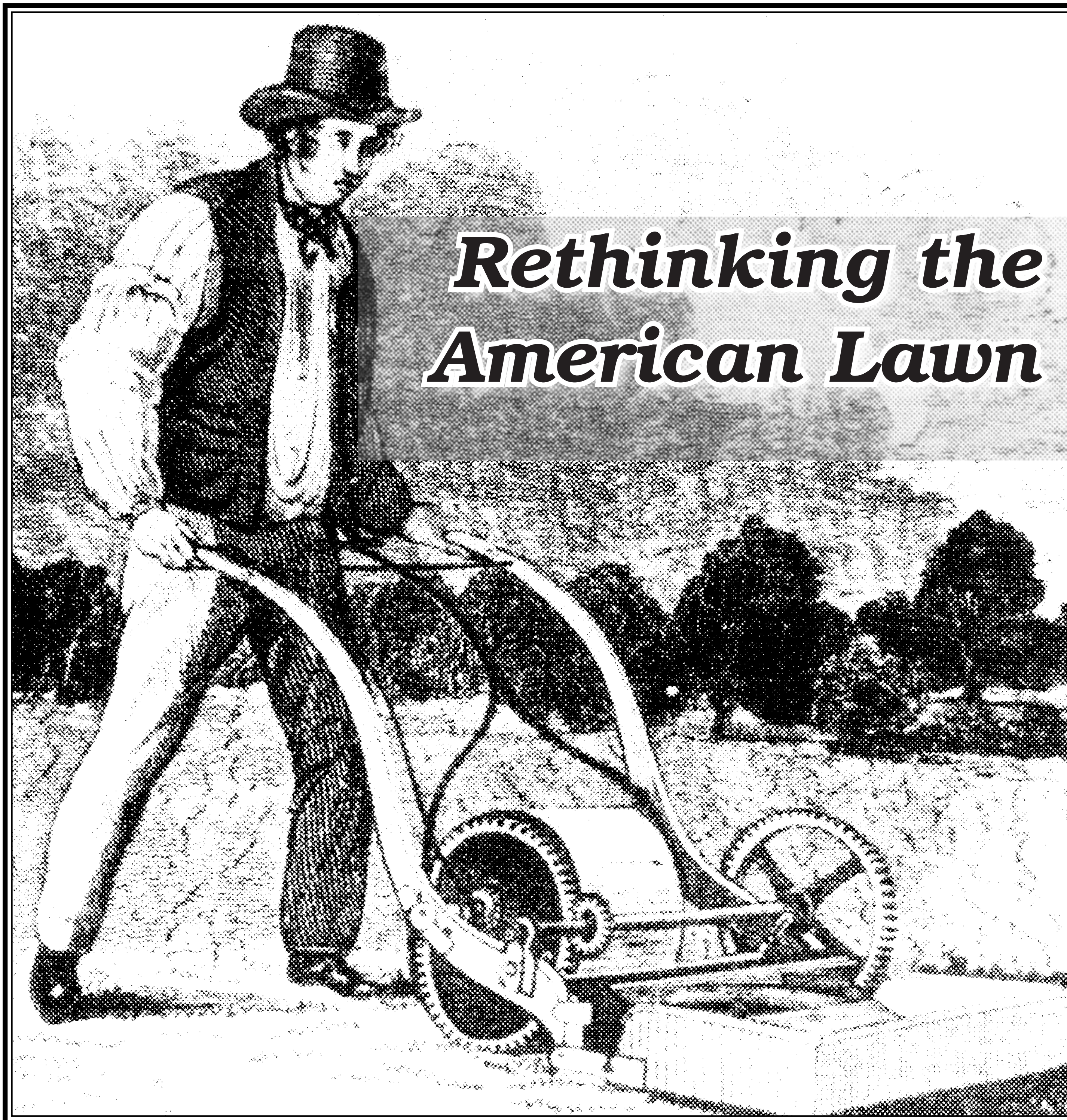
25th Year of Publication

COMMON SENSE PEST CONTROL QUARTERLY

VOLUME XXV, NUMBER 1, WINTER 2009



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B · I · R · C

The Bio-Integral Resource Center

BIRC, A NON-PROFIT CORPORATION, WAS FORMED IN 1979 to provide practical information on the least-toxic methods for managing pests. The interdisciplinary BIRC staff and an international network of advisors and research associates have designed highly effective alternative solutions to a wide variety of pest problems throughout the world. This work has been based on the principles of 'Integrated Pest Management' or 'IPM'.

IPM IS A DECISION-MAKING PROCESS that considers the whole ecosystem in determining the best methods for managing pests. The objective of an IPM Program is to suppress the pest population below the level that causes economic, aesthetic, or medical injury. IPM strategies are designed to be the least disruptive of natural pest controls, human health, and the general environment. Horticultural, physical, mechanical, biological, least-toxic chemical, and educational tactics are integrated to solve pest problems with a minimal reliance on pesticides.

THE IPM APPROACH HAS GAINED FAVOR with government and business because it is cost-effective. Community groups and pest management professionals are enthusiastic about IPM programs because the use of toxic materials is reduced while better pest control is achieved.

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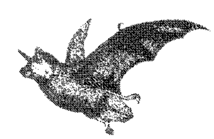
If you have a specific pest management question, first check our website, www.birc.org. Often you will find a publication that covers your problem. If you do not find the solution on our website, you can write us with a description of the pest and the problem. Include scientific names of the pest. You can also email this information to birc@igc.org. We will respond as quickly as possible.



Common Sense Pest Control Quarterly is published four times per year by the
Bio-Integral Resource Center (BIRC), PO Box 7414, Berkeley, CA 94707, 510/524-2567.

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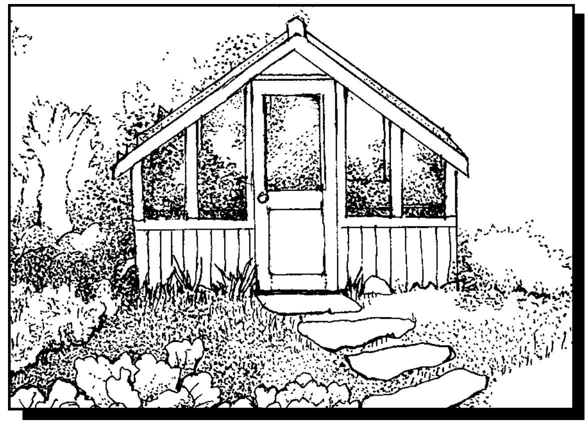
Making a Lawn Really Green



By William Quarles

The suburban lawn has become a symbol of community, personal identity, self esteem, and status. Community pressure may have caused you to sweat with seeding, overseeding, aerating, dethatching, fertilizing, mowing, fighting hungry insects and aggressive weeds. The perfect lawn may have become such an obsession that you can maintain it only by polluting the environment with a chemical cocktail of insecticides, fungicides, herbicides, and synthetic fertilizers (Jenkins 1994; Robbins 2007).

But there may be a better way. The purpose of this article is to briefly review the history of the American lawn, list some problems with lawn chemicals, describe alternatives to chemical management, and to suggest alternative landscape designs. We hope to convince landscape professionals that an organic or IPM lawn service may represent a new business opportunity.

History of the American Lawn

The "industrial" or "chemical" lawn, maintained by continuous applications of chemical pesticides, fertilizers, and large quantities of water is only about 60 years old (Bormann et al. 1993; 2001). Early U.S. settlers planted herb gardens, vegetables, and ornamentals, but did not have lawns. The first written mention of a lawn in the U.S. was in 1733, but lawns became widespread only in the late 19th century, and evolved along with inventions of the lawn mower in 1830 and the lawn sprinkler in 1871 (Jenkins 1994).

America inherited the lawn concept from Europe and England, where landscape designers such as Capability Brown made extensive use of open spaces and grassy plantings around large country estates (Bormann et al. 1993; 2001). Early U.S. lawns followed this pattern, but development of the railroad, the streetcar, and later the automobile led to a larger number of homes with smaller lawns. Developers in the 1950s built millions of suburban homes, each with its own identical lawn merging with others into a sea of green that defined communities. According to Steinberg (2006), "the lawn became the outdoor expression of fifties conformism."

Before World War II Americans were more relaxed about weeds in the lawn. Clover, in fact, was not viewed as a weed, but as desirable. After the war, an obsession developed for a perfect weedfree lawn. Synthetic herbicides were aggressively promoted by suppliers of lawn chemicals, such as O.M. Scott and Sons. To keep lawns green and weedfree all year, the company developed a calendar schedule of chemical pesticide and fertilizer applications. There was an explosion of home and garden magazines touting the perfect lawn. Many of these were supported by pesticide ads (Jenkins 1994; Robbins 2007).

It was one quick step to chemical lawn management companies. ChemLawn was founded in 1968 in Troy, Ohio and built its business entirely on applications of liquid fertilizers and pesticides. By 1998, it had two million customers and more than $142 million in sales (Jenkins 1994; Steinberg 2006).

Today there are about 58 million lawns covering 25 million acres. An additional 15 million acres of turfgrass covers roadside landscaping, 16,000 golf courses and 700,000 playing fields. More than $40 billion each year in the U.S. is spent on turfgrass (Steinberg 2006; Lawn 2009).

What's Wrong with Lawn Pesticides?

Because turfgrass is everywhere—growing on lawns, golf courses, athletic playing fields, and in municipal parks and other areas, and since pesticide treatments are often applied, there can be a significant risk of chemical exposure. Repeated applications can lead to water contamination (see Box A). At schools, children can be exposed to residues on school lawns and playing fields.

According to a Beyond Pesticides factsheet, "of 30 commonly used lawn pesticides, 19 have studies pointing to carcinogens, 13 are linked with birth defects, 21 with reproductive effects, 15 with neurotoxicity, 26 with liver or kidney damage, 27 are sensitizers or irritants, and 11 have potential to disrupt the endocrine (hormonal) system" (BP 2009a).

To be fair, these toxic results may involve doses larger than a child or dog would receive by crawling around on the lawn. But how bad is the exposure? About 78 million households use home and garden pesticides. About 90 million pounds of herbicides are used each year. About 2.8 to 3.2 pounds of pesticide active ingredient per acre are applied to lawns and gardens (BP 2009a). Just walking across a treated lawn leads to appearance of pesticides in urine (Bernard et al. 2001). Lawn pesticides can be tracked inside houses (Nishioka et al. 1999). Inside houses they degrade slowly, and exposure becomes constant (Stout et al. 2009).

These pesticides are getting inside us and our children (CDC 2003; EWG 2003). The University of

Washington analyzed urine samples from children aged 2-5 years from 96 households. Pesticide metabolites were detected in about 70% of them. Concentrations were higher when lawn and garden pesticides had been used (Lu et al. 2001).

Exposure Correlates with Health Problems

At least 18 studies show a link between pesticide use and childhood leukemia. At least 14 studies show an association between pesticide use and brain cancer. Largest risk estimates were associated with use of pesticides in the home and garden and on pets (Zahm and Ward 1998). Children are more vulnerable and are more likely to be exposed to lawn, garden, and household pesticides. From 1973 through 1989, the cancer rate of U.S. children increased. Though correlation does not prove causation, lawn pesticide applications also increased during this time. There was a 23.7% increase in leukemia, a 28.6% increase in brain and nervous system cancers, and a 26.9% increase in cancers of the kidney. These are the kinds of cancers that can be caused by chemical exposures (NRC 1993; Zahm and Ward 1998; Robbins 2007).

Living in homes and gardens treated with pesticides leads to a 6.5 fold increase in the risk of leukemia. Exposure to herbicides and insecticides have been linked to an increased risk of Parkinson's disease, and golf course superintendents are twice as likely to have brain cancer or non-Hodgkin's lymphoma as the general population (Kross et al. 1996; Solomon et al. 2000). Exposure of dogs to lawns treated with 2,4-D leads to an increased risk of canine lymphoma (Hayes 1991). Other problems with pesticides, and especially herbicides, can be found in Box A.

Pesticide Bans

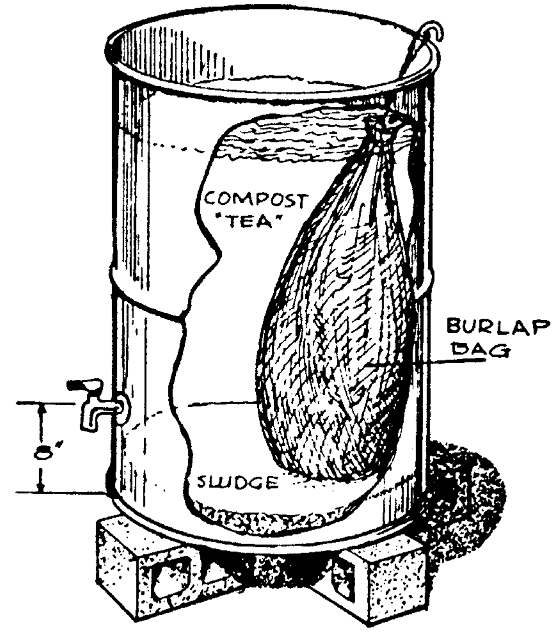
The environmental movement has grown along with the turfgrass industry, and in the last 20 years major changes have taken place nationwide. Yearly growth of ChemLawn has dropped from 25% in the 1980s to 3% a year. Now, 33 states and 400 school districts have policies or programs requiring integrated pest management, pesticide bans, or pesticide right to know provisions (Steinberg 2006; Owens and Feldman 2002; BP 2009b).

Though IPM programs and pesticide bans have been established in a checkerboard pattern throughout the U.S., Canadians have been more uniformly restrictive. Concern about possible health effects led Quebec to ban the cosmetic use of lawn pesticides in 2003. Ontario passed a similar ban on sale and use of 80 ingredients and 250 products in April 2009. Alberta banned herbicide-fertilizer lawn mixtures in 2008, and more than 100 Canadian cities have passed bans on lawn chemicals. New Brunswick has banned 2,4-D and over-the-counter sales of more than 200 lawn care pesticides. Landscapers are allowed to use these products only if they are trained and certified IPM professionals (Babbage 2009; HortIdeas 2009).

Alternatives to the Chemical Lawn

Lawn pesticide restrictions are likely to increase, as a consequence of the "green" movement in the U.S. Fortunately, there are alternatives to the chemical lawn. Alternatives include the freedom lawn, the organic lawn, the IPM lawn, and lawn replacement. The freedom lawn is the easiest. Just water and mow what you have now. Accept weed and insect intrusions as an educational process. Many people, weary of lawn labor and unwilling to use pesticides arrive at the freedom lawn by default (Bormann et al. 1993).

Another alternative is the organic lawn. The organic lawn adds good cultural techniques and organic fertilizers to the management scheme. Feeding the soil with composts, compost tea, and organic fertilizer increases microbial activity. Healthy microbial activity reduces thatch and diseases. Good cultural techniques reduce turfgrass stress. Since no toxic pesticides are added, the turfgrass benefits from biological controls, providing healthy turfgrass with few pest problems (Rodale et al. 1970; Williamson 2006).



Organic lawns use no synthetic pesticides or fertilizers. Organic fertilizers, composts, and compost teas increase microbial activity, and reduce thatch and diseases.

The IPM lawn involves pest identification and learning pest lifecyles and biology. Monitoring leads to informed management so that treatments are used only when necessary. Resistant turfgrass species and good cultural practices prevent pest problems that would require chemicals. Physical methods, ecological balance, and natural biological controls are part of the picture. As a last resort, least-toxic chemical treatments can give relief when stresses or extremes have disturbed the natural balance (Olkowski et al. 1991; Quarles 2001; Quarles 2006).

School districts and municipalities switching to IPM methods have found that intensive chemical management is not necessary. Lawns and turf can be maintained by organic methods, integrated pest management (IPM), and good cultural practices (see below) (Daar and Drlik 1997; Schultz 1989; Sachs and Luff 2002).

IPM or Organic Lawn Management Companies

IPM or organic management provides new business opportunities for lawn companies. There are customers that want chemical free lawns, but do not have the time or the knowledge to maintain them. Professional lawn care companies earned about $5.6 billion from about 5 million customers in 1995, so the market is

Box A. Problems with Urban Pesticides

Glyphosate may be one of the more benign herbicides, yet it is surrounded with controversy. Part of the problem is that glyphosate is applied more than any other herbicide in the U.S. About 5-8 million pounds are used on lawns, and 85-90 million pounds are used in agriculture each year. In various formulations such as Roundup®, Rodeo® and others, it kills a wide variety of species including grasses, broadleaf, and woody plants. There is widespread exposure to glyphosate. A large scale USGS study from 2001 to 2006 found that glyphosate or its degradation products could be found in 57% of the streams and 15% of the wells in the U.S. (Scribner et al. 2007).

Glyphosate itself has low acute toxicity and is not a carcinogen (Franz et al. 1997). However, some of the inerts in the formulation may cause toxicity problems. Ingestion of about 85 ml of the concentrated formulation can be deadly. According to the CA EPA Pesticide Illness Surveillance Program, glyphosate herbicides cause more illnesses than any other pesticide. Inhalation of aerosols can cause irritation and discomfort, and eyes can be damaged if exposed. Exposure to glyphosate formulations has been associated with certain kinds of cancer (Cox 2004; Steinberg 2006; Bradberry 2004; Robbins 2007). Roundup is also toxic to amphibians and aquatic life (Giesy et al. 2000; Relyea 2005)

Recent laboratory tests show that concentrations of glyphosate formulations typically found as residues in food can kill human cells. Roundup may also be an endocrine disruptor. Effects vary with the inert ingredients in the formulation (Benachour and Seralini 2009; Benachour et al. 2007).

Urban Water Quality Problems

Application of lawn chemicals is causing pollution of water (Larson et al. 1997; Beard and Kenna 2008; Barbash and Resek 1996). According to the latest study produced by the U.S. Geological Survey, more than 97% of urban streams and more than 55% of urban wells are contaminated with at least one pesticide. About 6.7% of the stream sites and 4.8% of the wells had concentrations that exceeded human health benchmarks. About 83% of the urban streams had pesticide concentrations that were hazardous to aquatic life. In urban areas, five lawn and garden herbicides and three insectides were found most frequently. The urban herbicides were simazine, prometon, tebuthiuron, 2,4-D, and diuron. The insecticides were diazinon, chlorpyrifos, and carbaryl. Urban streams also showed contamination with agricultural herbicides such as atrazine (Gilliom 2007; Gilliom et al. 2007), which is associated with hormonal problems in amphibians (Hayes et al. 2002).

So many mixtures were found, the authors believed that "the total combined toxicity of pesticides in aquatic ecosystems may often be greater than that of any single pesticide that is present" (Gilliom 2007). Water contamination may be a health problem, since seasonal variations of pesticides in water correlate with increased birth defects and birth of premature babies (Winchester et al. 2009).

The USGS study period was 1992-2001, and since then insecticides applied have changed. Diazinon, chlorpyrifos, and carbaryl have been restricted in urban areas, and have been replaced by pyrethroids, fipronil, imidacloprid and others (Moran 2005).

Persistent Herbicides

Herbicides have become a problem in water, but they can also contaminate compost. Most problematic are the persistent herbicides clopyralid and picloram. Clopyralid is used on lawns to control dandelions, clovers, and other broadleaf plants. Because of its persistence, one or two applications can last a whole season. Unfortunately, clopyralid can damage sunflower, beans, tomatoes and potatoes at extremely low soil concentrations—about 10 parts per billion. These minute concentrations can appear in municipal composts or in home composts produced from treated grass clippings (Bezdicek et al. 2001; Houck and Burkhart 2001).

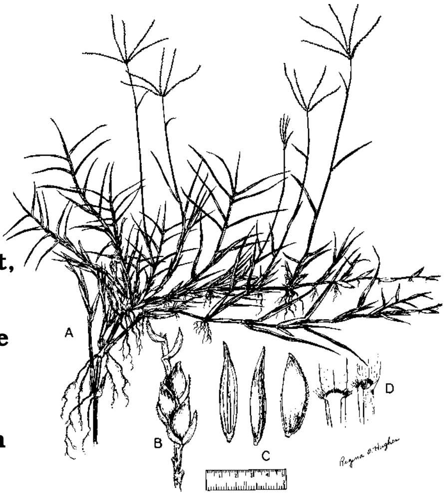
Resistant Weeds

Another problem with herbicides is that either weeds become resistant or that continued use changes the weed spectrum so that susceptible annual weeds are killed, but more difficult perennial weeds invade the area. There are at least 55 weed species resistant to atrazine alone (LeBaron and McFarland 1990). Worldwide, there are at least 216 herbicide-resistant weed species (Green et al. 1990).

Application of herbicides to lawns can encourage some weeds. Use of the herbicide 2,4-D encourages oxalis. Nutsedges have become more common in California partly due to overreliance on herbicides that kill competing weeds but are not very effective on nutsedge (Elmore 1994).

potentially a large one (Christians 2007). Companies can consult with customers to set tolerance levels for weeds. Plants such as clover or daisies might be tolerated at relatively high levels, others like plantain would have low action thresholds. Monitoring and good cultural management techniques (see below) can be combined with organic and slow release fertilizers. Lawns can be adequately maintained with relatively high treatment thresholds, such as 5-15% weed cover, or 15-30 chinch bugs, *Blissus spp.,* per square foot. Pesticide treatments of any kind are rarely necessary (Daar 1992; Quarles 2006).

Drought resistant, hardy turfgrass that fits your climate should be chosen. Pictured here is bermudagrass, *Cynodon dactylon,* a warm season grass.



Choice of Turfgrass

Alternatives to the chemical lawn start with proper choice of turfgrass. Turf species chosen for your lawn should be adapted to your climate. Kentucky bluegrass, *Poa pratensis*, is a favorite cool season grass. Other popular cool season grasses are fescues, bentgrasses, and ryegrasses. Warm season grasses include bermudagrass, zoysiagrass, centipedegrass, bahiagrass, and St. Augustinegrass (Christians 1998; Christians 2007). Grass mixtures are often used for turfgrass plantings. One popular mix is 80% fine bladed tall fescue, *Festuca arundinacea*, and 20% perennial ryegrass, *Lolium perenne*. This mixture is hardy and resistant to trampling and wear. New seedings begun in late summer will be denser and less prone to weed infestation than turfgrass planted at other times of the year (Daar 1992; Schultz 1989).

Cool-season grasses are planted in the fall or spring, and warm-season grasses in the spring or early summer. Generous use of seeds will help crowd out weeds. Using sod instead of seeds can also help stop weed emergence (Elmore 1993).

Some turfgrass cultivars are resistant to insects, disease, and require low maintenance. One outstanding candidate is the native turfgrass, buffalograss, *Buchloe dactyloides*. It grows to about 4-6 inches (10-15 cm), then stops growing. It requires little or no fertilizer or mowing, and 75-80% less water than bermudagrass or Kentucky bluegrass (see Resources) (Wasokowski and Wasokowski 1993; Daniels 1999).

Endophytic and Allelopathic Turfgrass

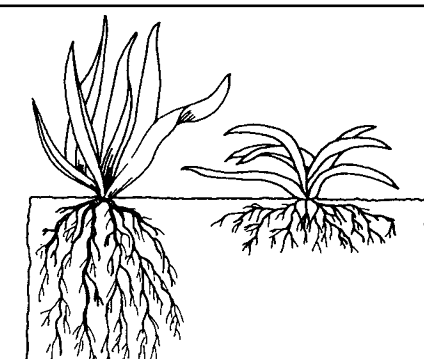
Allelopathic turfgrass such as ryegrass and tall fescue can help with weed problems. Lawn mixtures of tall fescue, *Festuca arundinacea*, and perennial ryegrass, *Lolium perenne*, will suppress prostrate pigweed, *Amaranthus blitoides*. Oxalis and large crabgrass is suppressed by the tall fescue culivars “Falcon” and “Olympic” (Elmore 1990).

Tall fescue cultivars “Missouri-96” and “Kentucky 31” has suppressed large crabgrass, *Digitaria sanguinalis*; birdsfoot trefoil, *Lotus corniculatus*; and red clover, *Trifolium* sp. Pest resistant ryegrass and fescue cultivars containing endophytic VAM fungi are commercially available. A low maintenance blend called Eco-Lawn™, composed of seven fine fescue grasses is resistant to insects and weeds (see Resources). Although effects are complicated, and might be site-specific, lawns constructed of these cultivars are more resistant to weeds, diseases, and some insects (Dilday et al. 1997).

Cultural Methods

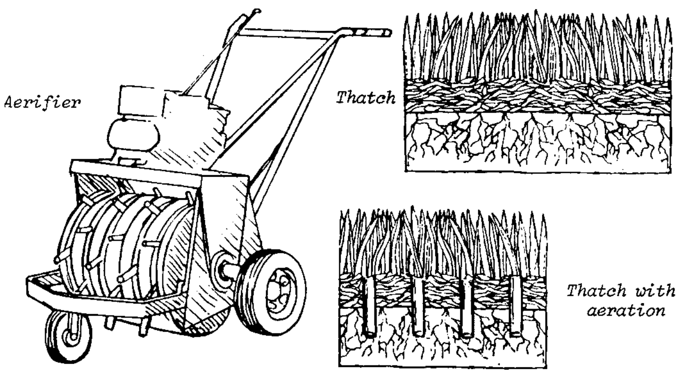
Good cultural practices are described in many books on turfgrass maintenance (Christians 2007; Madison 1971; Sachs and Luff 2002; Leslie 1994; Watschke et al. 1995). Weeds in lawns can be discouraged by reducing stress on the turfgrass, by proper watering and fertilization. For example, drought in California lawns encourages dandelion, clover, bermudagrass and knotweed. Excess water encourages annual bluegrass, crabgrass and bentgrass (Elmore 1994).

Appearance of weeds in a lawn are often signs of compacted soil, poor drainage or improper nutrition (Quarles 2001). Fertilize well with slow-release fertilizers such as corn gluten meal, or use a top dressing of composted steer manure. Lawn clippings left as a mulch are a good source of fertilizer. Weeds can also be discouraged by application of a shredded mulch of oak and maple leaves (Kowaleski et al. 2009). Do not overwater, but do not let the lawn wilt. Infrequent, deep watering is best for weed control (Daniel and Freeborg 1975: Daar 1992; Christians 1998; Sachs and Luff 2002; Busey 2003).



Pick turfgrass such as buffalograss, *Buchloe dactyloides,* that requires little water. When you water, water deeply and infrequently to increase root structure.

Fertilization can affect the weed spectrum on a lawn. Field experiments have shown that dandelions, *Taraxacum officinale*, may be encouraged by potassium rich fertilizers or additions of lime. This is another reason to use composts and other natural fertilizers for lawns (Tillman et al. 1999). Acidic soil also discourages dandelions (Busey 2003). In general, fertilization of cool season turfgrass is best in spring and fall, warm season grasses should be fertilized in the summer (Christians 1998; Christians 2007).



Aeration of soil helps increase microbial activity and eliminates excessive thatch.

Aeration and Thatch Removal

Healthy turf is more resistant to weeds, insects and diseases. Coring the soil with either a machine or a hand tool can help aerate the lawn, reduce soil compaction, and break up thatch (see Resources). The soil cores can then be broken up and worked back into the soil with a top dressing of screened compost and new grass seeds (Daar 1992). Increased thatch may be due to the chemical lawn approach, as heavy treatment with synthetic fertilizers and pesticides can kill microbes that degrade thatch (Jenkins 1994).

Coring turf to improve aeration can also bring weed seeds to the surface. To reduce problems, aeration should be done when the grass is growing vigorously. Aeration should not be done when weed seeds are germinating. Thus, if most of the weeds are spring annuals, aeration should be done in the late summer (Christians 1998; Christians 2007).

Sometimes aeration or thatch removal can be combined with overseeding. Frequent overseeding with perennial ryegrass in stands of Kentucky bluegrass has been shown to decrease weed problems and helps maintain vigorous turfgrass stands (Elford et al. 2008).

Mowing Height

For weed control, the higher the mowing height the better, because the taller grass shades weed sprouts from sunlight and helps to crowd them out. However, the best height varies with the turfgrass species, the site and the climate. Bluegrasses withstand weeds better when cut to 2 inches (5.1 cm) or higher. Bentgrass, bermudagrass, and zoysiagrass that have prostrate growth habits should not be mowed higher than 1 inch (2.54 cm) to avoid excessive accumulation of thatch (Daar 1992; Christians 1998).

Active Controls

IPM methods for lawn insects were reviewed in the Winter 2006 *Quarterly*. Common pests are grubs, billbugs, chinch bugs, cutworms, mole crickets, and sod webworm. Cultural controls such as proper fertilization and watering, physical controls, such as traps, and biological controls such as nematodes, BT, and beneficial fungi, can be integrated with least-toxic chemical controls such as neem, insecticidal soap, natural pyrethrins, and spinosad (Quarles 2006). Suppliers of least-toxic products can be found in the *2009 Directory of Least-Toxic Pest Control Products* (BIRC 2008).

The easiest treatment for lawn weeds is to ignore or tolerate them. Some "weeds" are even aesthetically pleasing and break up the monotony of a "perfect" lawn. When lawn weeds reach levels where they cannot be tolerated, active controls such as hand pulling, mechanical removal, flaming, hot water or least-toxic herbicides can be used (see Resources). Flaming can kill broadleaf weeds while sparing turfgrass (see Quarles 2003 for a description of weed control by flaming; see Resources for flamers). The Weed Hound and the dandelion knife make mechanical weeding easier (see Resources).

Some lawn weeds can be stressed and killed with hot water. Before using the water, rake and chop into the weedy area. Then pour about a half gallon of boiling water per square foot on the weeds. After adding water, cover with a tarp or other material to hold the heat (Freeborg and Daniel 1975).

Biocontrol nematodes watered into the soil will kill destructive grubs of the Japanese beetle, *Popillia japonica*.

Corn Gluten Meal

Though vinegar, soap and other least-toxic post-emergent herbicides are commercially available (see

Specialized weeding tools can help control lawn weeds.

Resources), the only least-toxic pre-emergent herbicide is corn gluten meal. Corn gluten meal (CGM) is a waste product left over from the processing of corn to produce corn syrup. Corn gluten meal is 60% protein and approximately 10% nitrogen (N) by weight. It has been used as an ingredient in dog food, fish food, and other animal feeds (Christians 1991; Christians 1995).

Its high nitrogen content and herbicidal properties make corn gluten meal a near ideal "weed and feed" product. The product can be applied to mature turfgrass as a top dressing and fertilizer. Over time, it acts as a pre-emergence herbicide that suppresses growth of annual weeds such as crabgrass, *Digitaria* spp., clover, *Trifolium* spp., and dandelion, *Taraxacum officinale*. Reductions of about 90% were seen over a 4-year period (Bingaman and Christians 1995; Christians 1991; Christians 1995).

Corn gluten meal can now be purchased at feed stores and from a number of garden suppliers (see Resources). The suppliers may or may not choose to label it an herbicide, but in any case, it is exempt from EPA registration (Quarles 1996; DPR 1999).

Alternate Lawns

If you are tired of the constant mowing, fertilizing and watering that a well-maintained lawn demands, you might want to try an alternate groundcover. Although these "alternate lawns" will not take the wear and tear of grass, if you have low traffic they might be what you need. Among the possibilities are chamomile,

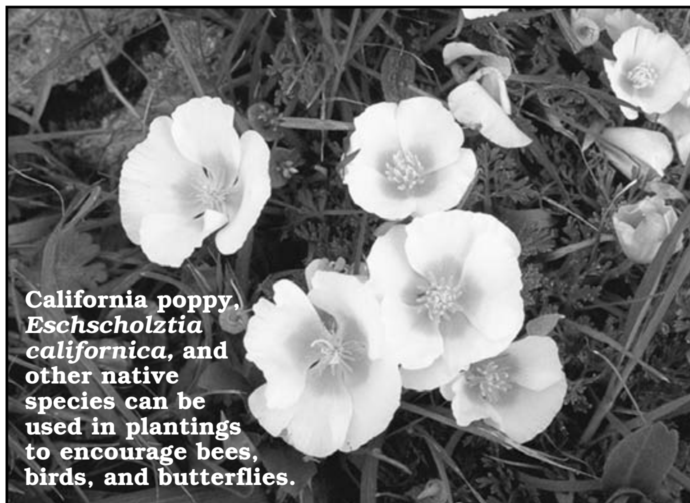
Lawns can be replaced by gravel mulch, by native grasses, ornamental planting beds and other landscape designs. Results are often pleasing, requiring less water and maintenance.

Chamaemelum nobile; dichondra, *Dichondra micrantha*; lippia, *Phyla nodiflora*; irish moss, *Sagina subulata*; thyme, *Thymus serphyllum*; and bugleweed, *Ajuga* spp. (Arbuckle 1993).

Lawn Replacement

Some families need lawns. They have young children or pets, and a lawn can provide a lot of happiness for them. If turfgrass is needed, it can be managed by organic or IPM methods. For other families, an outdoor patio or deck can be combined with habitat for butterflies, bees, birds or other wildlife. These kinds of gardens can give as much or more personal enjoyment than turfgrass growing in a backyard lawn (Marinelli and Roach 1993; Quarles 2004).

Lawn replacement has been touted by a number of high profile gardening magazines. One alternative is mowed pathways in native meadowgrasses and wildflowers. America is blessed with a number of strikingly beautiful wildflowers such as California poppy,



California poppy, *Eschscholztia californica,* and other native species can be used in plantings to encourage bees, birds, and butterflies.

Photo courtesy Br. Alfred Brousseau

Eschscholtzia sp.; black-eyed susan, *Rudbeckia* spp., purple blazing stars, *Liatris* spp., and others. Seed mixtures are available to suit the needs of your climate (Daniels 1999). Mowed, gravel, or flagstone pathways can be integrated with strategically placed raised beds containing vegetables and herbs. Sheet mulching can be used to convert part of your lawn to planting beds (Quarles 2008a).

Butterfly, Bee, and Bird Gardens

Plants attractive to butterflies include butterfly bush, *Buddleia davidii*; yarrow, *Achillea millefolium*; aster, *Callistephus* sp.; coneflower, *Echinacea purpurea*; lavender, *Lavendula* sp.; lilac, *Syringa* sp.; burning bush, *Dictamnus* sp. and others. Much information on butterfly gardens is available on the internet and in classic books on the subject (Xerces 1990).

Birds need trees for shelter. Plants that provide seeds, berries, or fruit are also attractive. Sunflower, *Helianthus* sp.; *Cosmos* sp., purple coneflower, *Echinachea* sp., manzanita, *Arctostaphlos* sp., crabapple, *Malus* sp., elderberry, *Sambucus* sp., cotoneaster, and blackberry are attractive to birds. Extensive lists can be found on the internet and helpful advice can be found at your local horticultural nursery (Roth 1998).

Plantings for bee gardens were reviewed in the last *Quarterly* (see Quarles 2008b). Attractive plants include scorpion weed, *Phacelia* spp.; sunflower, yarrow, mints, borage, bachelor's button, blackeyed susan and others.

Conclusion

Turfgrass is not necessarily bad, but each of us should examine whether or not a grassy front yard really fits our needs. There are a number of other options such as bee, bird and butterfly gardens or plantings of herbs and vegetables that may actually fit better as a representation of personal identity and needs. For those who want to give up the constant mowing that a lawn entails, an alternative groundcover or buffalograss can be planted.

If you decide to keep your lawn, use organic or IPM methods to maintain a truly green lawn that does not pollute the environment. Lawn weeds can often be controlled by cultural methods and mowing. In some cases, limited physical controls such as hand pulling, flaming, or a weeding tool may be necessary. Occasionally, a least-toxic pesticide may be needed. An organic or IPM lawn is truly green, and may be a better representation of your personal identity and your dedication to the community than the chemical lawn approach.

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Resources

Buffalograss-**Seedland**, 9895 Adams Rd., Wellborn, FL 32094; 386/963-2079, Fax 386-963-2079; www.seedland.com. **Bamert Seed Co.**, 1897 CR 1018, Muleshoe, TX 79347, 800/262-9892, www.bamertseed.com

Corn Gluten Meal—**Gardens Alive**, 5100 Schenley Place, Lawrenceburg, IN 47025; 812/537-8650 or 812/537-8652, Fax 812/537-8660; www.gardensalive.com; **Grain Processing Corporation**, 1600 Oregon St., Muscatine, IA 52761; 563/264-4265, Fax 563/264-428; www.grainprocessing.com, **Soil Technologies**, 2103 185th Street, Fairfield, IA 52556; 800/221-7645, 641/472-3963, Fax 641/472-6189, Peaceful Valley (see below)

Endophytic Lawn Grasses—**Pennington Seeds**, PO Box 1280, Atlanta Hwy, Madison, GA 30650; 706/342-1234, 706/342-0446; www.penningtonseed.com; **Turf Seed,** 7644 Keene Rd., Gervais, OR 97026; www.turfseed.com; **Wildflower Farm** (Eco-Lawn™), Coldwater, ON L0K 1E0, 866/476-9453, www.wildflowerfarm.com

Flamers— **Flame Engineering Inc.**, PO Box 577, LaCrosse, KS 67548-0577; 800/255-2469, 785/222-2873, Fax 785/222-3619; www.flameengineering.com , Peaceful Valley (see below)

Herbicidal Essential Oils—**Marrone Bio Innovations** (Greenmatch®), 2121 Second St., Suite B-107, Davis, CA 95618; 530/750-2800; www.marronebioinnovations.com. **EcoSmart Technologies** (Matran®), 318 Seaboard Lane, Suite 208, Franklin, TN 37067; 888/326-7233, Fax 615/261-7301; www.ecosmart.com; **St. Gabriel Laboratories** (Burnout®), 14044 Litchfield Rd., Orange, VA 22960; 800/801-0061, 540/672-0866, Fax 540/672-0052; www.milkyspore.com

Herbicidal Fatty Acids—**Planet Natural** (Scythe®), 1612 Gold Ave., Bozeman, MT 59715; 800/289-6656, 406/587-5891, Fax 406/587-0223; www.planetnatural.com

Herbicidal Soap—**Woodstream**, 69 N. Locust St., Lititz, PA 17543-0327; 800/800-1819, 717/626-2125, Fax 717/626-1912; www.woodstreampro.com

Lawn Seed—**Peaceful Valley Farm Supply**, PO Box 2209, 110 Springhill Drive, Grass Valley, CA 95945; 530/272-4769. **Harmony Farm Supply,** 3244 Gravenstein Hwy, No. B, Sebastopol, CA 95472; 707/823-9125.

Nematodes— **BioLogic**, PO Box 177, Willow Hill, PA 17271; 717/349-2789, Fax 801/912-7137; wwwbiologicco.com; **Hydro-Gardens, Inc.**, PO Box 25845, Colorado Springs, CO 80936; 800/634-6362, 719/495-2266, Fax 719/495-2266; www.hydro-gardens.com; **Nature's Control**, PO Box 35, Medford, OR 97501; 800/698-6250, 541/245-6033, Fax 541/899-9121; www.naturescontrol.com

Turf Hound (aeration tool)—**Hound Dog Products,** 465 Railroad Avenue, Camp Hill, PA 17011; 800/393-1846, Fax 800/567-1904; www.hound-dog.com

Vinegar— **Ecoval**, 293 Church Street, Oakville, ON, Canada L6J 1N9; 866/298-2229, Fax 866/239-8342; www.naturesglory.com

Weed Hound (weeding tool)—**Hound Dog Products,** 465 Railroad Avenue, Camp Hill, PA 17011; 800/393-1846, Fax 800/567-1904; www.hound-dog.com

Weeding and Aeration Tools—local hardware store

*For other suppliers see the *2009 Directory of Least-Toxic Pest Control Products*, Bio-Integral Resource Center, PO Box 7414, Berkeley, CA 94707; 510/524-2567, birc@igc.org

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