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1995 Technical Resource Issue

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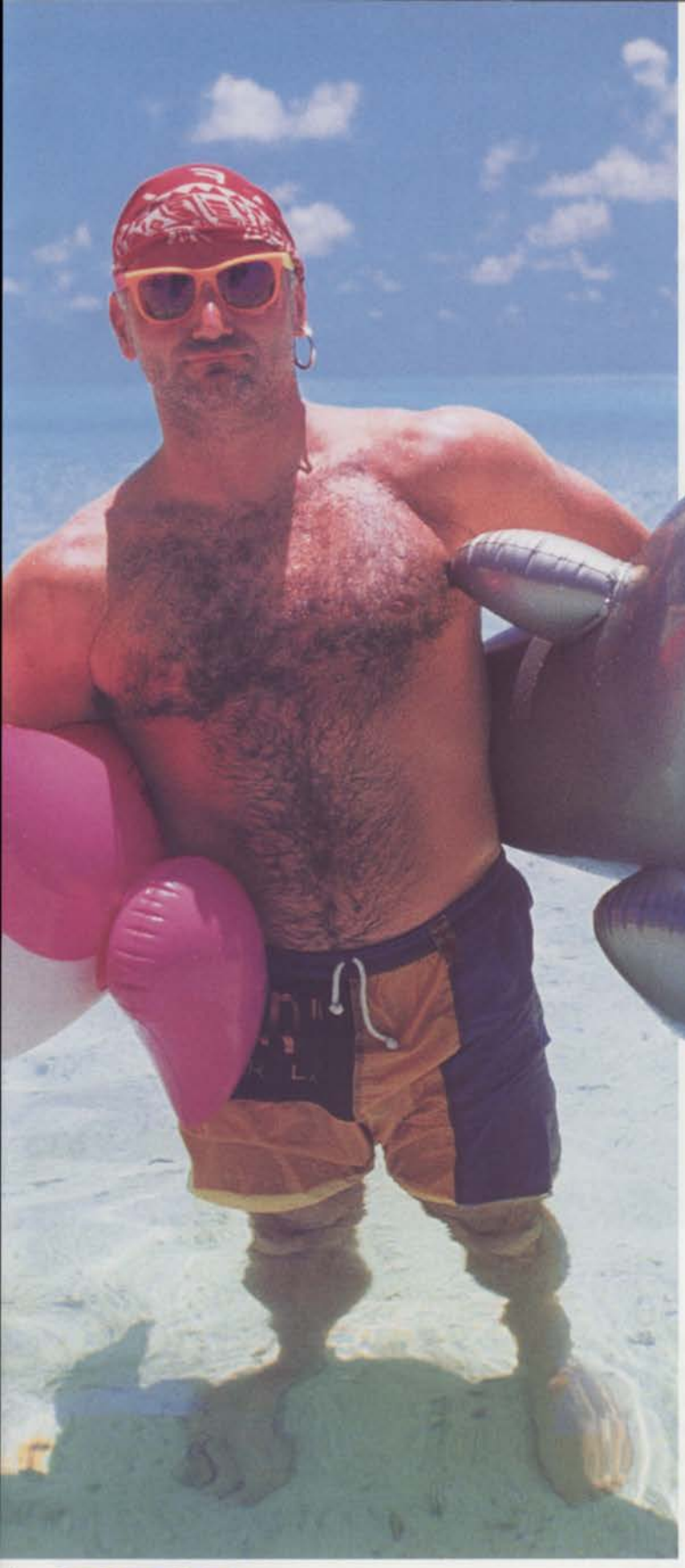

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December 1995 • Volume 16 • Number 12

Lawn&Landscape

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ISS Landscape Management Services, Atlanta, Ga.

Cover Photo

This commercial landscape sits atop the deck of a parking garage, and is part of the Promenade II corporate grounds in downtown Atlanta. The grounds, measuring approximately one acre, are maintained by ISS Landscape Services, and are billed at $75,000 per year. The project won ISS the Associated Landscape Contractors of America's Grand Award for Commercial Landscape Maintenance, Office and Industrial Sites.

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EDITOR'S NOTES

Sue Gibson
Editor

It's amazing how much energy this industry generates. The new logo of *Lawn & Landscape* carries a message that we serve "the $40 billion professional landscape contracting market." That number in itself is incredible, but at the industry's main event — the Green Industry Expo — the reason seems obvious. The place is full of energy, ambition, possibilities.

I really enjoy seeing all the industry's elements come together in one place each year — the contractors, suppliers, associations, the media, newcomers, old-timers, followers and leaders.

It's fascinating to watch new contractors learn the basics of business operation and horticulture and it's interesting to see the industry's movers and shakers share their knowledge and pass on the reins of leadership. I'm encouraged when I see new volunteers step forward each year to accept the burden of leadership for their organizations. It's exciting to see new products, services and companies make this pilgrimage.

Many people attend these events because they're heavily committed to professionalism and the benefits that the three associations offer. Others come to shop, meet and socialize with their peers, learn how to solve a problem that's been bugging them, share their own solutions or just observe the scene.

Any astute observers at this year's GIE show in Fort Worth saw an industry that continues to grow with great vigor, consolidate power in different markets and challenge every company large and small.

And make no mistake about it — energy and strength are rooted in challenge. You don't become a smart business person without making mistakes and learning from them. You can't really know what to expect from that storm front up ahead unless you've already weathered a few storms. There's no gain without some pain.

The keynote speaker, former POW Charlie Plumb, gave an excellent and stirring example of overcoming challenge. Fortunately, very few of us have had to suffer like he did in captivity, but we can all learn the same lessons: that we have to control our own businesses, that we need to rely on others to help us solve problems and that we must take risks in order to achieve larger goals.

Capt. Plumb's obvious strength and positive outlook should be inspiring to all of us when we're challenged in business. The process of overcoming challenges energizes all of us when we succeed. It can make a company more focused, more competitive and more long lasting. — Sue Gibson LL

Lawn&Landscape

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Managing Diseases In Turf & Ornamentals

Plant diseases are harder to control than pest or weed infestations. They can be managed, however, with good cultural practices and the use of specialty fungicides.

By Joe Rimelspach

FEW THINGS in life can be controlled. You cannot control the weather, your employees, what plants are growing in existing landscapes, what customers want from a landscape service and more. And you cannot control plant diseases! You can manage landscapes, influence the health of plants, and change plants in the landscape, but you will be hard pressed to completely control plant diseases. They can be managed, but not totally controlled.

Managing disease problems in the landscape is a challenging and complex process, even for the best landscape manager. Part of the difficulty is that plant diseases are compared to insect and weed problems, which usually can be seen with the naked eye and frequently are outside of the plant. Because it is easier to identify the insect or weed, it is easier to assess "control." Since diseases are caused by microscopic organisms — pathogens — and are usually inside the plant, identification of the problem and assessing "control" is difficult.

PLANT HEALTH MAINTENANCE. Understanding how to maintain plants in a healthy condition is the key to preventing most plant diseases. They are caused by pathogenic organisms that are opportunistic. They prey on weak or stressed plants. By keeping plants growing well, disease problems can usually be reduced or prevented.

This is not an all or nothing situation, but the degree of disease prevention will vary depending on how weak the plant becomes, how the environment affects the disease causing organism, the plant's genetic makeup and its susceptibility to disease.

Plant health maintenance can be separated into two parts: planting and installation, and caring for established plants.

Fungicide diseases like cedar apple rust gall shown on a jumiper are more prevalent in warm, wet springs. Management strategies may include pruning galls and thinning out plants. Photo credit: Joe Rimelspach

A HEALTHY START. Getting a lawn and landscape off to the right start will really pay off in reduced disease problems.

The key to success is the soil. The challenge is to improve the soil and correct problems such as compaction, poor drainage, low organic matter, nutrient imbalance, pH, buried debris and improper grading.

Healthy plants need improved levels of organic matter and soil nutrients. Incorporating compost can have a tremendous impact on improving soil. Remember, all sources of organic matter are not equal. Obtain materials from reliable and reputable suppliers. Find one that has quality, well composted material and it will serve you well in managing healthy plants and landscapes.

A good quality topsoil can be incorporated to the existing soil. Again, have a high confidence level in the quality of soil you are getting and be aware of weeds, herbicides and other undesirable elements that can be brought in on soil.

Plant selection is the next step. Match the plant to the site. Select plants with documented disease resistance to the major problems in the landscape. These will vary with different regions of the country, but the accompanying tables show the more common diseases.

Select healthy plants and sod. Look for obvious signs of insects or diseases. Avoid sod with a thick layer of thatch or the kind that has been grown on a soil of a dramatically different soil structure (such as sod grown on a peat soil to install on a heavy clay). Avoid trees and shrubs with wounded trunks, cankers, small root balls or plants that have not been cared for properly by the grower.

Use care when planting the lawn, trees, shrubs and flowers. Finally, water and maintain the plants until they become established at the new site. This may take anywhere from six months to several years.

INHERITED PROBLEMS. Existing landscapes are where many maintenance contractors inherit plant and site problems that can affect plant health. The genetics of the plants cannot be changed and often, only minor changes can be made with the soil and site, so very real expectations should be established with the customer as to what can be done to "control" disease problems. A weak or stressed plant may not be diseased today, but will be prone to problems tomorrow.

The following are some approaches to maintaining existing landscapes for greater plant health:

- Prune trees and shrubs to prevent crowding and provide better air circulation. By improving air flow, leaves will dry faster, which reduces disease problems on foliage. Remove crowded plants to allow adequate space for root growth and development. Crowded plants compete for nutrients, water and light and are more sickly.
- Mowing is the most frequent maintenance practice of turfgrass care, so follow the golden rules of mowing to have the greatest impact on turf health. Mow with sharp blades at the recommended height and frequency.

Improper mowing stresses turf and can result in brown grass and disease problems. Some of the most common problems are scalping, mowing turf that is wilted or under moisture stress, mowing the same pattern and allowing the grass to grow too tall. These practices can contribute to serious problems with leaf spot and patch disease problems.

- Fertilization is a tremendous tool to maintain healthy plants situated in a low quality of soil. Many of the new turfgrass cultivars have vigorous growth and need adequate fertilization to achieve their optimal growth potential. Fertilization levels for lawns will vary, but often 2 to 6 pounds of N per 1,000 square feet per year is recommended. Use soil testing to determine the right ratio of P and K levels.

Trees, shrubs and flowers will also require fertilization to be healthy. The type of soil required by these plants and the nutrients available at the site will influence the amount and frequency of fertilization needed. There have been great improvements in the fertilizer industry with many new slow-release and poly-coated products available. As with turf, use soil tests to know how much P and K to apply.

- Watering is essential for all plant growth. The trick is to have the right amount. Too much or too little will cause plants to be stressed and may lead to disease problems. One of the most common problems is root rot from overwatering and from poor drainage.

There is no secret to proper watering other than to have uniform soil moisture in the root zone of the plant. It sounds so simple, yet as we all know, it can be challenging to achieve. Many

diseases can be dramatically increased if plants are subjected to widely fluctuating soil moisture levels (dry to flooded). These include: pythium, phytophthoro and verticillium wilt.

• Soil compaction is the common term, but the real problem is the lack of adequate oxygen in the root zone. Plant roots require air to breathe just like you and me. In many cases, if soil oxygen levels are increased, plant health greatly improves. Aeration of low oxygen soil is highly recommended for turf, trees and shrubs. Soil aeration alone has improved tree growth equal to or greater than fertilization where grown in heavy clay soils. In the case of flowers, plant them in an improved soil mix in the flower bed.

• Much has been written about the benefits of mulching and its ability to

(continued on page 12)

Turfgrass Diseases *(Characteristics and Management)*

DISEASE NAME *(Pathogen name)*	SUSCEPTIBLE GRASS	TEMPERATURE/MOISTURE (that encourages disease)	*MANAGEMENT STRATEGIES
Brown Patch/Rhizoctonia Blight *(Rhizoctonia solani)*	TALL FESCUE Ryegrass Kentucky bluegrass Fine Fescue	Hot/wet	1. Avoid excessive nitrogen fertilization. 2. Avoid excessive watering and poor drainage. 3. Remove surrounding vegetation; increase sunlight.
Dollar Spot *(Sclerotinia homeocarpo)*	BLUEGRASS BENTGRASS Fescues Ryegrass	Moderate/wet leaves and dry soil	1. Avoid nitrogen deficiency. 2. Choose resistant grass varieties. 3. Water to increase growth.
Leafspot/Melting Out *(Drechsler & Bipolaris spp.)*	(Leafspot: spring and fall) (Melting Out: summer) KENTUCKY BLUEGRASS FINE FESCUE Ryegrass	Leafspot — cool/wet Melting Out — hot/dry Tall fescue	1. Raise cutting height. 2. Mow frequently to avoid stressing turf. 3. Avoid excessive nitrogen. 4. Avoid light, frequent watering and prolonged wet grass.
Necrotic Ring Spot *(Leptosphaeria korrae)*	KENTUCKY BLUEGRASS Ryegrass	Warm, extremes in soil moisture (fluctuating from wet to drysoils)	1. Avoid low mowing heights. 2. Reduce excessive thatch. 3. Use Kentucky bluegrass and perennial mixtures. 4. Avoid excessive watering or drought stress. 5. Use very slow release fertilizer.
Powdery Mildew *(Erysiphe graminis)*	KENTUCKY BLUEGRASS Fine fescue	Moderate/high humidity	1. Reduce shade. 2. Increase air circulation by removing surrounding vegetation. 3. Use resistant Kentucky bluegrass varieties.
Pythium Blight *(Pythium spp.)*	PERENNIAL RYEGRASS BENTGRASS Kentucky bluegrass (Seeding Grass)	Very hot/wet	1. Improve soil drainage. 2. Increase air circulation by removing surrounding vegetation. 3. Avoid excess watering. 4. Avoid high rates of nitrogen.
Red Thread *(Laestisaria fusiformis)*	PERENNIAL RYEGRASS FINE FESCUE Kentucky bluegrass Tall Fescue	Moderate/Wet Foliage	1. Follow balanced fertilization program. 2. Promote growth by aeration, watering, etc. 3. Use resistant varieties.
Rust *(Puccini spp.)*	PERENNIAL RYEGRASS KENTUCKY BLUEGRASS	Cool/wet foliage, dry soil	1. Avoid nitrogen deficiency. 2. Use resistant varieties of Kentucky bluegrass perennial ryegrass. 3. Water if dry, promote growth.
Summer Patch *(Magnaporthe poae)*	KENTUCKY BLUEGRASS Fine fescue	Warm, extremes in soil moisture (fluctuating wet to dry)	1. Avoid low mowing thatch buildup. 2. Maintain soil pH between 6 and 7. 3. Water frequently during dry periods to avoid heat stress. 4. Use slow-release nitrogen. 5. Use Kentucky bluegrass and perennial ryegrass mix.

**For fungicide recommendations check with county cooperative extension officer and the state land grant university in your area.*

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(continued from page 10)

reduce plant competition around trees, reduce weed problems, conserve soil moisture, improve soil, protect plants from mowers and other functions.

But don't overdo a good thing. Mulch that is too deep can create problems such as keeping the soil too wet, making the trunks of plants wet and causing crown rot. It is also difficult to get water through deep mulch after prolonged dry periods.

DIAGNOSING DISEASES. Start the diagnosis process by learning to identify plants in the landscape. Next, learn what each plant needs to grow (soil type, light, water, care, etc.) and what the healthy plants look like in all seasons. Dig up the plants and learn what the roots look like when they're healthy.

Remember that diagnosis is a process unique to every person. One useful method is detailed below:

1. Gather information on the plant. How does it grow? What is needed for healthy plant growth? What are the overall weather patterns now and in the past? Review information on soils, horticulture, entomology, agronomy and plant pathology.

2. Observe the problem. What do you see? What is the overall condition of the plants and landscapes in your community? What is the condition of plants native to those planted by man?

3. Observe the landscape site. Check the areas where the problem exists. Identify the plant. Use a soil probe to check soil. Note maintenance practices.

4. Examine close up. Look at the leaves, stems, roots and crowns of affected plants.

5. Examine microscopically. Identify insects or disease organisms.

6. Gather information and ask as many questions as possible: When did the problem start? How did it develop? Any problems in the past?

7. Pinpoint the problem. Narrow down to a specific problem. Is it a disease, insect, site condition, environmental factor or a combination of these? Take your time. You may need additional help or lab verification.

8. Develop a plan to address the problem. Some environmental problems can be modified. Correct and/or change the maintenance practices. Use resistant plants if possible. Consider fungicides or other disease management products and develop a preventative program.

We may never know why some plant problems develop. Some problems are easy to diagnose, some are difficult. Don't be too proud to get help or ask for a second opinion.

Common Tree & Shrub Diseases *(Characteristics and Management)*

DISEASE NAME (caused by)	COMMON PLANTS WITH PROBLEM	ENVIRONMENT THAT FAVORS DEVELOPMENT	*MANAGEMENT STRATEGIES
Anthracnose *(fungus)*	Maple, ash sycamore, oak, linden, chestnut & walnut	Cool, 50-55F. Moist conditions in spring, especially after buds break and as new leaves develop.	1. Practice tree health care; fertilization, pruning, watering etc. 2. Prune out infected twigs. 3. Promote drying of foliage by providing light and air circulation. 4. Replace susceptible trees with more resistant plants.
Cankers *(fungus)*	Most plants are susceptible (poplar, willow, boxelder, Colorado spruce, plum, mountain ash, dogwood, boxwood)	There are many types of cankers; in general, weather that stresses plants or factors that wound branches greatly increase the disease.	1. Avoid wounding branches or trunk. 2. Prune out dead infected branches and remove from property. 3. Maintain plants in good vigor by proper watering, fertilization, etc.
Fire Blight *(bacteria)*	Plants in the rose family. (crabapple, rose, pear, cotoneaster, mountain ash, pyracantha, plum, etc.)	Warm, rainy springs or wet periods during the growing season.	1. Practice sanitation by removing infected shoots. Prune 12-18 inches below damaged area, sterilize tools. 2. Avoid heavy amounts of nitrogen fertilizer. 3. Plant resistant trees or cultivars.
Leaf Spot *(fungus, bacteria, virus & environmental)*	Most plants are susceptible to some kind of leaf spot.	Variable, but often wet foliage increases the problem.	1. Maintain vigor of plants, water, fertilization, aeration. 2. Remove fallen infected leaves. 3. Replace problem plants with a more desirable plant.
Powdery Mildew *(fungus)*	Maple, buckeye, serviceberry, euonymus, sycamore, cherry, oak azalea, rose lilac, viburnum, crape myrtle, tulip tree and many others.	Warm, shaded, damp areas with high relative humidity. Water on leaves is NOT needed.	1. Design landscape for good air circulation and light penetration. 2. Prune and thin dense plantings. 3. Water early in day to shorten the time of high humidity. 4. Select plants with resistance for problem sites.
Root Rots *(fungus)*	Most plants grown in wet sites can develop this problem. Sensitive plants include: taxus, azalea, roses, pine, dogwood, rhododendron.	Wet soils. Warm, wet conditions are especially bad.	1. Divert water away from area. 2. Install drainage systems. 3. Improve "heavy" soils before planting. 4. Modify irrigation if too wet. 5. On weakened plants, prune top to bring in balance with weakened root system. Also, fertilize moderately. 6. Select plants more tolerant for wet sites.
Rust *(fungus)*	Birch, juniper, crabapple, hawthorn, hemlock, eastern red cedar.	Warm, moist conditions. There are many rust diseases. Timing and weather may be different for each.	1. Plant resistant varieties. 2. Do not crowd plants, thin to increase light and air circulation. 3. Improve plant vigor; fertilizer, proper watering, mulching, etc. 4. Prune and remove galls.
Scab *(fungus)*	Crabapple	Warm, wet springs.	1. Select resistant varieties. 2. Sanitation; rake and dispose of leaves. 3. Fertilize trees to maintain good vigor and growth.
Tip Blight of branches *(fungus)*	Juniper, pine, Russian olive	Varies depending on specific disease. Frequent rain often increases diseases.	1. Prune out affected areas. 2. Improve vigor of plants with fertilization, watering, mulching, etc. 3. Use plants without this problem as replacements.
Verticillium Wilt *(fungus)*	Maple (esp. Japanese, Norway & sugar). Japanese barberry, catalpa, redbud, smoke tree, Russian olive, magnolia, sumac, lilac and many others.	Fungus is in the soil. Excessively wet or dry periods over several years cause root injury and weaken the plant.	1. Water plants during drought stress. 2. Fertilize plants to maintain health and vigor. 3. Remove infected plants and replace with resistant tree or shrub.

**For chemical recommendations check with county cooperative extension office and the state land grant university in your area.*

MANAGEMENT STRATEGIES. Disease management strategies take two methods: preventative or reactive/curative. A preventive approach is often the best for a plant disease since once it is in the plant, the disease-causing organism can often be quite destructive and impossible to eliminate. An example of this would be verticillium wilt.

Inherited problems in an existing landscape require reactive/curative strategies.

Remove plants that have a chronic problem and replace them with resistant varieties. This is expensive, but if you compare it to the cost of a preventative chemical program, it will often be cheaper in the long run. Examples of this would be crabapple with apple scab, lawns with patch disease problems or roses with black spot.

If you cannot afford to replace the plant, remove it and change the landscape by mulching the area or replacing plants with turf.

Crop rotation is another alternative, although this sounds like something a farmer, rather than a landscape manager, would use. However, there are cases where this can be a useful tool.

For example, if a shade tree declines from verticillium wilt, there may be a need for a replacement shade tree in the landscape and a different non-susceptible tree should be installed.

By removing diseased parts of plants, the disease may not be cured but the plant will look better and can be maintained for as long as possible. Some examples of this involve diseases that only affect sections of trees, such as fire blight, tip blight of pine and cankers. When this approach is used along with improved plant health management, often many years can be obtained.

Modify the environment by changing the amount of water an area receives from irrigation, pruning to increase light, installing drainage, and taking other steps to improve conditions for healthier plants.

CHEMICAL OPTIONS. We have fewer chemicals to use for diseases, compared to those for controlling pests in the landscape such as weeds and insects, and they need to be used differently to manage a disease problem.

There are some excellent fungicides, but remember these only work on fungal-caused diseases and not diseases caused by bacteria (fire blight on apples or bacterial wilt on geranium) or other organisms. Remember that there are two types of fungicides: contact or protectant, and systemic.

Contact/protectant fungicides cover the plant surface and prevent infection. Usually, they are applied at intervals of five to 14 days because the fungicides are degraded or are washed away. Newly developing plant leaves and stems are not protected.

Thorough coverage of the plant is absolutely critical to successful protection. Contact/protectant fungicides commonly used include: captan, chlorothalonil, mancozeb and thiram.

Systemic fungicides are absorbed into plant tissue and may provide some curative action. Most systemic fungicides move upward in plant tissue. Of the currently available systemic fungicides, only fosetyl-Al (Aliette) moves downward significantly. Control by systemic fungicides is often much longer than contact fungicides, and some redistribution occurs as the plant grows.

There are many factors to consider for successful use of fungicides. Before implementing a fungicide program, it should be carefully planned and researched.

This year, there is a new registered turfgrass fungicide, myclobutanil (Eagle®). This sterol inhibitor has good activity on many turf diseases.

Another product, which is still being tested, is B-methoxyacrylate (Heritage™). This belongs to a new class of chemistry and shows great promise in both the agriculture and turf and ornamental markets. LL

The author is extension plant pathologist at The Ohio State University, Columbus, Ohio.

Insect Controls Become Environmentally Sensitive

IPM techniques and new biological controls are the wave of the future. Their unique modes of action will change customers' expectations of landscape services.

By David Shetlar

EVEN THOUGH most Americans have few daily concerns about pesticides and their effect on the environment, there are still many concerned citizens who feel that the least environmentally disruptive and toxic option should always be chosen when available.

In addition, the U. S. Environmental Protection Agency has shown more interest in registering products that are less toxic.

These factors will contribute to the continuing increase in the use of integrated pest management techniques. Implementing these techniques will require lawn and landscape contractors to use some of the many new pesticide and biological tools available today.

PYRETHROIDS. The new pyrethroids are the synthetic mimics of the botanical insecticide pyrethrin, and have had considerable improvements over the last few years. The first pyrethroids, like their botanical cousins, had very short residual activity (hours to a few days), a narrow spectrum of activity and often were irritating to humans.

The newer pyrethroids appear to have longer lasting residuals, a broader spectrum of activity and greatly reduced irritation effects. Look for bifenthrin (Talstar®), cyfluthrin (Tempo®, Decathlon®) and lambda-cyhalothrin (Scimitar®). Talstar and Scimitar even have activity against spider mites.

Pyrethroids should be considered in regions where environmentalists are commenting about pounds and pounds of pesticides being used on landscapes (an incorrect statement).

These new pyrethroids are used at 0.05 to 0.2 pounds of active ingredient per acre. Remember these low rates when purchasing pyrethroids because the cost

(Left) Sod web-worm larva killed by insect parasitic nematodes. (Above) Rose aphids are easy to manage with soaps and oils.

of product per gallon appears to be very high until you figure in the use per acre.

NEW CHEMISTRY. The discovery of imidacloprid (Merit and Marathon®) has led to the identification of a new class of insecticides — the chloronicotinyls. When first tested, this compound seemed to affect young insects only and appeared fairly slow to act. Therefore, scientists thought that this must be a new type of insect growth regulator.

However, further studies have shown that this compound blocks the nicotinic acetylcholine receptor sites of the insect nervous system. This unique mode of action acts mainly on those systems and results in greatly reduced activity on mammals, birds and fish, which use a different neural transmitter.

Another unique property of imidacloprid is its systemic action. It can be applied as a granular on the ground or as a spray to plant foliage, where it is absorbed and translocated throughout the plant. This property makes imidacloprid an ideal product for ornamental plants in the management of difficult sucking insects (adelgids, aphids, lace bugs, mealybugs, scales, thrips, whiteflies and leafhoppers), leafminers and pine tip moths.

Imidacloprid also has good activity against foliage-feeding elm leaf beetles, sawflies and Japanese beetle adults. Preliminary tests for borer control have had mixed results, probably because the application timing has not been researched adequately.

In certain areas, imidacloprids have long lasting control capabilities, especially against turf-infesting white grubs. The 0.3 pound-a.i./acre rate has provided excellent control of Japanese beetle, black turfgrass ataenius, masked chafers, European chafer, Oriental beetle, Asiatic garden beetle and May/June beetle (Phyllophaga) grubs in turf.

However, to get the average of 90+ percent control, imidacloprid must be applied when the white grub adults are laying their eggs or when the first instar grubs are present. Several studies have indicated that applications made in late May and early June have controlled the subsequent August-through-October white grub populations.

BACTERIA. Although usually considered a biological control, the bacterium *Bacillus thuringiensis* (Bt) produces crystalline proteins that destroy the gut linings of certain insects. Therefore, technically, Bt products really should be considered a microbial pesticide since we are using the toxin produced by the bacterium to manage insects. At present,

organic gardeners still consider Bt to be a natural, organic product.

When first discovered, the Bt toxins appeared to be active only against foliage-feeding caterpillars. We now have over 5,000 identified strains of Bt and most of these produce a protein crystal, which probably can affect some insect or another.

Some of the newer strains have better activity than the early strains for killing caterpillars. Most of these strains belong to the B.t. "kurstaki" variety (i.e. Caterpillar Attack®, Dipel®, Javelin®, Thuricide® and others). The B.t. "israelensis" varieties (i.e. Vectobac®) have activity against mosquito and black fly larvae in aquatic habitats.

B.t. "tenebrionis" (also known as "san diego") varieties (i.e. M-One®, M-Trak®, Trident II®) have activity against leaf beetle larvae. These beetle varieties have been used successfully for management of elm leaf beetle and willow leaf beetle larvae. The key to success is to make the application when the larvae are still small.

The newest Bt variety to be developed is "japonensis" strain Buibui. This strain was able to kill white grub larvae in the laboratory and recent field tests have confirmed that surface applications of the Bt provide excellent control of Japanese beetle and masked chafer grubs. Expect products on the market within a year or two.

In the mean time, environmentally sensitive areas (parks, landscapes near waterways, etc.) can be treated with the currently registered Bt products when leaf-feeding caterpillars or leaf beetles are problems.

BACK TO NATURE. Pyrethrin, rotenone and nicotine have been the standard botanical insecticides used for years. However, recent research has indicated that many of these "organic" pesticides have adverse side affects comparable with many of the synthetic pesticides.

On the other hand, azadirachtins, the active insecticidal chemical found in neem tree oil, appears to have minimal adverse impacts. This compound acts as a feeding deterrent and insect growth regulator. It has very low mammalian toxicity and almost no affect on other vertebrate animals. As with most IGRs, azadirachtin has been slow in development because research on timing of the applications to susceptible stages of the insect is critical.

At present, several products containing azadirachtin (BioNeem, Turplex, Azatin®) are available for use on ornamental plants and turf. On ornamentals, tough-to-manage whiteflies and

leafminers can be controlled, as well as a host of other leaf-feeding pests. Cutworms and sod webworms in turfgrass also are managed well with azadirachtin. The key to successful use of azadirachtin is to monitor the pest and make an application when the pest insect is an actively growing nymph or larva. The younger the better.

Insecticidal soaps and horticultural (and dormant) oils continue to gain favor for management of a variety of ornamental pests. Spider mites, scales and aphids, which often are resistant or difficult to manage with traditional contact and stomach insecticides, can be easy to manage with soaps and oils. Originally, we thought that soaps and oils suffocated the insect or mite, but we now know that the action is a bit more complex.

Soaps and oils disrupt cell membranes, causing the cell contents to leak out. This is why the insect or mite must be touched somewhere on the body for the action to take effect. Soaps and oils also can act as penetrants, aiding in the passage of a standard pesticide through the waxy covering of insect cuticle.

RAPID CHANGES. The ornamental and turf management industries are changing rapidly to reflect the wants and needs of their customers. Greater use of IPM principles will require an

(continued on page 22)

Control Products *(for common ornamental pests)*

(Standards and Alternatives)

PEST	STANDARD PRODUCTS	ALTERNATIVES
Aphids	acephate, bendiocarb, carbaryl, chlorpyrifos, diazinon, malathion	azadirachtin, bifenthrin, cyfluthrin, imidacloprid, lambda-cyhalothrin, oils, soaps
Canker-worms	acephate, bendiocarb, carbaryl, chlorpyrifos	azadirachtin*, bifenthrin, Bts 'kurstaki'*, cyfluthrin, lambda-cyhalothrin, oils*, soaps
Elm Leaf Beetle Larvae	acephate, bendiocarb, carbaryl, chlorpyrifos, diazinon, malathion	bifenthrin, Bts 'tenebrionis' & 'san diego'*, cyfluthrin, imidacloprid, lambda-cyhalothrin, oils*, soaps*
Lace Bugs	acephate, carbaryl, chlorpyrifos, malathion	bifenthrin, cyfluthrin, imidacloprid, lambda-cyhalothrin, oils, soaps
Mealybugs	acephate, carbaryl, chlorpyrifos, diazinon, malathion	azadirachtin, bifenthrin, imidacloprid, lambda-cyhalothrin, oils, soaps
Scale Crawlers	acephate, carbaryl, chlorpyrifos, diazinon, malathion	bifenthrin, cyfluthrin, imidacloprid, lambda-cyhalothrin, oils, soaps
Spider Mites	abamectin, dicofol, dienchlor, oxythioquinox	bifenthrin, lambda-cyhalothrin, oils, soaps
Whiteflies	acephate, bendiocarb, chlorpyrifos,diazinon, disulfoton, malathion	azadirachtin, bifenthrin, cyfluthrin, imidacloprid, lambda-cyhalothrin, oils, soaps

** For best efficacy, apply when larvae or nymphs are very young.*

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insect control strategies

(continued from page 20)

intensive educational effort for both the industry and for customers. In order to use the IPM tactics, reliance on alternative biorational and biological controls will be needed.

It also means that we must have employees who are trained well enough to make decisions on site and we must educate customers to expect target applications.

Fortunately, through research, development of proper application techniques and timing have made many of the alternative controls as effective as the former standard pesticides for lawn and landscape contractors. LL

The author is landscape entomologist at The Ohio State University, Columbus, Ohio.

Disclaimer: Mention or absence of any product in this article is not meant to be an endorsement or criticism. Lawn & Landscape *wants to learn of new products as they are available. Please send announcements to:* L&L, *4012 Bridge Avenue, Cleveland, OH 44113. Read the label of any pest management product before using.*

Control Products *(for common turfgrass pests)*

(Standards and Alternatives)

PEST	STANDARD PRODUCTS	ALTERNATIVES
Bluegrass Billbug Adults	chlorpyrifos, diazinon, ethoprop, ethoprop, fonofos, isazofos, isofenphos	cyfluthrin, lambda-cyhalothrin, nematodes
Billbug Larvae	bendiocarb, carbaryl, diazinon ethoprop, fonofos, isazofos isofenphos	imidacloprid, nematodes, endophyte enhanced grasses*
Chinch Bugs	bendiocarb, carbaryl,cyfluthrin, chlorpyrifos, diazinon, ethoprop, fonofos, isazofos	fluvalinate, lambda-cyhalothrin, endophyte enhanced grasses*
Mole Crickets	acephate, bendiocarb, carbaryl, chlorpyrifos, diazinon, ethoprop, fonofos, isazofos, isofenphos	cyfluthrin, lambda-cyhalothrin, nematodes
Sod Webworms	acephate, bendiocarb, carbaryl, chlorpyrifos, diazinon, ethoprop, fonofos, isazofos, isofenphos, trichlorfon	azadirachtin, cyfluthrin, fluvalinate, lambda-cyhalothrin, nematodes, endophyte enhanced grasses*
White Grubs	bendiocarb, carbaryl, diazinon, ethoprop, fonofos, isazofos, isofenphos, trichlorfon	imidacloprid

** when pest damage requires reseeding or renovation, use endophyte-enhanced perennial ryegrasses, tall fescues or fine fescues.*

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Pick the weed that PENDULUM Plus Fertilizer *doesn't* control, complete & mail the entry form, and you may win $10,000 in cash!

LARGE CRABGRASS
Digitaria sanguinalis

ANNUAL BLUEGRASS
Poa annua

CHICKWEED
Stellaria media

KNOTWEED
Polygonum aviculare

GREEN FOXTAIL
Setaria viridis

GIANT FOXTAIL
Setaria faberi

SPURGE
Euphorbia spp.

EVENING PRIMROSE
Oenothera biennis

GOOSEGRASS
Eleusine indica

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A.Thomas Perkins, Ph.D.

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Digitaria ciliaris

HOP CLOVER
Trifolium procumbens

BARNYARD GRASS
Echinochloa crus-galli

CUDWEED
Gnaphalium purpureum

FALL PANICUM
Pancium dichotomiflorum

PURSLANE
Portulaca oleracea

LAWN BURWEED
Soliva ptersosperma

HENBIT
Lamium amplexicaule

OXALIS
Oxalis spp.

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Brands of preemergent herbicides used in the past year: _____

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PTO-954

USE READER SERVICE #10

Weed Biology:
Measuring the Competition

A weed is not just a weed. They're the most competitive plants around. Contractors that know how weeds get their competitive edge can give healthy grass a winning chance.

By Karl Danneberger, Ph.D.

COMPETITION IS A FACT of life. Either in the business world or in sports, success is measured by how well you do against the competition. In weed control, agronomic practices are judged by how well the turfgrass competes against weeds. In devising a weed management strategy, contractors should assess the strengths and weakness of weeds and the desirable turfgrass. This is a critical step in developing a weed IPM program.

The term "weed" has no taxonomical meaning since it does not refer to a genus or family. Yet over 2,000 species of weeds have been identified by The Weed Science Society of America.

In general, weeds occur in disturbed situations. Thus, it is no surprise that most weeds are native to Europe where disturbances, primarily farming, were initiated long before North America was settled and subjected to disturbances (Tables 1 and 2). Since no taxonomic base exists for characterizing weeds, other methods need to be used to assess the competitiveness of weeds. In this article, biochemical, life cycle and something called r- and K- strategies are used to judge weed competitiveness.

BIOCHEMICAL. All plants, including weeds, carry on a process called photosynthesis. It is the process where a plant captures the energy from the sun and stores it in a usable form. A critical step in photosynthesis is the fixation of carbon. The carbon is derived from carbon dioxide and is used to construct organic molecules that contain the energy acquired from the sun.

In the process of carbon fixation, plants use one of three reactions. They are termed the Calvin-Benson cycle (C3), Hatch/Slack

Growth characteristics give weeds an advantage. Left, wild onion, right mouse-ear chickweed.

Common Dicot Weeds Found in Turf

COMMON NAME	BOTANICAL NAME	PHOTOSYNTHETIC APPARATUS	LIFE CYCLE	STRAT-EGIST	ORIGIN
Common Yarrow	Achillea millefolium L.	C3	P	K	Native
Wild Onion	Allium canadense L.	C3	P	K	Native
Wild Garlic	Allium vineale L.	C3	P	K	Europe
Yellow rocket	Barbarea vulgaris Br.	C3	P	r	Eurasia
Sheperdspurse	Capsella bursa-pastoris L.	C3	A	r	Europe
Mouse-ear Chickweed	Cerastium vulgatum L.	C3	P	r	Europe
Common Lambsquarters	Chenopodium album L.	C3	A	r	Eurasia
Prostrate Spurge	Euphorbia supina Raf.	C4	A	r	Native
Ground ivy	Glechoma hederacea L.	C3	P	K	Eurasia
Hawkweed	Hieracium pilosella L.	C3	P	K	Europe
Pennywort	Hydrocotyle sibthorpioides Lam.	C3	P	r,K	Asia
Purple Deadnettle	Lamium pupureum L.	C3	A	r	Eurasia
Henbit	Lamium amplexicaule L.	C3	A	r	Eurasia
Mallow	Malva neglecta Wallr.	C3	A	r	Eurasia
Black Medic	Medicago lupulina L.	C3	A	r	Eurasia
Common Yellow Woodsorrel	Oxalis stricta L.	C3	A,P	r,K	Native
Cinquefoil	Potentilla spp. L.	C3	P	K	Native
Buckhorn Plantain	Plantago lanceolata L.	C3	A,P	r,K	Eurasia
Broadleaf Plantain	Plantago major L.	C3	A,P	r,K	Europe
Prostrate Knotweed	Polygonum aviculare L.	C3	A	r	Eurasia
Common Purslane	Portulaca oleracea L.	C4 - CAM	A	r	Europe
Healall	Prunella vulgaris L.	C3	P	r	Native/Europe
Curly Dock	Rumex crispus L.	C3	P	r	Eurasia
Largeflower Pusley	Richardia grandiflora Steud.	C3	P	r	South America
Common Chickweed	Stellaria media L.	C3	A	r	Europe
Common Dandelion	Taraxacum officinale Weber	C3	P	r,K	Native/Eurasia
White Clover	Trifolium repens L.	C3	P	K	Europe
Puncturevine	Tribulus terresris L.	C4	A	r	Mediterranean
Speedwell	Veronica spp.	C3	P	r,K	Europe
Field Pansy	Viola arvensis Murr.	C3	A	r	Europe

Photosynthetic apparatus refers to the carbon dioxide fixing pathway. The pathways include Calvin-Benson (C3) cycle, Hatch (C4) cycle or Crassulacean Acid Metabolic Pathway (CAM).

Sources for some of the information in the table were obtained from:

1) Elmore, C.D. and R.N. Paul. 1983. Weed Science 31:686-692.

2) Muenscher, W.C. 1987. Weeds. Cornell University Press. Ithaca.

3) Murphy, T.R. Weeds of Southern Turfgrasses. Alabama Cooperative Extension Service, ANR 616.

or dicarboxylic acid cycle (C4) and Crassulacean Acid Metabolism pathway (CAM).

Turfgrasses that have a C3 pathway are often referred to as cool season turfgrasses while C4 species are referred to as warm season turfgrasses. The CAM pathway does not occur in turfgrasses, being confined to plants such as cacti, which are found in arid climates. Given the diversity in weed species, all three pathways are found. The majority of weed species found in turfgrass areas are either C3 or C4 plants with the exception of purslane, which expresses CAM characteristics, and carpetweed, which has been reported to be a C3-C4 intermediate (Kennedy and Laetsch, 1974).

In 1969, Black proposed that plant-weed competition could be based on photosynthetic efficiency. In general, C4 plants are more efficient at capturing CO2 under increasing temperature and light intensity than C3 plants. Based on the efficiency of capturing CO2, the competitive outcome between a C3 and a C4 plant would result in the C4 plant winning.

Thus, the more efficient capture of CO2 (C4) would provide a competitive advantage over the less efficient C3 plants. Although the competitive outcome between C3 and C4 plants will not always result in a C4 advantage (Gifford, 1974), this generalization will hold true in turf under many high light and temperature situations.

For example, a Kentucky bluegrass lawn is at a distinct disadvantage against C4 weeds like crabgrass, goosegrass and foxtail during the summertime. The C4 weeds are often the ones that literally take over an improperly maintained lawn.

In the southern United States, a different situation exists. Warm season turfgrasses are very competitive against weeds. For instance, a properly main-

tained bermudagrass turf in sunny, warm areas has very few weeds. However, bermudagrass grown in shade is noncompetitive against a number of weeds.

LIFE CYCLES. The life cycle of an annual weed is very intensive in that the weed seed germinates, grows vegetatively and produces seed within one year. The weed seed can occur at levels in the millions per acre.

Light is a requirement for many weed seeds to germinate. Thus, the need to maintain a dense turf provides a means of control by limiting light penetration to the weed seed. However, in experiments where researchers exposed weed seeds to

Common Monocot Weeds Found in Turf

COMMON NAME	BOTANICAL NAME	PHOTOSYNTHETIC APPARATUS	LIFE CYCLE	STRATEGIST	ORIGIN
Quackgrass	Elytrigia repens L. Nevski	C3	P	K	Europe
Alexandergrass	Brachiaria plantaginea Hitchc.	C4	A	r	Central America
Smallflowered Alexandergrass	Brachiaria subquandripara Hitchc.	C4	P	K	Asia
Sandbur	Cenchrus longispinusp Fern.	C4	A	K	Central America
Yellow Nutsedge	Cyperus esculentus L.	C4	P	K	Europe/Native
Purple Nutsedge	Cyperus rotundus L.	C4	P	K	Asia
Smooth crabgrass	Digitaria ischaemum Schreb.	C4	A	r	Europe
Large crabgrass	Digitaria sanguinalis L.	C4	A	r	Europe
Blanket crabgrass	Digitaria serotina Mitch.	C4	A	r	Europe
Barnyardgrass	Echinochloa crusgalli L.	C4	A	r	Europe
Goosegrass	Eleusine indica L.	C4	A	r	Asia
Tall fescue	Festuca arundinacea Schreb.	C3	P	K	Europe
Bearded sprangletop	Leptochloa fascicularis Lam.	C4	A	r	Central America
Nimblewill	Muhlenbergia schreberi Gmel.	C4	P	K	Native
Carpetweed	Mullugo verticillata L.	C3 - C4	A	r	Central America
Witchgrass	Panicum capillare L.	C4	A	r	Native

COMMON NAME	BOTANICAL NAME	PHOTOSYNTHETIC APPARATUS	LIFE CYCLE	STRAT-EGIST	ORIGIN
Fall panicum	Panicum dichotomiflorum Michx.	C4	A	r	Native
Torpedograss	Panicum repens L.	C4	P	r,K	Europe
Dallisgrass	Paspalum dilatatum Pior	C4	P	K	Europe
Kikuyugrass	Pennisetum clandestinum Hochst.	C4	P	K	Europe
Annual bluegrass	Poa annua L.	C3	A,P	r,K	Europe
Giant foxtail	Setaria faberi Hevrm.	C4	A	r	Europe
Green foxtail	Setaria virdis (L.) Beauv.	C4	A	r	Europe
Smutgrass	Sporobolus indicus L.	C4	P	r	Central (tropical) America

Photosynthetic apparatus refers to the carbon dioxide fixing pathway. The pathways include Calvin-Benson (C3) cycle, Hatch (C4) cycle or Crassulacean Acid Metabolic Pathway (CAM).

Sources for some of the information in the table were obtained from:

1) Elmore, C.D. and R.N. Paul. 1983. Weed Science 31:686-692.
2) Muenscher, W.C. 1987. Weeds. Cornell University Press. Ithaca.
3) Murphy, T.R. Weeds of Southern Turfgrasses. Alabama Cooperative Extension Service, ANR 616.

optimum temperatures and light, the weed seeds failed to germinate.

Weed seeds contain an internal clock called dormancy that prevents them from germinating at the wrong time. Winter and summer annuals exhibit annual cycles of dormancy/nondormancy. The winter annual life cycle starts with seed germination in the fall. These plants grow vegetatively during the winter months, then culminate with the production of a seed in the spring. After seed dispersal, the plants die.

The newly produced seeds are either conditionally dormant or innately dormant. Conditionally dormant seeds can germinate when soil temperatures are low. However, at this time of the year soil temperatures are normally too high. Innately dormant seeds cannot germinate at all. As summertime approaches,

the seeds undergo biochemical changes as they convert from dormancy to nondormancy. This process is called afterripening.

Afterripening is completed in late summer when: 1) the optimum and maximum temperatures for germination are high for the species; 2) a large percentage of seeds germinate within a very short time over a relatively wide range of temperatures; and 3) small percentages of seeds of some species will germinate, usually at low temperatures, in darkness. Those seeds that are near the soil surface germinate while those seeds at deeper soil depths do not, and thus reenter dormancy.

Summer annuals complete their life cycle during a single summer season. Summer annual seeds germinate during either the spring or summer and complete their life cycle by producing seeds before the first frost. The seeds that are produced are either conditionally dormant or dormant. Since soil temperatures in the fall are too low to promote germination, conditionally dormant seeds will not germinate.

Those summer annuals undergo afterripening during the winter. Afterripening is completed by early spring when: 1) the optimum and minimum temperatures for germination are as low as they can ever be for the species; 2) a large percentage of seeds germinate in a short time over the widest range of temperatures possible for the species; and 3) in some species a small percentage of seeds germinate, usually at high temperatures, in darkness. At this point, those seeds at the soil surface will germinate, while the vast majority of nondormant seeds deeper in the soil will reenter dormancy over the summer.

TIMING TURFGRASS. From a weed control perspective, turfgrass establishment should be timed to account for the life cycle of the weeds. Cool season turfgrass establishment in the spring faces stiff competition from summer annuals.

In the spring, the seeds of summer annuals in the soil have broken dormancy and are able to germinate at temperatures below their optimum. If the soil is disturbed (rototilled for example), weed seeds are brought to the surface, thus increasing the number of potential seeds that could germinate.

Given that most of the summer annuals are C4 plants (Table 1) and an increased number of seeds are present from soil disturbance, a very tough environment exists for cool season turfgrasses to compete. Conversely, in the late summer or early fall, establish

(continued on page 74)

Lawn & Landscape

Product & Literature Guide

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Every six months, advertisers and companies serving the lawn and landscape professional participate in this handy product and literature guide. The result is an impressive collection of products and literature targeted specifically to the lawn and landscape contracting professional.

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Company Index

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AMERIQUIP'S LIFT IS *Portable and Versatile*

◆◆◆ The Eagle 45 from **AmeriQuip** is a trailer-mounted, articulated aerial lift with a 25-foot side reach, 45-foot working height, positive bucket leveling and 360-degree continuous rotation and offers outstanding portability for easy access to a variety of maintenance tasks.

A proportional control valve with neutral position interlock allows simultaneous, two-function operation. An 8-hp gas engine is standard, and 24-volt electric power is optional.

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Bandit's Recycler is Built for EFFICIENCY

◆◆◆ **Bandit Industries** offers the Model 3680 Beast Recycler. The 3680 reduces trees, brush, stumps, pallets and similar materials to consistent particle size. The unit uses a unique cutter mill that regulates the amount of cut each time the swinging hammers or cutters strike the material.

The unit is easy to feed and is said to process material using less energy than other grinders. A full line of hand-fed (6-, 9-, 12- and 18-inch diameter capacities) and whole tree (towable or self-propelled 14-, 17- and 19-inch diameter capacities) chippers is also available.

Circle 501 on reader service card

Central Parts' Spreader Gives PRECISE WIDTHS

◆◆◆ The durable Super-Flo spreader is available from **Central Parts Warehouse**. The unit features a 1 1/4-hp, epoxy-sealed motor, electronic speed control allowing precise spread widths from 3 feet to 50 feet and a 9-inch stainless steel spinner disc with flighted auger.

The hopper holds 6 cubic feet, with a 650-pound capacity. The Super-Flo includes a heavy-duty mounting kit and a one-year parts warranty. Optional items include the new Class III quick disconnect mounting kit and Par 36 spreader light.

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EXCEL INTRODUCES *Zero-Turn 3000 Series Tractors*

◆◆◆ The new 3000-Series front-mount, zero-degree turning tractors from **Excel Industries** are said to provide Hustler quality at a more competitive price in the 60- and 72-inch markets. Model 3400 features a 28-hp Kubota water-cooled diesel engine, and Model 3200 comes with a 22-hp Kubota diesel.

Mowing decks include a 60-inch flail, a rear-discharge heavy-duty dual-trim rotary and two Quadcycler™ decks in 60- and 72-inch sizes. Dozer blade, V-blade or 54-inch, 2-stage snowthrower attachments are available.

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TUB GRINDER *is Durable and Towable*

◆◆◆ Ideal for grinding tree limbs, yard waste, wood chips, pallets or other debris, the HD 8 Whirlwind from **DuraTech** can be easily towed by a 3/4-ton pickup. With its 8-foot tub, the grinder offers a 26-inch long hammermill.

The tub is easily loaded by a skid-steer or other loader, and is powered by a 110-hp John Deere turbocharged diesel engine for extra power. Another feature is a full, 10-foot long pivoting conveyor that empties mulch or compost directly into a vehicle for hauling.

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Drainage System Removes Excess WATER FROM TURF

◆◆◆ **Fabriscape** offers a full line of landscape fabrics and drainage control products. The FabriDrain prefabricated drainage system is designed to remove excess water from saturated turf. It is said to install in less time without heavy equipment, requiring less manpower and causing less disruption of landscape.

Other products include a line of landscape fabrics, frost protection and germination blankets, burlap, construction fabrics and fences, polyjute erosion control aids, woven ground cover, securing pins, knives and replacement blades.

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DRAINAGE SYSTEM
Provides Economical Alternative

◆◆◆ Solve landscape drainage problems with the **Flo-Well** system. Like Legos, each 50-gallon Flo-Well assembles from three curved side panels and a top cover. At just 23 pounds with a load tolerance of 8,000 pounds, the units are lightweight and durable. They can also be stacked or connected to handle larger volumes of water.

Each Flo-Well is equal to 70 feet of drainage pipe in a rock-filled trench. A surface drain is offered as an accessory for more flexibility.

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Walk-Behind Mower Handles
COMMERCIAL DUTY

◆◆◆ The GreenStreek commercial walk-behind from **Greenline** is a 36-inch model with a two-year commercial warranty for the price of $1,695 (48-inch model shown is $1,895). The heavy-duty GreenStreek is powered by a 14-hp Kohler engine that is easy to handle and easy on the wallet.

Greenline has offered equipment and parts factory-direct to the lawn and landscape contractor for eight years. Our catalog offers savings of up to 60 percent off retail prices.

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Hardie's Rotors Provide HIGH PERFORMANCE

◆◆◆ The mid-range (25 feet to 48 feet) XL Series™ rotor is the first in a new generation of high-performance rotors from **James Hardie Irrigation**.

Among the XL's long list of features are: part- and full-circle operation in a single unit; six matched-precipitation-rate nozzles; anti-vandal Smart Arc™; power pause; reliable gear-driven/water-lubricated operation; slip clutch; convenient arc-setting indicators on the riser; standard rubber cover; and a full 4 3/4-inch pop-up height.

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Husqvarna Rolls Out Series of SWEDISH TRIMMERS

◆◆◆ A professional line of high-power, low-vibration trimmers is now available from **Husqvarna**. These Swedish-produced, fuel-efficient units feature the latest in ergonomic design and anti-vibration technology.

The new trimmer line includes five 25-cc models (the 225L, 225LD, 225R, 225RD and 225RJ); two 31-cc models (the 232L and 232R); and one 36-cc model (the 235R).

Each engine is said to consume 15 percent to 20 percent less fuel than many other trimmers in their classes, while delivering high power and torque to meet the demands of the pros.

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RETAINING WALL
System Offers Design Versatility

◆◆◆ StoneWall SELECT retaining walls from **ICD** provide the natural look of hewn stone in a stackable, mortar-free wall system offering unparalleled versatility. With one system you can build circular, serpentine or straight walls.

Steps, 90-degree corners and landscape lighting can be incorporated into wall designs. Combined with soil-reinforcing geogrids, walls over 30 feet high are possible. StoneWall SELECT is light-weight, and the profile is user friendly. The system provides a built-in batter. It is made of high-strength concrete and will last a lifetime.

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◆◆◆ The **Landscapers Supply** 1996 Wholesale Parts, Engines and Equipment Catalog has been published. With the Landscapers Supply Preferred Customer Card, you can take "90 days same as cash" to pay for your future purchases.

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LINE LAYER MAKES *Pipe Installation Easier*

◆◆◆ The small but rugged design of the **Line-Ward** L-2 Line Layer allows efficient installation of underground lawn irrigation systems.

The 800-pound L-2 uses a blade-drive system to reduce lawn damage while burying pipe up to 16 inches. At 26 inches wide, the L-2 can work in areas where large plows cannot go. It is perfect for contractors installing residential lawn sprinklers.

Line-Ward also offers a boring attachment for use with the L-2 for boring sidewalks and driveways up to 25 feet wide.

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New Roundup Pro Formulation IS MORE EFFECTIVE

◆◆◆ Roundup Pro from **Monsanto** is an improved and complete formulation labeled specifically for the lawn and landscape professional. The new formulation is said to optimize the performance of Roundup Pro against problem weeds and brush — including grasses, broadleaves and woody brush.

With Roundup Pro, you'll never have to add any surfactant — it is part of the formulation. Monsanto scientists specifically designed this formulation to maximize the product's performance.

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PAVE EDGE SYSTEM
Makes Installations Simple

◆◆◆ The **Pave Edge** paver restraint system is the only self-supporting edge restraint designed exclusively for pavers. Made of a strong PVC compound, it is totally invisible when in place and will not rust, warp or heave. Lightweight and simple to install, the Pave Edge system comes in 10-foot long sections that are both rigid and flexible for straight or curved edges.

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Rohm & Haas Offers Turf & ORNAMENTAL LINE

◆◆◆ **Rohm & Haas Company** offers a complete line of products for all your turf and ornamental needs. Dimension® turf herbicide provides season-long control against crabgrass, goosegrass and 20 other tough weeds. New Eagle® fungicide controls more than 15 turf diseases, including brown patch and dollar spot. And the dependable, cost-effective performance of Fore® fungicide forms a good foundation for any disease management program. Other Rohm & Haas products include Kerb® and Goal® herbicides, Dithane® and Systhane® fungicides and Kelthane® miticide. For more information, contact your local distributor.

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Scag Mowers Offer Quality & SERVICE SUPPORT

◆◆◆ In a recent independent survey sponsored by an industry publication, six hundred commercial landscape contractors were asked to rate the best commercial mowers. The answer by a wide margin was **Scag**.

Scag was ranked best among 11 brands of equipment. It was number one for quality, serviceability, warranty and dealer/distributor support, and tied for number one for parts availability.

Visit your Scag Dealer today and get the complete story about Scag's preferred line of walk-behinds, riding mowers and zero-turn radius riders.

Circle 516 on reader service card

Portable Drip System Improves TREE WATERING

◆◆◆ Treegator® Portable Drip Irrigation Systems from **Spectrum Products** irrigate newly planted trees. Combinations of 20 gallons and 50 gallons are available for trees from 1-inch to 24-inch caliper. Systems are reusable and made of reinforced polyethylene and heavy-duty nylon zippers. The product accepts up to 3-inch hoses and fills in less than one minute.

Treegator is said to reduce watering frequency by 50 percent and time spent at each tree by up to 90 percent, while reducing tree losses due to watering to less than 1 percent.

Circle 517 on reader service card

HEAVY-DUTY LOADER *Provides Top Performance*

◆◆◆ The **Thomas** T-173 HL S Series Loader is designed for profitable uptime, not costly downtime. It features a powerful 52-hp Kubota liquid-cooled diesel engine and boasts a full 1,700 pounds of lifting capacity. As the job changes, the T-173 HL S changes with it. Simply drive up to one of the many attachments, lock it in place and you're ready for a whole new job.

The performance-packed T-173 HL S Series is designed to get your job done. . . fast.

Circle 518 on reader service card

Toro's Mid-Size Walk-Behind GETS MORE POWER

◆◆◆ **Toro** is proud to announce our most popular mower — the mid-size walk mower — is now available with a new 16-hp Briggs & Stratton Vanguard engine with full pressure lubrication. The unit continues to feature its dependable 4-speed, gear-drive transmission and power reverse.

The mower is equipped with the patented T-Bar steering system that concentrates all controls in one simple system, so you can control mower speed and steering without moving your hands. Operator presence control allows automatic neutral return on traction drive without engine kill.

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New Look For LAWN & LANDSCAPE

◆◆◆ The number one publication for the lawn and landscape industry just got a new look.

Lawn & Landscape magazine is still the best forum in the green industry for news, features, technical articles and in-depth analysis of the industry's most important issues. Now, the redesign puts this coverage in a more readable format. Contact *Lawn & Landscape* for information on advertising or circulation.

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Just For Front-Line Workers – T&O SERVICE TECH

◆◆◆ *Lawn & Landscape* magazine is proud to introduce *T & O Service Tech*, the first and only publication serving the needs of the industry's front-line turf and ornamental crew members in the professional lawn & landscape contractor market. The editorial covers such issues as proper mixing and handling of pesticides, safe equipment use, maintenance techniques, providing good customer service and much more. Contact *Lawn & Landscape* for advertising or circulation information.

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SERVING THE $40 BILLION PROFESSIONAL LANDSCAPE CONTRACTING INDUSTRY

Spring Fertilization:

Take it Easy on Nitrogen

Too much nitrogen can overstimulate turf growth, at the expense of fall's root system development. It may not be obvious for the first few seasons, but overstimulated grass will eventually show the strain.

By Nick Christians, Ph.D.

Thinking on the timing of N fertilization has undergone considerable changes in the past 25 years. In the 1960s and early 1970s, the standard turf fertility program relied on relatively heavy spring N fertilizer applications, with less emphasis on fall treatments. It has come full circle since then and programs now emphasize moderate N applications in spring with higher amounts in fall.

To see what impact timing of N applications can have on turf survival, we need to consider how grasses function.

GROWTH CHARACTERISTICS. Grasses are green plants. Their green color comes from a material called chlorophyll, which allows plants to produce their own food, called carbohyrates, through a process called photosynthesis. Carbohydrates are critical to the plants' survival, particularly during times of environmental stress and during recovery from damage when stored carbohydrates are needed for regrowth.

Figure 1 shows the shoot growth pattern of cool- and warm-season grasses. Cool-season grasses grow rapidly when they emerge in the spring. They slow considerably during the stress period of midsummer and increase growth again in the fall. The fall peak of growth is not as high as the spring peak, even though temperatures are quite similar.

When you study grass growth patterns, it becomes apparent that their genetic system is programmed to do some very logical things. Emergence from dormancy in spring requires the consumption of much of the stored carbohydrates in the plant.

The plant logically responds by producing

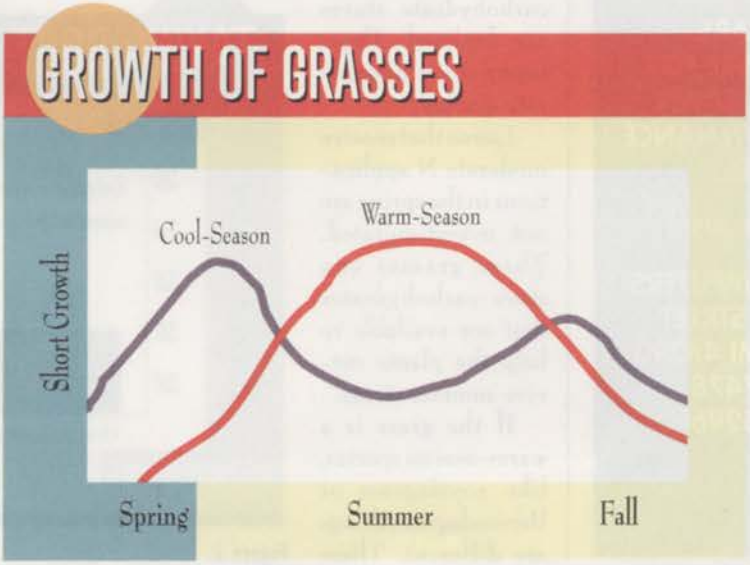


Figure 1.

as much green tissue as possible to undergo photosynthesis and replace the carbohydrates that have been depleted.

In summer, cool-season grasses are under stress due to high temperatures and may need to rely on the food stored during spring growth.

In the fall, the grass increases shoot growth, but not to the extent that we see in the spring. This again makes sense from the plant's standpoint. The cool temperature period of late-summer and fall is a good time to produce carbohydrates. Rather than expending them in the excess growth of tissue, the plant undergoes a more moderate growth rate and stores the excess carbohydrates.

Now, let's return to those lawns that were deteriorating in late summer following a heavy spring fertilization. In the spring, the cool-season grasses are predisposed to the rapid production of shoot growth. It is easy to overstimulate growth at that time of year with excess N. The turf will look good, initially, but the plant will consume the carbohydrates in the production of shoot growth that it should be storing for the stress period of summer.

This may work for a while, but under the right conditions, problems can develop. In severely stressful summers, particularly if the grass is allowed to go in and out of dormancy during the midseason, needed carbohydrate stores are depleted. These lawns could deteriorate quickly.

Lawns that receive moderate N applications in the spring are not overstimulated. These grasses can store carbohydrates that are available to help the plants survive summer stress.

If the grass is a warm-season species, like zoysiagrass or Bermudagrass, things are different. These grasses emerge from dormancy slowly in the spring and thrive in the high temperature periods that put such stress on the cool-season grasses (Fig.1). Warm-season grasses should be fertilized when they are growing actively. One pound N to 1,000 square feet per growing month is a standard recommendation. Fertilizing warm-season grasses in early spring does nothing for the dormant warm-season grasses and may encourage cool-season weeds.

THE NITROGEN EQUATION. The amount of N to be applied to cool-season grasses, and the timing, varies with species.

Soil type and water have an impact. Grasses grown on sandy soils will likely require more N than grasses grown on heavier soils. Rainfall and irrigation also will make a difference. The more water the turf receives, the more it will grow and the more N it needs. Leaching of N can also increase with rainfall and irrigation.

There is no clear answer to the question of how much N to apply. It will not be the same between regions and it will not likely be the same within a region. There are some general guidelines, however, that can be used in developing a sound fertilizer program.

Table 1 includes an N application schedule for cool-season lawns. This is an approximate program and will have

TAKING ROOT

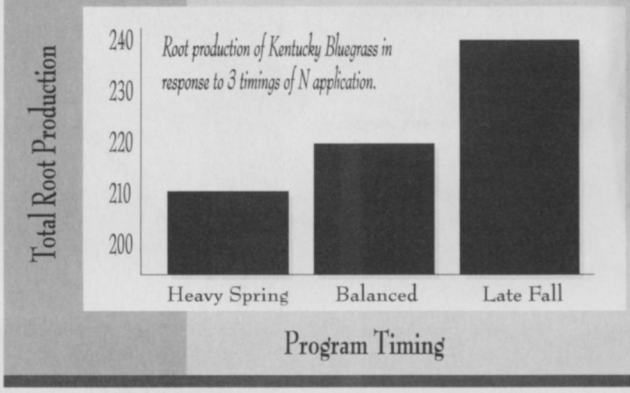


Figure 2.

to be tailored for specific conditions. The program in Table 1 is designed to match the needs of the plant.

It is possible to apply too little N in the spring. If the plant is yellow (chlorotic), it will be incapable of undergoing maximum photosynthesis and carbohydrate supply may be reduced.

Spring N applications generally should not exceed a total of 1.5 pound N per 1,000 square feet. In very wet conditions, or if the turf is established on a sandy soil, more N than that shown in Table 1 may be needed. In dryer years, or for turf established on a heavier soil that is higher in organic matter, less N may be required.

No N is recommended in the heat stress period of July, but if the turf shows signs of chlorosis in midsummer, a light N application may be warranted. The late-summer and early fall is a good time to boost the N application.

In low maintenance areas, where budgets allow only one application of N per year, an August to September application would be best.

APPLICATION OPTIONS. A late-fall application of N should be timed after the last mowing in the fall and before the soil temperatures fall below the critical root growth temperature.

In 1985, a four-year fertilizer study was initiated at Iowa State University to investigate the effects of N application timing on three Kentucky bluegrass varieties. The objective was to observe and compare the effects of heavier spring N treatments, a program that included balanced treatments in spring and fall and a late fall program. (Table 1.)

The study included urea, ureaform, methylene urea and methanol urea N sources, each applied to separate plots according to the program shown in Table 1. Data were collected on visual quality, clipping yield, thatch development, shoot density and root weight during the 1986, 1987 and 1988 seasons.

Yearly ratings were mostly higher for the heavy spring program. However, in 1987 and 1988, the heavy spring pro-

gram resulted in production from 3 to 10 percent more total shoot growth than the balanced and heavy fall programs. Root growth was favored by the late fall program, producing root mass 9 percent greater than the balanced program and 8 percent greater than the heavy spring program (Figure 2).

Conditions that lead to late summer deterioration in quality were not a problem on this site during the study and the area was irrigated. The loss of quality in July and August was not observed on the plots treated with the heavy spring treatments.

But the trend toward rapid shoot growth and subsequent reduced root growth clearly were present on areas treated with high rates of N in the spring. It is likely that the long-term effect would be damage to the grass receiving the heavy spring treatments.

HOW ABOUT P AND K? The application of phosphorus (P) and potassium (K) should be based on a chemical soil test. The amounts of P and K needed in a fertility program will vary greatly among lawns. There are many situations where levels of P and K are high enough that N may be sufficient.

In other cases, either P, K or both elements may be needed in larger amounts. On many soils, K will be the element needed in the largest quantity next to N. This is particularly true on sandy soils that have a low K-holding capacity. Potassium sources may add to the burn potential of fertilizers. The higher the temperature, the more likely these fertilizer materials will damage the turf. When high K levels are used, time applications in cooler temperature periods of spring and fall. LL

The author is professor of horticulture in the College of Agriculture at Iowa State University, Ames, Iowa.

Yearly N Applications & Timing

(in the Iowa State University N-Timing Study conducted between 1985 and 1989)

MONTH	HEAVY SPRING	BALANCED	LATE FALL
	Pounds N per 1,000 square feet		
April	0.5	1.0	0.5
May	1.5	1.0	0.75
June	—	—	—
July	—	—	—
August	1.0	1.0	0.75
September	1.0	1.0	1.0
October	—	—	—
November	—	—	1.0

Table 1.

Finding the Right Mower

ALTHOUGH using the proper mower for the job suggests itself by the simplest of variables — yard size, number of obstructions, weather conditions — there are some fine points to the decision-making process.

Typical Mower Characteristics

Type	Description	Terrain	Vegetation	Debris & Foreign Material	Typical Mowers	Typical Mowing Hieghts	Typical Take Off	Mowing Frequency	Level	Irrigation	Fertilizer	Pest Control	Mulch/ Catch Require.
AAA	Golf greens & tees	Flat to rolling	Grass, single type	None	Reel	Less than 1/2"	1/8" to 1/4"	daily to every other day	Very high	Frequent	High	High	Catch
AA	Golf fairways and sports fields	Flat to hilly	Grass, single type	Little	Reel/ Rotary	1/2" to 1"	1/4" to 1/2"	2 to 3 times per week	High	Frequent	High	High	Catch
A	Residential, condo, office complexes	Flat to hilly with landscaped berms	Grass, single type	Some, twigs & branches	Walk-behind & small riding rotary	1" to 3"	1" to 3"	at least once per week	High	Frequent	Medium	High	Catch/ mulch
B	Apartments, businesses, smaller public areas, maintained golf roughs	Flat to hilly, with landscaped berms	Grass, single type	Some, twigs & branches	Walk-behind & small riding rotary	1 1/2" to 3 1/2"	1" to 4"	at least once per week	Medium	Some	Low	Medium	Catch/ mulch
C	Utility turf, parks, schools, colleges, cemeteries and memorial gardens golf roughs	Flat to hilly, some steep slopes	Mixed grasses and weeds	Some, twigs & branches	Riding rotary	2" to 4"	2" to 5"	weekly	Medium to low	Little	None	Low	Mulch
D	Rough mowing, right-of-way, dams & levees	Flat, hilly & steep slopes	Mixed grasses and weeds	High amount, bottles, cans, vehicle parts	Tractors with flails and pull-behind rotary	4" to 8"	3" to 2'	every 2 to 4 weeks	Low	None	None	None	None
E	Extremely rough, Solid waste	Hilly, rough, ruts & washouts	Wild vegetation	High amount	Tractors with flails and pull-behind rotary	6" to 10"	6" to 5'	2 to 4 times per year	Low	None	None	None	None
S	Specialty	Steep slopes	Grass & wild vegetation	High	Specialty flail & rotary	6" to 10"	6" to 5'	2 to 4 times per year	Low	None	None	None	None

Credit: Excel Industries Inc.

Formula for Success: Using Soil Enhancers

Don't settle for substandard soil. Organic, inorganic and synthetic soil enhancers can correct practically any soil deficiency and increase your success at growing without breaking the bank.

By C. Neal Howell

Have you ever considered a soil enhancer? What on earth is a soil enhancer you might ask? Is it the same thing as a soil amendment? Basically, enhancers and amendments are the same with a little marketing savvy thrown in for good measure.

For purposes of definition, we'll say that they're anything added to the soil to correct a physical problem. Also, for the purposes of this article, we will not include NPK fertilizers, even though they are definitely soil enhancers.

FORMULA FOR PERFECT SOIL. What makes up the perfect soil? It must have a number of qualities. It must provide adequate water retention, release needed moisture upon plant demand while also managing to hold sufficient nutrients, provide an ample supply of beneficial organisms while also allowing just the right amount of air to reach the plants' roots.

If you're not satisfied with the soil types or conditions in the area you're contemplating planting, there are a number of soil enhancers that can help you modify the conditions to really improve your success rate in growing top-quality turf and ornamentals.

Soil enhancers can be broken down into three groups: organic, inorganic and synthetic. All have different advantages, depending on the local soil conditions, climate and growing requirements.

ORGANIC SOIL ENHANCERS. Organic products are derived from natural materials

and are physically manipulated to provide maximum benefits.

They function by physically separating the soil particles, thus allowing air and water movement and increasing the nutrient and water-holding capacity of the soil. They form humus upon decay and help maintain optimal levels of beneficial organisms.

Composts: Composts are formed by the breakdown of plants and plant residue. They make excellent mulches and, when worked into the soil, provide a high degree of water and nutrient-holding capacity. Composts can also enhance biological activity by providing optimum conditions for bacterial growth.

Sludges: These are products resulting from both aerobic (with air) and anaerobic (without air) digestion of sewage and composted sludges.

Other sludges are digested and then heated treated. These products can provide added permeability to clay and silt soils and also increase water-holding capacity of sandy soils.

In addition to providing soil enhancement/amendment properties, these products also provide considerable amounts of plant nutrients. They provide a food source for beneficial soil organisms, too.

The product Milorganite, which is marketed by the city of Milwaukee, Wis., is an excellent example of a waste product fulfilling a useful role in the green industry while providing a method of disposing of city wastes.

Manures: Composted cattle manures and poultry litters can be an economical source for enhancing problem soils. They offer fair to good water and nutrient-holding abilities and also provide some beneficial biological activity.

While raw animal/poultry wastes have fairly high nutrient contents, they may also have fairly high odoriferous qualities. This problem is greatly reduced, if not eliminated, by the composting process. Composting al-so helps to eliminate weed seeds and un-wanted biological organisms, as well as reducing salt associated with the content of raw manures and litters.

Sustane, an aerobically composted turkey litter, has been tested extensively in over 28 colleges and universities across the United States for the last eight years according to Gary Watschke, agronomist, Sustane Corp., Bloomington, Minn.

Other companies have also produced enhanced poultry litter products, such as Misty Grower, manufactured by Misty Mills of Lavonia, Ga.

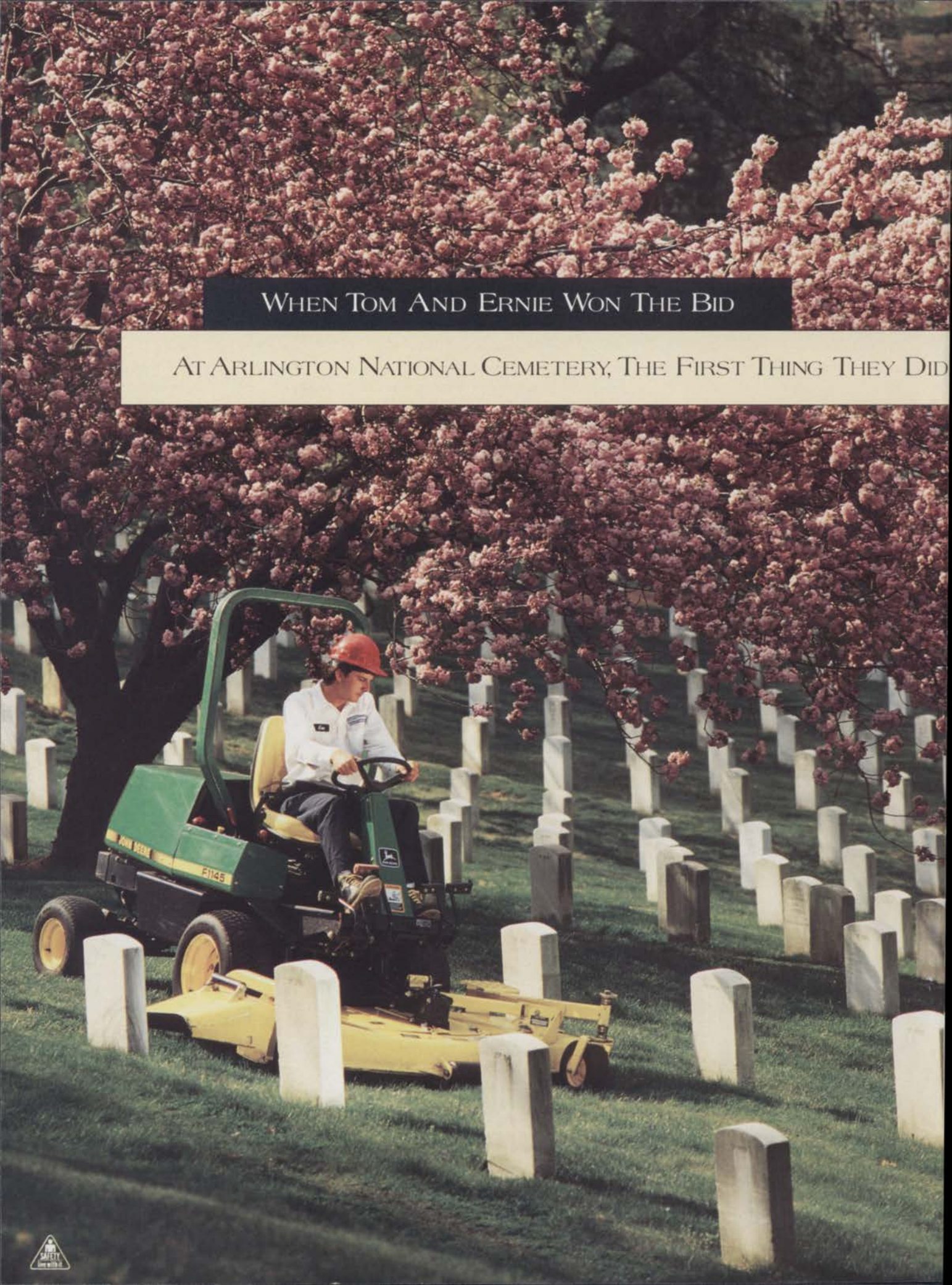
Rice Hull Compost: This is formed by grinding the hull from rice as it is processed at the rice mill. Rice hulls have a fairly high mineral content and allow excellent movement of air and water through the soil. They offer fair to good water-holding ability and their nutrient holding ability is fair.

Ground Fir Bark: This product is, as the name implies, a finely-ground bark from the western fir tree. It aids in water and oxygen movement through the soil and, while it has fair water-holding abili-

(continued on page 40)

Properties of Soil Enhancers

ENHANCER	WATER-HOLDING CAPABILITY	PERMEABILITY	NUTRIENT-HOLDING CAPABILITY	BENEFICIAL SOIL ORGANISMS	PH	LONGEVITY
Plant Composts	high	high	high	high	varies	6 months +
Composted Sludges	high	high	high	high	5.0-6.0	1-6 months
Heat Treated Sludges	high	high	high	high	5.6	1-4 months
Composted Manures	fair to good	fair to good	good	high	5.0-6.0	Up to 1 year
Rice Hull composts	fair to good	high	fair	high	5.5 - 6.0	20 + years
Ground fir bark	fair	high	low	fair	3.2 -4.0	5 + years
Peat & sphagnum moss	extremely high	high	high	high	4.3 - 5.0	5 + years
Peat, Reed-Sedge	very high	high	very high	high	6.5 - 7.0	5 - 20 + years
Sawdust or wood shavings	poor to fair	high	poor to fair	fair	varies	6 months - 5 years
Calcined clay	high	high	fair	poor	7.0	indefinitely
Perlite	none	high	none	none	6.0 - 7.0	indefinitely
Vermiculite	high	high	high	poor	7.0	indefinitely
Sand	low	high	low	low	varies	indefinitely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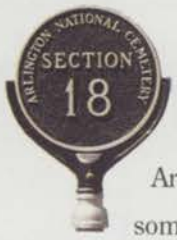
A John Deere 4x2 Gator® Utility Vehicle helps the crew lay more than 34,000 yards of sod a year.



The company that was chosen from nearly 300 for the maintenance of Arlington National Cemetery had a somewhat easier time when it came to choosing their equipment.

For Ernie Leister, vice president of operations for Winter Maintenance and Landscaping,

WAS CALL JOHN DEERE

Tom Speirs

there was really only one choice all along—John Deere. "Arlington is as demanding a client as there is, there's absolutely zero tolerance here on quality," says Ernie, "that's why we've gone with John Deere."

Tom Speirs, president of Agro-Lawn,Winter's partner on the project, agrees. Not only is their client demanding, but also the job itself.

"The cemetery is about 620 total acres. The developed areas are about 500 acres of general turf and 20 acres of specialized. We mow general turf weekly, 38 times a year, on a 5-day cycle, not counting the trimming. The specialty areas we mow twice a week. With a schedule like that, you know these mowers have to be tough."

The floating decks also help. Says Ernie, "In real rough terrain like we have here, they won't scalp. Any other machine you put down here will. But with John Deere's floating deck and easy adjustment, you can fine-tune, almost like trimming an airplane wing when you're flying."

To handle the mowing, with less than half the manpower of the previous contractor–Tom and Ernie use six front mowers (five F935s and one 4-wheel-drive F1145) plus five wide-area walk-behinds.

Ernie Leister

Their crew also refills graves, puts down 34,000 yards of sod per year, picks up trash, and removes leaves in the fall. That's where their six Gator vehicles and the 755 Tractor/loader/tiller come in.

Of the Gators, Tom says, "They make this operation possible, especially when you're sodding a 5x10-foot site in the middle of a 22-acre parcel, and you have three more 40 acres away. How you gonna get there? Wheelbarrows? We also use them for floral pickup. Before we got our Gators, our guys were drivin' along the roadway with a truck, then runnin' in 300 yards to collect the flowers, then runnin' back to throw them in the truck. These vehicles are a real work saver. They're worth their weight in gold."

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Soil Composition Properties

SOIL TYPE	PERMEABILITY	WATER-HOLDING	NUTRIENT-HOLDING
Clay	low	high	high
Silt	low	high	high
Loam	medium	medium	medium
Sand	high	low	low

(continued from page 37)

ties, its nutrient-holding ability is low. It helps soil resist compaction and can last five or more years in the soil. The pH generally runs from 3.2 to 4.0.

Peat: Peats are formed by the decomposition of plant materials while either submerged or in very wet areas. They come in various configurations depending upon the type of plant they were formed from and the length of decomposition. As a rule, they offer very high water and nutrient-holding abilities but some varieties are difficult to rewet after drying. They usually last far longer in the soil than other cellulose products.

Peat Moss and Sphagnum Moss: These peats have the ability to hold up to 30 times their weight in water but have a pH of around 4.0 to 4.5. Contractors should take care in mixing these with soils because they are difficult to combine and the mosses are sometimes difficult to rewet if allowed to dry out. They do provide a home for beneficial soil organisms. The more decomposed they are, the more they enhance the plant's growth abilities.

Reed-Sedge Peat: This is very high in water and nutrient-holding ability, with a pH of 6.5 to 7.0. It mixes well with soil and rewets easily.

Sawdust and Wood Shavings: These products have been very widely used due to their easy availability. They provide good movement of air and water through the soil but poor to fair nutrient and water retention. Depending on the type of wood used, they may last from six months to five or more years in the soil. The pH will vary depending upon wood source used.

INORGANIC ENHANCERS. Inorganic products also separate the soil particles allowing more efficient movement of air and water. However, they do not provide humus or promote its production. They can increase the soil's water and nutrient-holding capacity to some degree.

Calcined clay: These materials consist of fired clay particles which, while allowing excellent movement of air and water through the soil, have relatively poor nutrient retention. The amount of water that the soil can hold is high, but its release is hampered. These products have been used primarily in high-value plantings due to their high cost. Care should be used in applying these products to areas with high traffic or on contact sports fields, as they tend to provide little or no cushioning .

Perlite: A naturally-occurring mineral which has been heat treated to produce a low-density product which increases air and water movement through the growing medium, perlite has no water or nutrient-holding ability and has no effect on pH.

Vermiculite: This also is a naturally occurring mineral that, upon being subjected to heat, pops like popcorn into a light-colored, bead-like material which has the ability to hold many times its own weight in water. Even when fully saturated with water it still has the ability to allow movement of air to plant roots. Vermiculite doesn't break down so it lasts indefinitely. The primary use has been in potting soils for nursery use.

Sand: Traditionally, sand has been regarded as a low-cost, long-lasting amendment. Unless used in very high concentrations (75 percent and above), it can cause compaction of finer textured soils. The primary use of sand has been in applications requiring excellent drainage such as athletic fields, golf greens, tees and nurseries.

SYNTHETIC OPTIONS. Synthetic enhancers can increase water-holding capacity of the soil and help with nutrient holding, but they do not allow for additional

movement of air or produce humus.

The chemical industry has spawned a number of products that can assist growers in enhancing soils. For localized dry spots, a number of wetting agents have been developed that break the surface tension of water and allow it to penetrate soils. While these products do not physically alter the soil, they can achieve some of the same results on a short-term basis.

LESCO-Wet, according to Steve Jedrzejek, director of technical services, LESCO, Rocky River, Ohio, has the ability to make "water wetter," thus allowing easier soil penetration.

Terry Boehm, business manager of United Horticultural Supply, Salem, Ore., feels there is a place for problem-solving materials like Respond, UHS' wetting and penetrating agent. "This product was designed for use on turfgrass soils which are water repellent."

Another unique synthetic product is Hydretain 77, manufactured by Ecologel USA Inc., Ocala, Fla. According to Richard Irwin, company president, it is a liquid product that can be added to soils without tilling it in. Once the product is in place, it acts as a water absorber, pulling moisture from the air, dew and other sources. It then stores the water as microscopic droplets on plant roots and soil particles. It "can reduce watering requirements of plants by as much as 50 per cent or more," Irwin stated.

The author is an industry consultant with Key Solutions, a division of Iris Sales & Solutions Inc., Rocky River, Ohio.

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Basics of Micronutrients:

Just a Dab Will Do

Without the necessary micronutrients in the soil, many plants would exhibit sickly or stunted growth. In most cases, the right diagnosis and only a small amount of a missing micronutrient is needed to return a plant back to health.

By. C. Neal Howell

MICRONUTRIENTS — are they really necessary? Do you suspect that they are just another load of fertilizer? Rest easy. If you've been using micronutrients, you haven't been wasting your time or money.

To date, micronutrients have not had the kind of research done on NPK fertilizers. While some research has been done on iron, little attention has been paid to the others. Because of this, many people misunderstand the use of micronutrients in the landscape.

Roses (above) and gardenias (below) both show the characteristic leaf chlorosis (yellowing) associated with an iron deficiency. The problem can be corrected by managing soil compaction, moisture levels, pH levels and other soil materials keep iron from being available to growing plants.

MICRONUTRIENTS' ROLE. Micronutrients are among the 16 essential elements required for plant growth and reproduction. These elements include: carbon, hydrogen, oxygen (which are free elements) and nitrogen, phosphorus and potash (the primary elements). Secondary nutrients include calcium, sulfur and magnesium plus the micronutrients — iron, manganese, zinc, boron, molybdenum and copper.

While the major and secondary nutrients provide the basic building blocks for healthy growth, micronutrients provide for the synthesis of chlorophyll and other major plant functions.

Scientists have proved that plants need micronutrients to grow, but how do you know if your plants and turf need applications of micros?

Make yourself the expert in case a customer thinks the turfgrass is "looking a little peaked." Plants will give visual clues to their needs but you must know the clues and know what the plant is trying to say.

(continued on page 44)

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(continued from page 42)

Since micronutrients cannot be readily translocated (or shifted from leaf to leaf), plants will tend to demonstrate micronutrient deficiencies by exhibiting a lack of the element through leaf chlorosis (yellowing) or unnatural growth patterns. These symptoms generally appear on new growth.

IRON IS BASIC. Iron is essential for the synthesis of chlorophyll in plants, but it is not a part of the chlorophyll molecule. Iron also activates several systems in the plant such as photosynthesis, respiration and nitrogen utilization.

The lack of iron in soils is not generally a great problem since it comprises about five percent of the earth's crust. The problem is that iron can be rendered unavailable to plants due to a number of factors, which follow:

1. pH Levels. Iron is least available at a soil pH of 7.4 and above. Iron deficiency may also occur in acidic soils that are too low in total iron. One of the reasons why is adverse soil pH. For example, with iron, each unit increase in the pH from four upwards causes a decrease of 1,000-fold in the availability of iron.

Iron is essential for the synthesis of chlorophyll in plants, but it is not a part of the chlorophyll molecule. Iron also activates several systems in the plant such as photosynthesis, respiration and nitrogen utilization.

In many cases, the prime culprit in turf and ornamental problems has been an out-of-balance pH. Most times, ornamentals are easier to read than turfgrasses, due to the size of the leaves involved and the plants' growing habits.

A major problem with ornamentals is that they are often planted as foundation plantings around the perimeter of buildings that may have concrete foundations. These foundations often weather and produce free calcium which raises the soil pH and effectively blocks the uptake of soil-supplied iron.

The best way to diagnose these problems is with a portable pH meter. Once you know the soil's pH, it's a simple matter to check for optimal pH for your plants and, if the pH is outside the acceptable range, adjust it. It's a good add-on service.

2. Excessive amounts of carbonates

(continued on page 40)

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(continued from page 44)

and bicarbonates. These excesses often go hand-in-hand with a pH imbalance. Plants in highly limed soils can exhibit iron chlorosis, since calcium seems to have an antagonistic reaction to iron.

3. Excess amounts of other metallic ions. Iron uptake is often blocked in areas where soils contain excessive amounts of cobalt, copper, zinc or manganese.

4. Moisture extremes. Poorly drained soils are very prone to poor iron availability. Plants suffering from drought are unable to fully utilize iron.

5. Compaction. Lack of oxygen to the root zone of plants can produce iron chlorosis.

6. High phosphate levels. Phosphorus has an antagonistic reaction with iron and can block its availability in areas where high-phosphate fertilizers have been used for extended periods of time. Iron chlorosis can be prevalent.

7. High nitrogen levels. High nitrogen levels can produce stress in plants where soil is low in iron, resulting in chlorosis.

8. Lack of zinc. In many western and midwestern areas, low zinc levels can prevent maximum iron use.

9. Lack of manganese. Utilization of iron has been improved in many areas, particularly in Florida by the addition of manganese to the soil.

10. Areas with exposed subsoils. In many cases, leveling or contouring soils strips away the naturally occurring iron, leading to plant chlorosis.

11. Low potassium levels can hinder iron movement within plants.

LOOK FOR DEFICIENCY. What are the symptoms of iron deficiency? The first is a general lack of green color in the plant. Often, veins in the plant appear to be green while the areas between the veins fade into a yellow color.

In severe cases, the entire leaf can turn yellow or almost white, due to a lack of chlorophyll.

The second symptom of iron deficiency is that the plant may appear to be stunted and, often, does not have as strong a root system as the nonaffected plants have.

Molybdenum toxicity like that shown in this experiment may result in leaf browning, necrosis and other symptoms.

If you have plants that are exhibiting iron chlorosis or you don't think the turf is green enough, what should you do? Try ironing your plants. There are a number of iron micronutrient products available to correct iron chlorosis, many of which can be tank mixed with herbicides for easy application.

Dark green color is the key. Whether your turf is chlorotic or your customer just wants extra green, iron can help achieve results without growth associated with high nitrogen regimes. University research has also shown applications of iron have helped to reduce the incidence of summer diseases and increased root growth.

Iron applications work best in early fall to help strengthen the plant for winter.

Research has shown that late fall iron applications can aid in preventing winter kill and can extend color far beyond usual dormancy. Fall applications can also promote earlier spring green up and reduce nitrogen rates.

Spring applications of iron may be tank mixed with fertilizers and pesticides to enhance spring and early summer color. Iron applications at any time can allow reduction of nitrogen rates without a loss of color or promoting high growth rates.

THE MANGANESE FACTOR. Manganese is not present in large quantities in most soils. It averages from a trace to just over seven percent by weight in most soils and is found naturally in oxides and manganic minerals. Manganese is readily available at a soil pH below 6.0, but shifts to the unavailable form at a pH above 6.5.

The following situations promote manganese deficiencies:

1. Decaying plant material in high organic or mineral soils which can tie up to 93 percent of manganese.

2. Poorly drained soils.

3. Slightly acid to alkaline soils.

4. Overlimed clay soils, especially ones with low organic matter.

5. Areas with high levels of copper, iron or zinc.

6. Low light intensity.

7. Low soil temperatures.

Manganese deficiencies can occur in just about any part of the country, but are especially common in areas with high pH soils. Deficiencies are also common in areas subjected to intense irrigation, especially those with poor drainage. As much as 95 percent of available manganese can be lost to leaching where excess water is allowed to accumulate.

OBVIOUS SYMPTOMS. Deficiency symptoms usually occur on new growth since, like iron, manganese is not mobile within the plant. The color will fade between the plant veins, turning a medium yellow while the midrib stays dark green.

Manganese deficiencies usually produce a more mottled yellowing than do iron deficiencies and do not affect leaf size or texture, just color. It may initially resemble an iron deficiency, but, with lack of manganese, small dead spots

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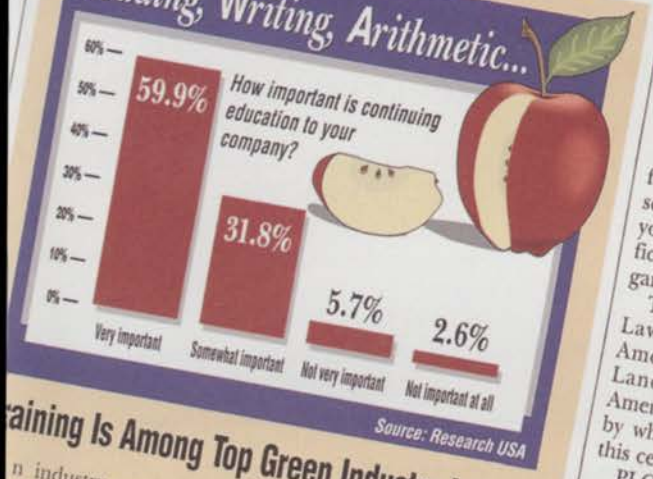

...aining Is Among Top Green Industry Issues

n industry survey found that many owners and agers of lawn and land- e firms are concerned t the types and quality of ng available in their area eir service technicians. lso noted that training ntinuing education is he most serious issues ne industry today.

The survey, sponsored by *T&O Service Tech* and conducted by the Chicago-based firm Research USA, polled a random sample of lawn and landscape industry owners and managers from across the country. Nearly 60 percent of the respondents said that continuing education is important

(Continued on page 10)

...: Use 'Em Right or You'll Lose 'Em

York to California points in-between, fed up with leaf e turning out the st dimming them of this nearly ol of our trade. ething like this ng to contrac- re bans or re- put into place, rson running the morning or too late in the evening that gets angry. From that point on, the battle begins. 00 communities restrict blower use.

Operate power blowers at reasonable hours.

(Continued on page 10)

Associations Stress Certification Benefits

In the highly competitive green industry, being a top performer in professionalism is essential. One way to document your expertise is by gaining certification from a professional organization.

To this end, the Professional Lawn Care Association of America and the Associated Landscape Contractors of America are providing the means by which technicians may gain this certification.

PLCAA's program, offered in conjunction with the University of Georgia, is a correspondence course titled, "Principles of Turfgrass Management." This 14-section, self-directed course gives participants up to a year to complete, but many finish in half that time, according to Ann McClure, executive director of PLCAA.

The course includes a mid-term and final exam, and those passing the tests receive the title of Certified Turfgrass Professional. PLCAA members receive a discount, and can call 800/458-3466 for information. Non-members can call the University of Georgia at 800/542-8097.

ALCA's certification program for the service technician, the Certified Landscape Technician – Exterior program, is currently offered in California, Oregon and Washington. Illinois, New York, Maryland, Virginia, Washington, D.C., North Carolina, South Carolina, Texas, Utah, Wisconsin, British Columbia and Ontario are scheduled to come on line next year.

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(continued from page 40)

appear as deficiency increases. The leaf tip almost always remains green while the leaf begins to roll and wither as the deficiency progresses.

Manganese serves several functions within the plant, including aiding iron in the synthesis of chlorophyll, increasing the availability of other elements and helping in the formation of serval enzymes within the plant.

One of manganese's most important roles is its ability to assist in converting nitrogen to plant protein. Simply put, without sufficient manganese in an available form, utilization of nitrogen will slow down dramatically to the point that the majority of nitrogen in the soil will be unavailable to the plant.

IRON AND MANGANESE. Iron and manganese play closely related roles in plant metabolism and should be used carefully. One should not be applied in the absence or exclusion of the other.

Manganese is very easily displaced by iron and the use of an EDTA manganese chelate can be disastrous if used in the presence of free iron in the soil. The iron will quickly displace the manganese and can actually increase a manganese deficiency.

Manganese can be displaced by other micronutrients and is, apparently, the least preferred in plants' tastes. Given the choice, a plant will fill up on other elements and exclude manganese from its diet even if it is in shortest supply to the plant.

Visual manganese deficiency symptoms are not easily diagnosed on turfgrasses. Ornamentals, with their larger leaf surfaces, are better indicators.

The best advice on using manganese or any other micronutrients is to use them based on soil and tissue tests. Request the DTPA extraction test for available iron and balance the iron levels against the available manganese.

If you can't wait for the test results, a simple field demonstration will generally determine if manganese or iron deficiencies exist. Set up plots and apply the two micronutrients at the label rates and, if greenup occurs within 24 hours, a deficiency for that nutrient exists.

CORRECT ZINC LEVELS. How much zinc is enough? How much is too much? At what point do soil levels indicate a need for additional zinc?

Zinc has long been recognized as an essential element for plant growth. It is present in nearly all soils in small amounts which should, theoretically, be of sufficient quantity to provide for

normal plant functions. Under certain conditions, however, its availability is reduced to the point that it becomes the limiting resource.

Conditions which decrease the availability of zinc are: Soil pH above 6.5; light soils; high organic matter soils; cold and/or wet soils; compacted soils; excess irrigation; high levels of phosphorus or magnesium; exposed subsoils; and liming.

ZINC DILEMMAS. The important question is what happens when turfgrass is deficient in zinc? While there has been considerable research on zinc on agricultural crops, not much has been done of turfgrass and most authorities recognize that a deficiency is a problem.

The first symptom of zinc deficiency is stunted growth. The leaves appear thin and tend to shrivel with the younger leaves being affected first. Bermudagrass will sometimes develop white, crystalline spots over the leaf surface.

Zinc is needed for auxin formation, for the elongation of internodes and for the formation of chloroplasts and starches. Zinc also serves as an enzyme activator. It is essential for normal leaf development, shoot elongation, pollen development and seed production.

NEW DEFINITIONS. Recent research has shown that levels of zinc reported as excessive were, in fact, probably not detrimental to turf. For optimum color and turf health, it probably should be part of your fertilization program.

The addition of zinc may also prevent problems following an application of lime on other soils, especially those with high organic content.

High pH soils in the western U.S. seem to respond very well to applications of zinc. As a result, it should be a part of the micronutrient package west of the Mississippi River.

THE GREAT PRETENDER. Boron has been described as "the great pretender" since it can mask its deficiency by causing the plant to exhibit symptoms of several other nutrient deficiencies. Boron is essential for development and growth of plant cells in the meristem or new tissue growth areas. As a result, visual deficiencies are usually identified by stopped growth of the terminal bud followed quickly by the death of young leaves.

Several visual symptoms can indicate a deficiency of boron:

1. Death of terminal buds which causes lateral shoots to develop.
2. Chlorotic, thickened, curled and wilted leaves.

3. Improper pollination, flowering and fruit or seed set.

Deficiency symptoms in turf are vague and plant quality is reduced before plant growth. Since boron is not translocated within the plant, deficiencies are first observed in the youngest plant tissues — not unlike an iron deficiency.

Usually, stress from lack of boron will be evident when the plant is growing rapidly, flowering or suffering from drought stress. Applications of boron to turfgrass should always be based on soil and tissue tests.

BORON BLOCKERS. Conditions which adversely affect boron uptake include:

1. Soils with a high pH (in many cases soil pH of 6.0 and above).
2. Soils with high levels of nitrogen and potassium.
3. Excess irrigation or heavy rainfall in the area.
4. Drought.
5. Sandy soils (especially with a pH of 7.5 or higher).

Most labs can run soil tests for boron. Exercise care in selecting a lab since recommendations for agricultural crops differ greatly from those of turfgrasses.

ENZYME ACTIVATOR. Copper is required in small doses, next to the smallest amounts of any micronutrient. Copper deficiencies are probably less common than those of other micronutrients. Six to 20 ppm in plant tissue is usually adequate for most plants.

It functions as an enzyme activator and works to aid plant respiration and photosynthesis. It cannot be translocated, so a continuous supply of copper is necessary to prevent new growth from being affected.

Copper deficiency has been diagnosed in 14 states; the majority of the affected areas have sandy, peat or muck soils. The sandy soils of the Atlantic coastal plains, for example, are often deficient in copper. Peat and muck soils in Florida, New York, Indiana, Ohio, Michigan, Minnesota and Washington also have demonstrated deficiencies of copper at some level.

Deficiency symptoms on turfgrass are seldom seen outside of the lab environment, but growth can be reduced if conditions are unfavorable for copper uptake.

CHECK THE SYMPTOMS. Obvious deficiency symptoms of copper include:

1. Dieback of terminal shoots in trees.
2. Stunted growth.

3. Wilting and death of leaf tips.

4. Poor pigmentation.

Uptake also can be hampered by applying high rates of phosphorus, zinc or nitrogen. In addition, peat, muck and other organic soils can tie up copper.

Soil and tissue tests still remain the best method for identifying deficiencies.

The first symptom of zinc deficiency is stunted growth. The leaves appear thin and tend to shrivel with the younger leaves being affected first.

NITRATE REDUCER. Molybdenum is the element required in the smallest amounts by plants. It is also present in extremely small amounts in soils. Most soils will contain only about 2 ppm total.

It is essential for the reduction of nitrates by turf and ornamentals. Plants cannot change nitrate nitrogen into amino acids without an adequate supply.

Applications of molybdenum have spurred growth and, while those increases have been attributed to molybdenum, no one can say what caused the growth. Visual symptoms of molybdenum deficiency in turfgrass have not been documented on turfgrass growing under normal conditions.

Symptoms of molybdenum deficiency in plants include:

1. Stunted plants similar to those with a lack of nitrogen.

2. Rolling or cupping of leaves with a marginal scorching.

Conditions which can inhibit the uptake of molybdenum are low pH soils and sandy soils.

Soil tests may not reflect a true picture of molybdenum levels since requirement levels for this nutrient are so low. Tissue tests are the best method for detecting a problem.

If you are having a problem maintaining top quality turf and ornamentals and have exhausted all other possible remedies, try correcting for a molybdenum deficiency. Usually an application of lime to acid soils will free up existing molybdenum, unless you're working with a sandy soil.

Then, an application of molybdenum will be required. Molybdenum should not be routinely applied with every fertilizer application, but used under certain conditions. LL

The author is an industry consultant with Key Solutions, a division of Iris Sales & Solutions Inc., Rocky River, Ohio.

Static Pump Systems

Doomed to Fail

Actual installation conditions play a major role in the ability of pump system conponents to provide adequate performance.

Irrigation pumps are designed for high performance, but atmospheric factors, system location and choice of equipment may restrict output. Corrective steps include analysis of the problem and careful adjustments.

By Larry Keesen

Ed. Note: This article is condensed from The Complete Irrigation Workbook: Design, Installation, Maintenance and Water Management, *which will be published this spring by* Lawn & Landscape *magazine.*

The single biggest reason why pumping systems fail to operate as designed is because of poor suction conditions between the point where the water enters the pumping system (intake) and the pump impeller. Intake pipe sizes, screens, lifting water from lower elevations, altitude, atmospheric pressure and water temperature are some of the factors that affect pump performance.

Virtually all irrigation pumps use centrifugal force to increase water pressure. The two basic pump types are horizontal end suction centrifugal and vertical turbine. A third is the submersible pump, which is a type of vertical turbine with a submersible motor installed below the pump bowls.

The end suction single-stage centrifugal pump, referred to simply as a centrifugal pump, is the most common in landscape irrigation because of price and reasonable efficiency. The suction size is usually one pipe size larger than the discharge and the one-impeller pump discharges water at a right angle to the water entering the eye of the impeller.

The volute or housing around the impeller can be rotated to provide a variety of discharge directions. The top horizontal direction is the most popular because it allows discharge parallel to the ground surface, and places the priming port at the highest point allowing all the air to be removed from the pump volute when the pump is primed. End suction pumps require priming if they are installed above water level, and if they are not the self-priming type.

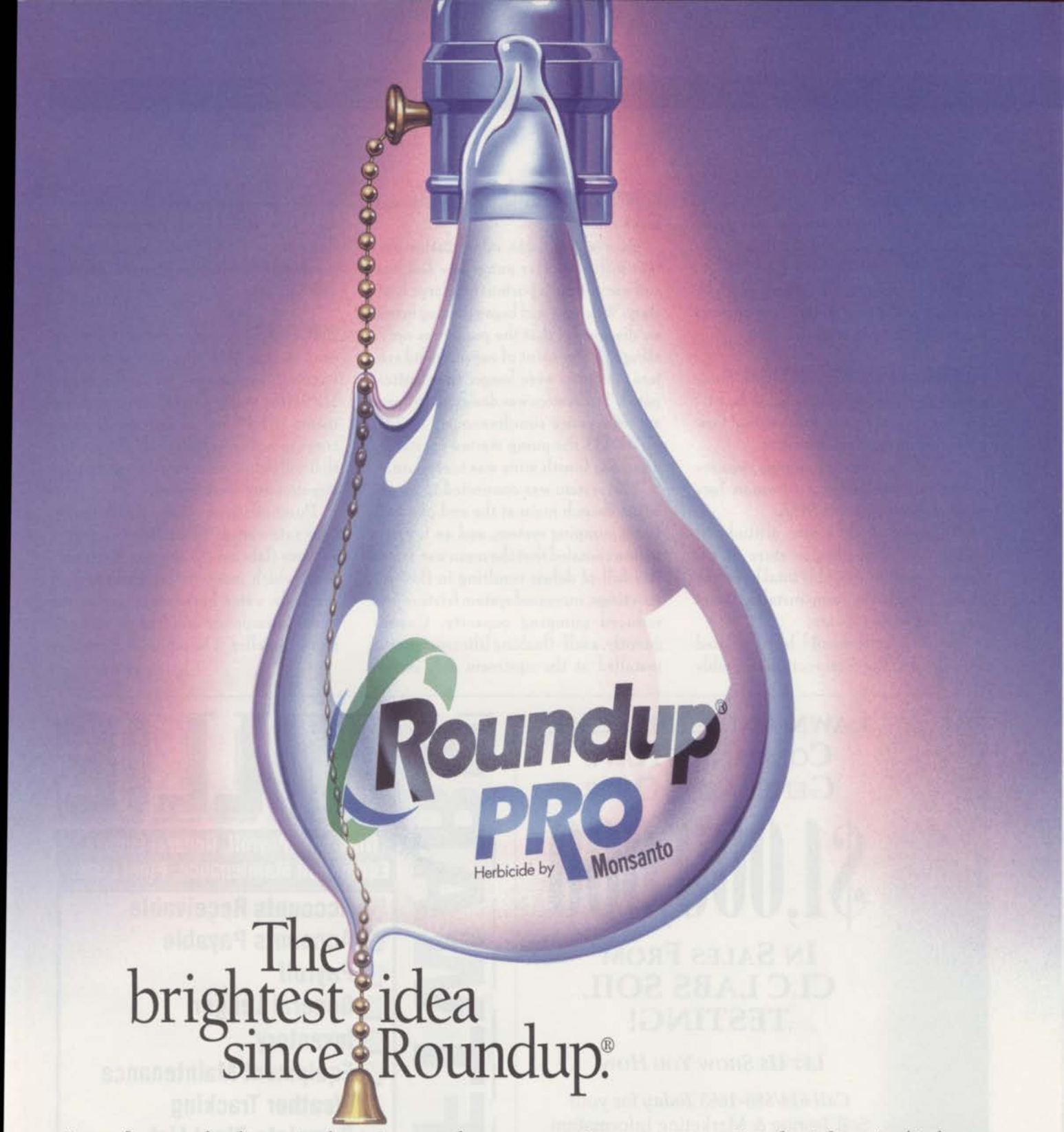
Vertical turbine pumps are used in high water pressure sites or when water is pumped from a deep well (submersible pump). Turbine pumps are usually multistage because of the increased pressure requirement. Each stage is a bowl assembly with an impeller.

As water leaves the impeller in the first bowl, vanes inside the bowl diffuse and guide the water to the eye of the second impeller. The process is repeated for each additional stage.

Water moves vertically up the inside of a shaft or column and is discharged at a 90-degree angle just below the pump motor. A vertical turbine pump functions as a series of centrifugal pumps, with each stage boosting the pressure in succession. Vertical turbine pumps do not require priming because the bowls and impellers are installed at a minimum submersion level established by the pump manufacturer.

The difference between submersible and vertical turbine pumps is the installation of

(continued on page 54)



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(continued from page 52)
the submersible motor below the pump bowls and impellers, which are then connected with a short drive shaft. When installing a submersible pump in a lake or canal, make sure water always covers the motor to keep it cool.

PUMP SUCTION & DISCHARGE CONDITIONS. These conditions, among others, must be calculated accurately to ensure actual flow will meet design requirements.

Calculating system pumping requirements involves using a common formula to determine NPSHA:

Example: With a site altitude of 2,000 feet, water temperature of 60 degrees, suction assembly total head loss of 7.4 feet and the pump installed 5 feet above the water surface.

Velocity head should be calculated and added to the total suction assembly head loss. Velocity head is measured in feet of head.

Several years ago, an irrigation system with a booster pump was designed and installed in a portion of a large cemetery. When the turf began turning brown we discovered that the pump was operating at 75 percent of capacity and system runtimes were longer then anticipated. The system was designed to operate four zones simultaneously at 240 GPM, but the pump started cavitating when the fourth zone was turned on.

The system was connected to an existing 8-inch main at the end of a lake water pumping system, and an investigation revealed that the main was 1/2 to 2/3 full of debris resulting in flow restrictions, increased system friction and reduced pumping capacity. Consequently, a self-flushing filter system was installed at the upstream side of the booster pump to protect the entire system. The NPSHA was decreased below that required (NPSHR) by the pump, resulting in cavitation at increased flow conditions.

PUMP CURVES. A pump curve is used to indicate the flow rate of the pump at varying pressures, impeller sizes, NPSHR, brake horsepower requirements (BHP) and efficiency. A pump curve may show additional information that will help in selecting the right pump, impeller and horsepower.

Pump efficiency changes as the pump flow rate varies. The efficiency curves are arcs (labeled 63 percent & 66 percent) which indicate the percentage of available water horsepower verses the brake horsepower required to turn the pump impeller. The pump and impeller

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(continued from page 54)
selection should be based on the system flow and pressure requirements, while maintaining high efficiencies.

INTAKE & SUCTION LINE INSTALLATION. Avoid any air entrapment in the lines when installing the suction intake and piping. Always use an eccentric reducer coupling at the pump intake with the flat or straight side up, instead of the common concentric reducer fitting. This reduces the chance of air entrapment in the suction piping.

Always use 45-degree elbows for changes in direction and maintain a uniform incline to the pump when suction lift is a factor. Install a straight length of pipe that is a minimum of five pipe diameters in length between the eccentric reducer and the first 45-degree elbow to reduce turbulence at the pump inlet. If this is unsuitable, install a straightening vane upstream of the eccentric reducer.

Install a vacuum gauge with a test cock on the straight length of pipe upstream from the eccentric reducer. The vacuum gauge reads in inches of mercury (Hg) and can be used to verify the friction head loss in the intake piping. The multiplier to convert Hg to head in feet is 1.13. If the vacuum gauge reads 6.5 inches of Hg, multiply 1.13 x 6.5 to determine the total suction head of 7.35 feet, then subtract the elevation difference between the pump impeller and the water level.

If the elevation difference is 5 feet, the actual friction head loss is 2.35 feet. Try keeping the friction head loss below 3 feet if possible. Compare the actual reading to original calculations to verify accuracy.

Water intakes from lakes, rivers and ditches should be located well below the surface of the water to prevent a vortex and air entering the intake screen and pipe. Also, keep the inlet (4-inches and smaller) at least 18 inches from the bottom to avoid debris intake that could be stirred up from the intake turbulence. Intake velocity through the screen should be kept to less than 0.5 feet per second.

PUMP & DISCHARGE FITTINGS. A pressure gauge, isolation valve, check valve and unions are recommended at the pump discharge. Additionally, air-relief valves should be installed at all high points in the system to remove trapped air.

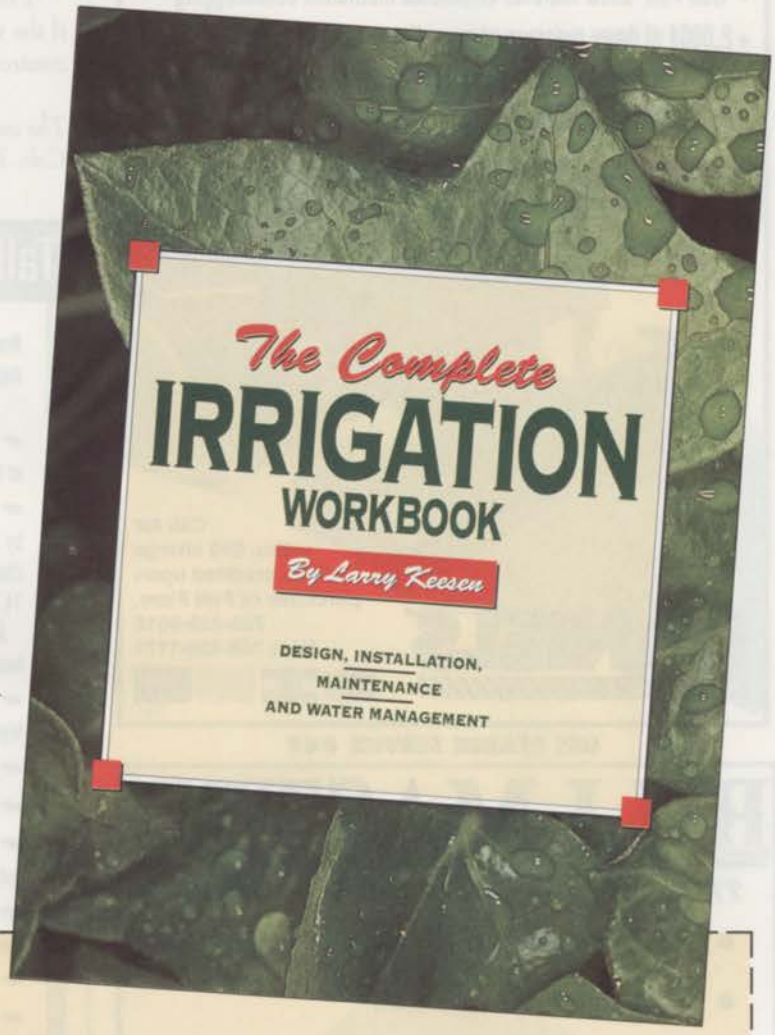
Install pipe supports for pipe sizes of 3 inches and larger. Install the pump on a raised concrete base with rubber mounts between the pump and the concrete.

(continued on page 58)

ANNOUNCING...

THE COMPLETE IRRIGATION WORKBOOK: DESIGN, INSTALLATION, MAINTENANCE AND WATER MANAGEMENT.

BY LARRY KEESEN



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- System Hydraulics
- Irrigation Installation

(continued from page 50)

Pressure and flow switches can be used to protect the pump if the water intake flow is interrupted. Pressure relief valves and control valves can be installed to avoid excess pressure. LL

The author is vice president of Keesen Water Management, Aurora, Colo. To order The Complete Irrigation Workbook, *see page 57.*

Talking Pumps

Knowing pump terminology is the first step in understanding how to get maximum capacity from pumps. The following terms define specific performance variables:

- HEAD pumping design is always calculated in feet of head instead of psi (one foot of head equals 0.433 psi), because of the ease of use and precise calculations required.
- ATMOSPHERIC PRESSURE is the pressure exerted in every direction at any given point by the weight of the Earth's atmosphere. Increased altitude and storms will cause a change in atmospheric pressure. At sea level, normal atmospheric pressure is equivalent to 14.7 psi or 33.9 feet of head; barometric pressure is 29.9 inches of mercury.

  At an altitude of 6,000 feet the atmospheric pressure is 11.8 psi or 27.2 feet of head and the barometric pressure is 24 inches.
- STATIC DISCHARGE HEAD is the elevation difference between the impeller eye and the highest sprinkler nozzle in the system.
- PRESSURE HEAD is the operating pressure in feet of head required at the nozzle.
- FRICTION HEAD is pipe friction or pressure loss measured in feet of head instead of psi.
- VELOCITY HEAD is the energy required to attain a certain velocity. The higher the velocity the greater the velocity head.
- TOTAL STATIC HEAD is the difference in elevation between the water source and the point of discharge.
- TOTAL HEAD is the sum of all heads that affects the pump's ability to produce flow.
- VAPOR PRESSURE is the pressure at which water will change to vapor (boil) at a certain temperature. The vapor pressure of water increases with temperature.
- SHUTOFF HEAD is the maximum head the pump will produce at a zero flow rate.
- CAVITATION is the rapid creation and disintegration of vapor bubbles that occurs when the pressure on the water is less than the vapor pressure.
- NET POSITIVE SUCTION HEAD REQUIRED (NPSHR) is the suction head or pressure required by the pump at the eye of the impeller to ensure that the liquid will not boil (cavatate) under the reduced pressure, and the impeller will operate without cavitation.
- NET POSITIVE SUCTION HEAD AVAILABLE (NPSHA) is the suction head or pressure that is available at the eye of the impeller after head losses, elevation differences and vapor pressure are subtracted from the site atmospheric pressure. NPSHA should always exceed NPSHR by at least 3 feet of head.
- SUCTION LIFT occurs when the water level is lower than the pump impeller eye. When the pump is located above the water source, a partial vacuum is created at the eye of the impeller. The difference between the atmospheric pressure on the water and the vacuum at the eye of the impeller drives water up the suction piping.
- SUCTION HEAD occurs when the water level is higher than the pump impeller eye, and this produces pressure from the weight of the water (measured in feet of head) against the impeller eye, which is added to the atmospheric pressure.

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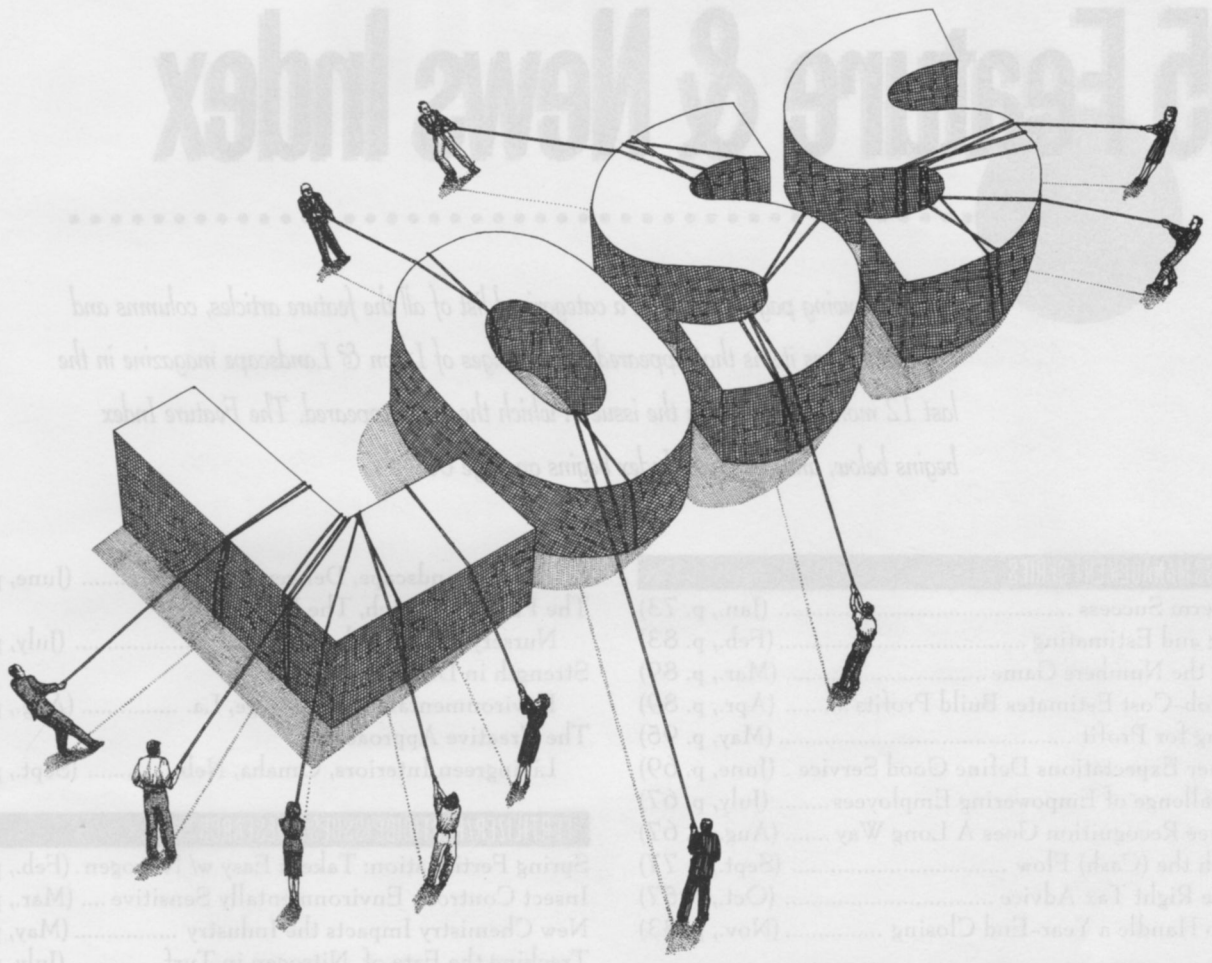

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'95 Feature & News Index

In the following pages you'll find a categorized list of all the feature articles, columns and important news items that appeared on the pages of Lawn & Landscape magazine in the last 12 months, along with the issue in which the story appeared. The Feature Index begins below, and the News Index begins on page 65.

BUSINESS MANAGEMENT SERIES

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COVER PROFILES

FERTILIZER/PESTICIDE ISSUES & RESEARCH

INDUSTRY NEWS & ISSUES

(continued on page 02)

Light Insurance

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(continued on page 68)

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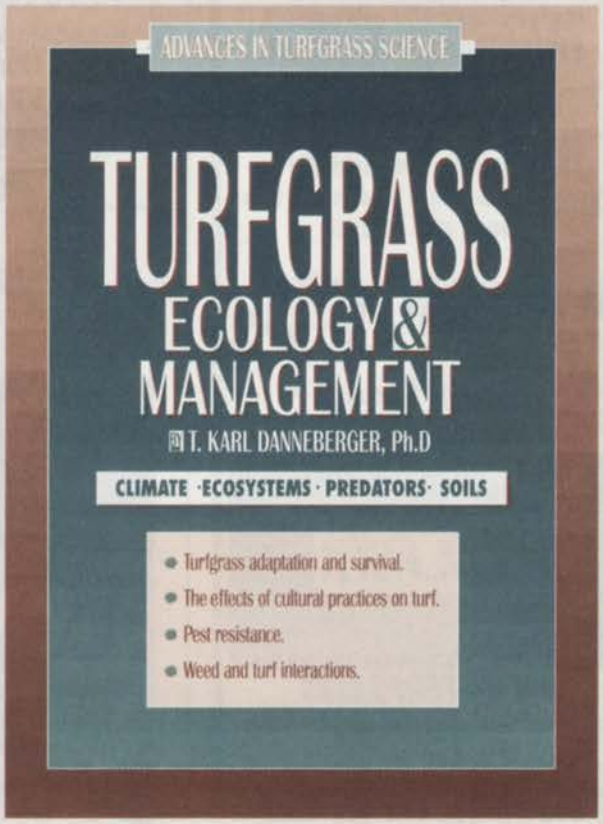

(continued from page 66)

GENERAL INDUSTRY NEWS

LEGISLATION/POLITICS

MANUFACTURERS

JAN. 3-5 Ontario Turfgrass Symposium, Toronto. Contact: 519/767-1114.

JAN. 5-8 GrowerExpo '96, Chicago. Contact: 800/456-5380.

JAN. 9-11 Eastern Pennsylvania Conference & Trade Show, King of Prussia, Pa. Contact: 610/828-0253.

JAN. 9-11 Wisconsin Turfgrass and Greenscape Expo '96, Madison. Contact: 608/845-6536.

JAN. 10 PLCAA Regional Workshop on Managing Productivity, Charlotte, N.C. Contact: 800/458-3466.

JAN. 10-12 North Carolina Turfgrass Conference & Show, Charlotte. Contact: 910/695-1333.

JAN. 12-14 Professional Lawn Care Association of America Management Conference, Phoenix, Ariz. Contact: 800/458-3466.

JAN. 15-18 Michigan Turfgrass Conference, Lansing. Contact: 517/321-1660.

JAN. 16-18 Mid-America Green Industry Convention, Kansas City, Mo. Contact: Professional Lawn Care Association of Mid-America, 816/561-5323.

JAN. 16-18 Landscape Ontario's Congress '96, Toronto. Contact: 905/875-1805.

JAN. 17 Landscape and Nursery Expo/96, Sacramento, Calif. Contact: 916/442-4470.

JAN. 17 Professional Landscape & Turf Conference,White Plains, N.Y. Contact: 914/636-2875.

JAN. 18-19 Mid-America Horticultural Trade Show, Chicago, Ill. Contact: 708/526-2010.

JAN. 19-20 WinterGreen '96, College Park, Ga. Contact: Georgia Green Industry Association, 706/492-4668.

JAN. 19-20 Landscape Maintenance Association Equipment Show Roundup, Tampa, Fla. Contact: 941/680-4008.

JAN. 22-24 Central Environmental Nursery Trade Show, Columbus, Ohio. Contact: 614/899-1195.

JAN. 23-25 36th Virginia Turf and Landscape Conference and Trade Show, Richmond, Va. Contact: 804/340-3473.

JAN. 24-26 Midwest Regional Turf Foundation Expo, Indianapolis, Ind. Contact: 317/494-8039.

JAN. 25-26 Northern California Turf and Landscape Exposition, Contact: 510/490-6292.

JAN. 26-27 Alabama Nurserymen's Association Trade Show. Contact: 334/821-5148.

JAN. 29-30 PLCAA Legislative Day on the Hill, Washington, D.C. Contact: 800/458-3466.

FEB. 1-3 New England Grows, Boston, Mass. Contact: 508/653-3009.

FEB. 1-3 Turfgrass Producers International Winter Conference, Austin, Texas. Contact: 708/705-9898.

FEB. 1-5 AAN Management Clinic, Louisville, Ky. Contact: 202/789-2900.

FEB. 5-11 Golf Course Conference & Show, Orlando, Fla. Contact: Golf Course Superinten-

CALENDAR

dents Association of America, 913/841-2240.

FEB. 11-14 ALCA Executive Forum, Phoenix, Ariz. Contact: Associated Landscape Contractors of America, 800/395-ALCA.

FEB. 14-15 Landscape Industry Show, Long Beach, Calif. Contact: California Landscape Contractors Association, 916/448-2522.

FEB 27-MAR. 1 International Erosion Control Association Conference and Exposition, Seattle, Wash. Contact: 800/455-4322.

FEB. 28 New Jersey Landscape '96, Secaucus. Contact: 201/664-6310.

FEB. 28-29 Southern Illinois Grounds Maintenance School, Collinsville. Contact: 618/692-9434.

MAR. 22-24 ALCA Student Field Days, San Luis Obispo, Calif. Contact: 800/395-ALCA.

JUL. 25-27 Turfgrass Producers International Summer Convention and Field Day, Sacramento, Calif. Contact: 708/705-9898.

JUL. 28-30 International Lawn, Garden & Power Equipment EXPO, Louisville, Ky. Contact: 800/588-8767.

AUG. 9-11 Southern Nurserymen's Association SNA '96, Atlanta, Ga. Contact: 770/973-9026.

AUG. 16-18 TAN-MISSLARK Show, Houston, Texas. Contact: 512/280-5182.

AUG. 20-24 American Association of Nurserymen Conference, Portland, Ore. Contact: 202/789-2900.

AUG 23-25 Farwest Show, Portland, Ore. Contact: 800/342-6401.

SEP. 4-8 Responsible Industry for a Sound Environment Annual Meeting, West Palm Beach, Fla. Contact: RISE, 202/872-3860.

SEP. 6-9 ALCA Interior Plantscape Conference & Trade Show, Nashville, Tenn. Contact: 800/395-2522.

OCT. 19-21 American Society of Landscape Architects Annual Meeting & Expo, Los Angeles. Contact: 202/686-2752.

OCT. 23-24 Pacific Hort Expo, Ornamental Research Conference & California Association of Nurserymen Convention, Las Vegas, Nev. Contact: 916/567-1133.

NOV. 3-5 International Irrigation Exposition, San Antonio, Texas. Contact: Irrigation Association, 703/573-3551.

NOV. 18-21 Green Industry Expo, Cincinnati Convention Center, Cincinnati, Ohio. Sponsored by the Associated Landscape Contractors of America, the Professional Lawn Care Association of America and the Professional Grounds Maintenance Society. Contact: 404/973-2019.

Dec. 10-13 Ohio Turfgrass Foundation Conference & Show, Columbus Convention Center, Columbus, Ohio. Contact: 614/261-6750. LL

To ensure that your meeting date is published, send an announcement at least 10 to 12 weeks in advance to Lawn & Landscape, 4012 Bridge Ave., Cleveland, OH 44113.

RATES

Effective with the January 1996 issue all classified advertising is 95¢ per word. For box numbers, add $1.50 plus six words. All classified ads must be received by the publisher before the first of the month preceding publication and be accompanied by cash or money order covering full payment. Submit ads to: LLM, 4012 Bridge Ave., Cleveland OH 44113. Fax: 216/961-0364.

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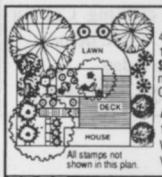

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AD INDEX

*Denotes regional advertising

(continued from page 30)

ing cool season turfgrasses is favored due to cooler temperatures and lack of competition from C4 annual weeds.

STRATEGIST WEEDS. Weeds are classified as r-strategists or K-strategists. The r-strategists are density-independent (do not compete well with turfgrass plants present), grow quickly and put most of their resources into reproduction.

The K-strategists on the other hand are density-dependent (compete well among other plants), and place more resources into growth and development. The r-strategists colonize open turf areas quickly.

Crabgrass is an r-strategist. It germinates quickly in open or thin turfgrass areas and colonizes by growing and developing rapidly. By late summer, crabgrass has completed its life cycle and produced seed.

Due to the fact that crabgrass plants place so much energy into completing their life cycles and reproduction, little resources are available for them to compete in existing stands.

Thus, management practices that promote good turfgrass density discourage the appearance of r-strategist weeds.

The K-strategists are more competitive than r-strategists in situations where turfgrass competition exists. K-strategists such as clover can survive and grow in fairly dense turfgrass. These types of weeds are more difficult to control with cultural practices and they require hand or chemical removal.

Some weeds can, depending on the environmental situation, be either r- or K-strategists. These weeds adapt to the given turfgrass situation.

In lawns, dandelions can adapt and be either r- or K-strategist. These weeds are difficult to control, and often depend on a combination of proper cultural practices and some degree of chemical control.

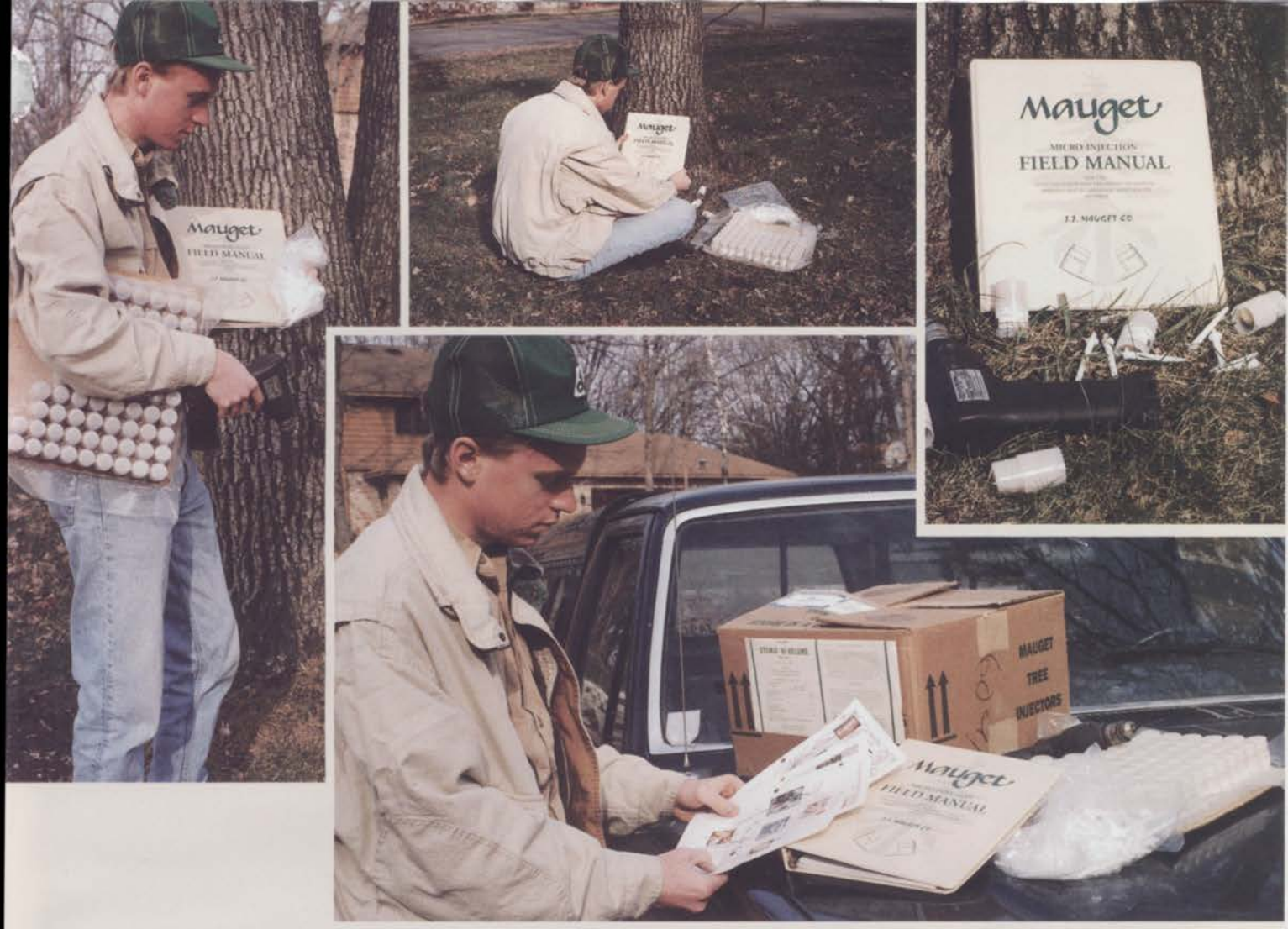
TURF RENOVATION. In renovating a turfgrass site, the type of weed strategist can be important. If a renovated site has a thatch layer present and good seed-soil contact does not occur, r-strategist weeds have a competitive advantage. The ability of r-strategists to complete their life cycle in an inhospitable environment has a definite advantage over turfgrass seed germinating under the same conditions.

Weeds are the most competitive plants we face. Knowing the competitive fitness of weeds will guide you toward the most effective means of controlling them and avoiding them. LL

The author is in the Department of Horticulture and Crop Science at The Ohio State University, Columbus, Ohio.

CORRECTION

Recent restructuring at DowElanco resulted in the formation of two sales districts dedicated exclusively to the turf and ornamental market. The new districts are currently staffed with 14 sales representatives to address current and new product development.



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