoria vaginalis	Pickerel weed
Nassella trichotoma	Serrated tussock
Opuntia aurantiaca	Jointed prickly pear
Orobanche spp.	Broomrape
Oryza longistaminata	Longstamen rice; Red rice
Oryza punctata	Red rice
Oryza rufipogon	Brownbeard rice; Red rice
Ottelia alismoides	Duck-lettuce
Paspalum scrobiculatum	Kodo-millet
Pennisetum clandestinum	Kikuyugrass
Pennisetum macrourum	African feathergrass
Pennisetum pedicellatum	Kyasuma grass
Pennisetum polystachyon; P. polystachion	Missiongrass
Phellodendron amurense	Amur cork-tree
Prosopis pallida	Kiawe
Prosopis reptans	Tornillo
Prosopis strombulifera	Argentine screwbean
Prosopis velutina	Velvet mesquite
Rorippa amphibia	Water yellowcress; Great yellowcress
Rottboellia cochinchinensis	Itchgrass
Rubus fruticosus	Wild blackberry complex

Additional Plants Banned in Massachusetts, continued

Rubus moluccanus	Wild blackberry
Saccharum spontaneum	Wild sugarcane
Sagittaria sagittifolia	Arrowhead
Salsola vermiculata	Wormleaf salsola
Salvinia auriculata	Giant salvinia; Eared watermoss
Salvinia biloba	Giant salvinia
Salvinia herzogii	Giant salvinia
Setaria pallidifusca; S. pallidefusca; S. pumila	Cattail grass; Yellow foxtail
Solanum tampicense	Wetland nightshade
Solanum torvum	Turkeyberry
Solanum viarum	Tropical soda apple
Sparganium erectum	Exotic bur-reed
Spermacoce alata	Borreria
Striga spp.	Witchweed
Tridax procumbens	Coat buttons
Urochloa panicoides	Liverseed grass

Additional Plants Banned in Connecticut

Scientific Name	**Common Name**
Nelumbo lutea (Wild.)Pers.	American water lotus

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