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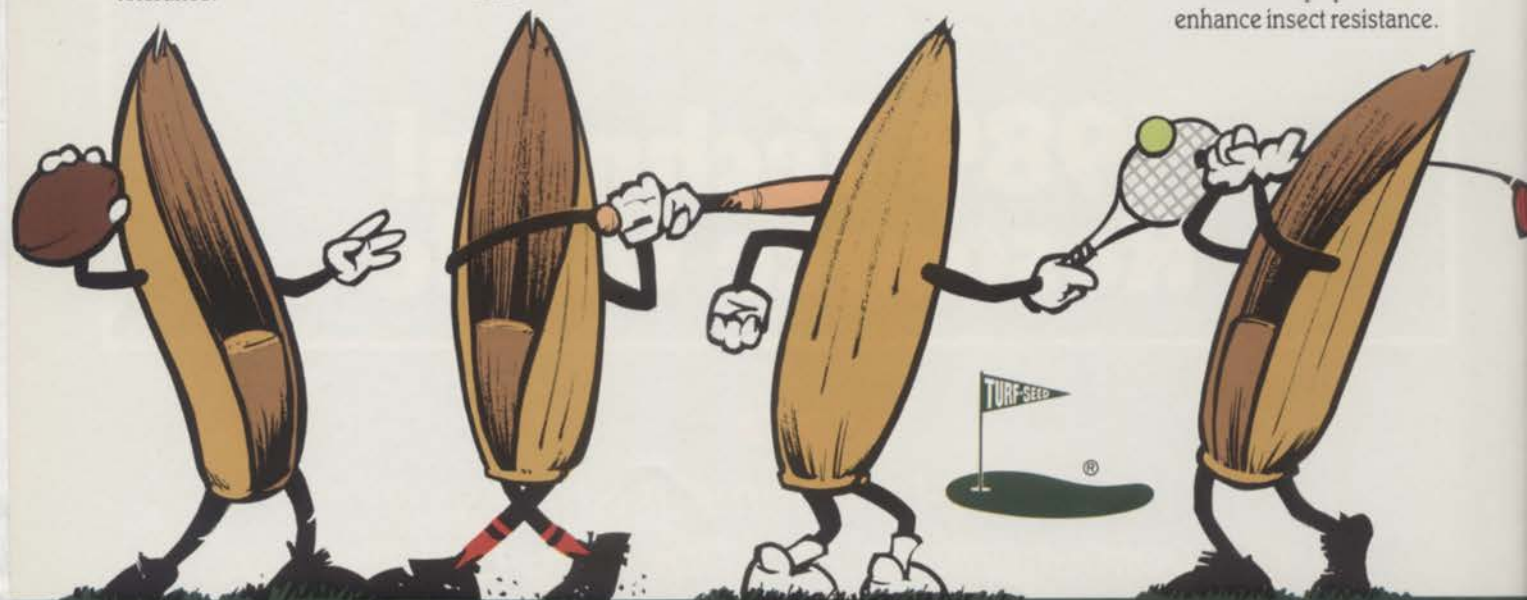
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FEATURES

TURF

10 Good Judgment, Proper
Timing Needed for Renovation

By Thomas Cook.



p. 70

14 Green Industry Outlook
Spurs Herbicide Development

By Bruce Branham.

22 Improving Preemergence
Herbicide Performance in Turf

By Prasanta Bhowmik.

26 Core Cultivation Effects
After Preemergent Applications

By Tony Koski.

EQUIPMENT

30 What Does it Really
Cost Your Company to Mow?

By R. K. Reynolds.

32 Regular Maintenance Services
Can Fill Irrigation Void

By Brendan Lynch and Brian Vinchesi.



p. 46

37 Year-Round Preventive
Maintenance Extends Engine Life

By George Thompson.

39 Avoiding Freezing,
Crystallization in Spray Rigs

By Mike Holcomb.



p. 26

DISEASES

42 Zoysia Patch: A Destructive
Root Rotting Turfgrass Disease

By Henry Wilkinson and Malcolm Shurtleff.

46 Rain, Stresses Result in
Varied Turfgrass Problems

By William Shane.

50 Mysterious Midwest Fungus
Blooms Pithomyces Chartarum

By Henry Wilkinson and Malcolm Shurtleff.

PESTS/INSECTS

54 Granular Formulations Continue to Interest Turf Managers

By Patricia Vittum.

58 IPM Programs Combine Biological, Chemical Controls

By John Goolsby.

62 White grubs: The Most Troublesome Turfgrass Pest?

By A.D. Ali.



p. 62



p. 37

WEEDS

66 Success, Failure In Controlling Crabgrass

By Peter Dernoeden.

70 Expanding Services Through Ornamental Weed Control

By Sean Casey.

74 Winter Weed Control In Warm-Season Turfgrasses

By Tim Murphy and B.J. Johnson.

FERTILIZATION

78 Reducing Nitrogen Loss, Increasing Efficiency in Soil

By Nick Christians.

82 Preparing a Balanced Diet For Turf, Ornamentals

By Neal Howell.

84 Mediocre Growing Conditions Accentuate Need for Fertilization

By David Whitworth.

MISCELLANEOUS

86 Regular Soil Analysis Eliminates Contaminants

By Jim Ware.



p. 30

DEPARTMENTS

94 Advertiser's Index

92 Classifieds

6 Editor's Focus

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EDITOR'S FOCUS

VARIOUS WATER DISTRICTS ON THE West Coast, Northern California in particular, have and will try to put the squeeze on lawn maintenance operators as long as water shortages continue to threaten the environment.

Before the development of various green industry councils, such water districts singled out turf as the "great water eater." Such tactics as paying homeowners money to retire their grass and banning all new landscape plantings — including pulling landscape contractors right off the job — were not uncommon.

Fortunately, some on-the-ball maintenance operators pulled together to fight off severe regulations before letting them get the best of them. Managing to pull together water usage statistics and detail the benefits of turf, water district officials became more willing to discuss reasonable legislation.

But while some contractors continue to fight turf removal, another has voluntarily removed turf in favor of wildflowers. This year, an Ohio landscaper seeded his front yard with cosmos, poppies, black-eyed Susans and 50 to 75 other species — annuals, perennials; both domestic and wild.

The lawn has caused quite a stir in the neighborhood, with reaction ranging from applause to criticism — more of the latter.

Despite criticism, the landscaper stands behind his country-style lawn as an alternative to a conventional yard.

These two examples serve to show the diversity in the maintenance of lawns across the country. And that's what you'll find in this third edition of *Lawn and Landscape Maintenance* magazine's Technical Resource Guide — an assortment of subjects to pique your interest.

What has become a sought after item, this resource guide offers more than 60 pages of technical and business information, color photos and graphs. Our technical resource guide was designed to offer our readers years of industry research in one easy-to-use publication.

Not only does the resource guide compile years of industry research into one book, it has an endless shelf life. A quick look through the table of contents can point you to a selected topic or favorite author.

Among the articles you'll find strategies



for proper turf renovation, improving pre-emergence herbicide performance in turf, new studies on the effects of core cultivation after preemergent applications, tips to find out what it really costs for your business to offer mowing services, preventive maintenance of equipment including irrigation systems, a look at conditions that favor plant pathogens, the increasing use of integrated pest management programs, controlling crabgrass, expanding services through ornamental weed control, soil analyses and preparing a balanced diet for turf and ornamentals.

In the coming year, *Lawn and Landscape Maintenance* will continue to cover the industry's developing trend toward full service, and tackle pertinent issues of the 1990s through a variety of business management and technical features.

Next month we'll bring you complete coverage of three national trade shows: The Professional Lawn Care Association of America, from Las Vegas; The Green Team Conference from St. Louis; and the International Irrigation Exposition from Anaheim.

We'll also provide you with an update on posting and prenotification regulations, tips to prepare mowers for the spring season and strategies for renewing annual contracts.

The issue will also contain our monthly look at news, people, new products and much more.

We look forward to hearing more from you in 1990.

Let us know what you think of the changes we've made in the magazine in the last year, as well as what you'd like to see in future issues. — *Cindy Code*

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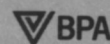
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Good Judgment, Proper Timing Needed for Renovation

IF YOU READ THE TRADE PUBLICATIONS OR LITERATURE from equipment and chemical companies, you know all about renovation. Promotional literature makes it all seem very simple. All you have to do is spray out the existing turf with a non-selective herbicide, dethatch and/or core cultivate the area, plant the grass of your choice, fertilize, water, and presto, you have a stunningly beautiful lawn that is dense, green and weed-free.

Does it really work like that? Is renovation a foolproof method for improving or replacing turf infested with weedy grasses or damaged beyond repair by insects or diseases? Is it the easy way to convert your lawn to the latest miracle grass created by turfgrass breeders? The answer is yes or no, depending on what you do, when you do it and how carefully you do it.

Like all cultural practices, renovation requires good judgment and proper timing to give top quality results. The purpose of this article is to guide you through some of the critical steps in renovation of lawns in temperate climates and to point out where mistakes are likely to occur. In addition, it will summarize the key steps necessary to achieve success with renovation.

WHAT IS RENOVATION? Renovation involves establishing new turf from seed without removing the old sod or preparing a seed bed via tilling and grading. We normally renovate turf areas in order to improve the quality of existing turf and/or change the grass species or cultivar to achieve a new look, improve wear tolerance, increase disease resistance, etc. To achieve these goals, there are three basic strategies you might use.



Renovation involves establishing new turf from seed without removing the old sod. Photo: Salsco Inc.

SIMPLE OVERSEEDING. The plan here is to simply introduce seed into existing turf by whatever means you have available. The most effective planting technique is to use a slicer seeder machine which cuts a slit in the turf and drops seed directly into the slit. Seeding can also be done by coring the turf area, broadcasting seed and then dragging the seed into the aerated holes and turf canopy.

In heavy wear areas, seed can be broadcast on the surface, followed by sand or soil topdressing. Of the three techniques, slicer seeding is probably the most reliable. Simple broadcast seeding is often effective when used on the center of football fields once most of the turf has been destroyed through heavy use. Overseeding is generally least effective on dense turf areas.

OVERSEEDING FOLLOWING SUPPRESSION OF EXISTING TURF. This technique is useful when you want to change the species composition of a turf that is dense and vigorous at the time you wish to renovate. The existing turf must be suppressed long enough to allow germination and early establishment of the overseeded grasses.

The most common procedure here involves severe dethatching, followed by scalping to thin out the existing grass enough to allow establishment of the overseeded grass. A general rule of thumb is



Turf renovation can be achieved without damaging desired shrubs and flowers.
Photo: Monsanto Co.

to get down to the bare soil with the dethatcher before seeding. Because plant competition may be severe, it is important to select overseeding grasses that germinate rapidly and are competitive in the seedling phase. Perennial ryegrass is often the only suitable grass for this method, but we have had success with chewing's fescue seeded into Kentucky bluegrass.

The best method for planting is probably the slicer seeder operated in two directions because it assures good contact between seed and soil. It's sometimes difficult to get uniform establishment with broadcast seedings unless they are mulched with a thin layer of sawdust or other available material to help maintain a moist surface environment for germination. It's important to avoid heavy fertilizer applications at the time of seeding because the existing grasses will grow too much and may out-compete the seeded grasses.

Chemical suppression of existing grasses with a plant growth regulator prior to renovation is another possibility, however, we haven't conducted any trials to see how well this would work. If successful, this could streamline the renovation process by reducing the need for the dethatching or scalping process. Potential negative effects for the growth regulators need to be determined.

COMPLETE RENOVATION. In this case, you generally will kill the existing turf via a non-selective postemergent herbicide, dethatch to remove thatch and debris down to the soil level, fill in any potholes, plant the seed, fertilize, water and watch for your new lawn. When all goes well, this is a very effective method of renovation, but there are several steps you need to perform properly to get the results you want.

One of the most important steps in this approach involves killing the existing grasses. There is a big difference between *spraying* and *killing* weedy grasses. In the rush to get the job done, some people simply spray the existing turf with glyphosate and a week later prepare and seed the area. Within a year, the undesirable weedy grasses have often recovered leaving the same mess you started with. Obviously, you didn't kill the grasses you were trying to get rid of.

What is the secret to controlling weedy grasses prior to renovation? First, you need to know what the weedy grasses are. Bentgrasses, roughstalk bluegrass, velvetgrass, tall fescue, quackgrass, bermudagrass and, of course, annual bluegrass are some of the common weedy grasses in most cool season grass regions.

Bentgrass, quackgrass and bermudagrass have rhizomes (underground stems) that may not be affected by foliar sprays if conditions aren't perfect. Velvetgrass has a pubescent leaf surface that may not absorb herbicides readily. Particularly under drought stress, velvetgrass may not absorb glyphosate and thus will often survive sprays. Annual bluegrass is easy to kill, but will quickly reinvade from seed if preemergence herbicides are not used to prevent germination.

To get a thorough kill of weedy grasses, you need to stimulate vigorous growth with water or fertilizer, quit mowing for a few weeks and time sprays properly. Most grasses are easy to kill in

the spring when they start to flower and in the fall when growth slows. At both times, translocation of herbicides to crowns, roots and rhizomes occurs, which enhances herbicide activity and maximizes kill of regenerative structures.

Velvetgrass (*Holcus lanatus*) is difficult to kill most of the time, but is susceptible in the spring when flowering occurs. Some prefer to spray in the spring at flower time, wait for several weeks and respray as needed if recovery occurs.

Annual bluegrass presents a special problem because it often comes back from seed after mature plants have been killed with herbicides. Until recently, there was no way to control annual bluegrass in new seedings, either chemically or culturally. With the development of ethofumesate (i.e. Prograss) we now have a chemical that can be sprayed on new seedings and renovation sites and selectively control annual bluegrass from germination up to the three- to four-leaf stage. Best results oc-

cur when new plantings of perennial ryegrass are sprayed at the one- to two-leaf stage.

Ethofumesate works best on moist soils low in organic matter. We normally irrigate after application to work this herbicide into the soil. Our tests show that commercially available cultivars of perennial ryegrass are quite tolerant to ethofumesate, even at the one-leaf stage of development. Limited tests indicate tall fescue is also tolerant, but other cool season grasses, particularly the fine fescues, are not tolerant to ethofumesate.

Currently, Prograss is registered for use only on seedling stands of perennial ryegrass. Testing at Oregon State University has consistently given 100 percent control of annual bluegrass in new seedings and renovated sites that were broadcast seeded. On no-till renovated sites planted with a slicer seeder, we generally get 90 percent to 100 percent control of annual bluegrass.

Regardless of the type of renovation you are attempting,

there are several key steps to keep in mind.

1. Choose grasses suited to renovation.

Grasses that germinate rapidly and establish quickly increase your chance for success. Perennial ryegrass has the highest success rate regardless of the actual type of renovation. Of the fine fescues, red and chewings are most competitive and will work where turf is suppressed or sprayed out prior to seeding. Hard fescue works best when existing grasses are killed prior to planting. Tall fescue is similar to red and chewings fescue. Bentgrass can work on suppressed turf or where existing turf has been killed. It is often quick to germinate, but slow to develop.

We have had good success with bentgrass/ryegrass mixtures broadcast on complete renovation sites. Generally, the ryegrass dominates early and the bentgrass shows up as the turf matures. Kentucky bluegrass is difficult to establish on overseeded or suppressed turf sites because



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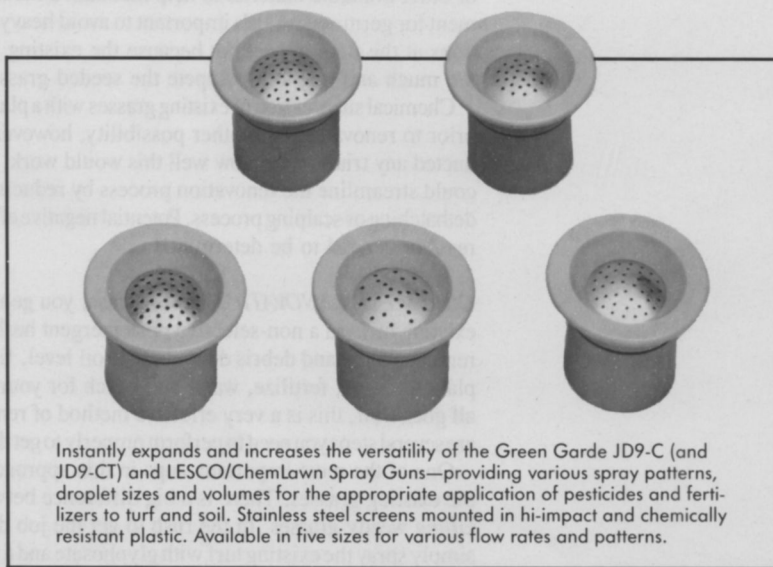
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it is slow to germinate and has a weak juvenile period. Your best chance with bluegrass is on completely renovated sites where existing grasses have been killed, eliminating competition.

2. Ensure good seed soil contact.

Establishment of renovated sites is often slow and stands are often very spotty. Many times this is due to poor germination because seed was sitting on the surface of compacted soil or hung up on top of thatch or organic debris.

Planting with a slicer seeder will generally avoid this problem, though small seeded grasses like Kentucky bluegrass may not emerge from deep slits. The slicer seeder is perfect for perennial ryegrass. Broadcast seedings are generally much more successful when mulched with sawdust, compost or straw. In fact, this is one of the most important keys to success on renovated sites. In spite of the ease of renovation, it is very difficult to produce a seed bed as good as that achieved by tilling and grading.

3. Seed relatively heavy.

Since surface conditions on renovated sites are often suboptimal, try to compensate in any way possible. One rule of thumb is to increase seeding rates by about 50 percent of the normal seeding rate. In the case of perennial ryegrass, increase the seeding rate from five pounds/1,000 square feet to seven to eight pounds/1,000 square feet. A similar approach works for most other grasses.

4. Plant at optimum times.

Spring and fall are good times for renovation. Throughout most of the northern states, Aug. 15 to Sept. 15 is hard to beat. The combination of warm days and cool nights promotes rapid germination and development. Midsummer is a very poor time because it's hard to keep seed moist enough to germinate without increasing the chances of damping off from fungal pathogens.

If you renovate in midsummer, either use treated seed or spray fungicides for damping off shortly after planting. Remember that root initiation is poor in the heat

of summer, so stand development is slow. Often, lawns renovated in July are no further along in October than lawns renovated in mid-August. April through mid-June works very well in many areas and is a great time to renovate athletic fields needed for fall sports.

It is important to renovate at times of least seed germination so that desired turfgrasses get a good head start.

5. Fertilize intelligently.

It is important to renovate at times of least weed seed germination so that lawngrasses get a good head start.

On complete renovations where existing grasses have been killed, it's recommended to push young plantings to speed fill-in and promote dense turf. This usually means a complete fertilizer applied at planting with nitrogen rates of one to two pounds N/1,000 square feet followed four to five weeks later with a second application at the same rate.

On simple overseedings and renovations on suppressed turf, fertilizer is counterproductive.

Nitrogen will stimulate growth of existing grasses and help them out-compete the seeded grasses. On these sites, try to starve the existing grasses by withholding fertilizer and removing clippings during mowing. Once the seeded grasses are up and somewhat mature, resume fertilization, but don't push the stand. High rates of nitrogen may favor the existing grasses more than the seeded grasses. This is more of a problem with the fescues, bent grasses and bluegrasses than with perennial ryegrasses.

6. Water carefully.

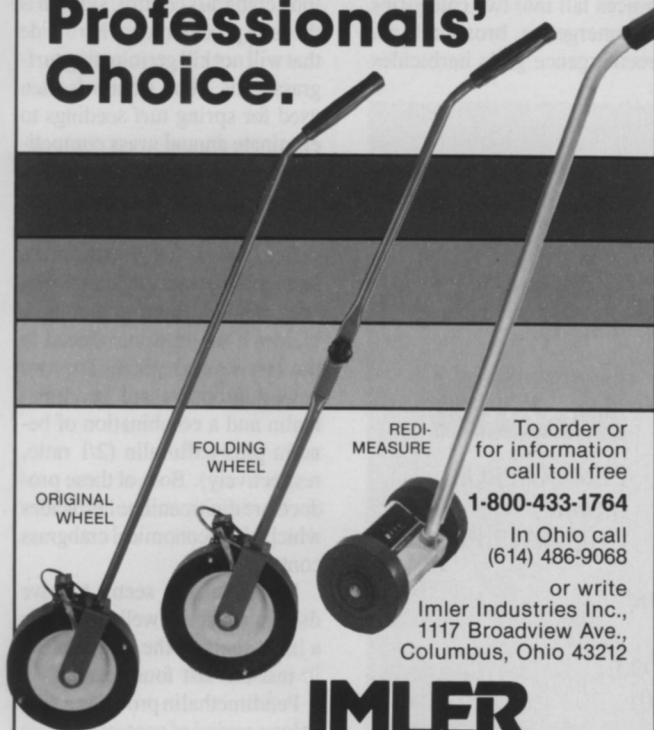
Properly planted, renovated sites require no more water than new seedings. In both cases, the goal is to keep the seed consistently moist to encourage rapid and uniform germination. Heavy irrigation on broadcast seedings may cause displacement, so light, frequent irrigations are best.

— Tom Cook ■

The author is an associate professor in the department of horticulture at Oregon State University.

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Green Industry Outlook Spurs Herbicide Development

THE TREMENDOUS growth in the green industry over the past 10 years along with the relative stagnation in traditional row crop agriculture has caused the agricultural chemical industry to focus on the turf industry as an area for new products.

The result of this focus is the development and testing of many potential herbicides for the turf industry. This article will bring you up-to-date with herbicide products that have recently been released or are in the final stages of testing for the turf market.

CLASSIFICATIONS. Herbicides can be grouped by several different categories including chemical family, mode of action, selectivity, etc. For this discussion, herbicides can be conveniently grouped by selectivity (Table 1).

Non-selective herbicides, e.g.

glyphosate, kill all vegetation and therefore have limited uses in turf weed control. Uses of non-selective herbicides include spot-treating weeds that can't be controlled with selective herbicides and edging around sidewalks and trees. The most commonly used herbicides are selective herbicides which eradicate weeds without injuring the turf.

Selective herbicides can be further divided into those that control either broadleaf weeds or grassy weeds. Within each weed type, the type of herbicidal action further divides the commonly used herbicides. Thus, preemergence herbicides work by killing the germinating weed seed, whereas postemergence herbicides work by killing the established weed. As can be seen in Table 1, most of our herbicide choices fall into two categories, postemergence broadleaf and preemergence grass herbicides.

The most expensive portion of a turf weed control program is the use of a preemergence herbicide. Most lawn maintenance operators are concerned about the price and performance of the available preemergence herbicides and spend considerable time and effort to choose the correct preemergence for their operation.

For many years there were only a handful of preemergence herbicides to choose from and in the cool season grasses benefin, bensulide and DCPA were the primary choices. Oxadiazon generally gives the best control of goosegrass (*Eleusine indica*) and is used extensively on warm-season grasses and in the transition zone where goosegrass is a problem.

While not known for season-long crabgrass control, siduron is the only preemergence herbicide that will not kill germinating turfgrass seeds. Thus, siduron is often used for spring turf seedings to eliminate annual grass competition or on turfs that are overseeded regularly such as athletic fields or golf course tees.

Because of the growth of the lawn maintenance industry, several new preemergence herbicides have been introduced in the last several years. The two newest products are pendimethalin and a combination of benefin plus trifluralin (2/1 ratio, respectively). Both of these products are dinitroaniline herbicides which give economical crabgrass control.

Pendimethalin seems to have done particularly well, capturing a large share of the marketplace in just the last four years.

Pendimethalin provides a fairly long period of control with use rates between 1.5 and 3.0 pounds AI/A. Caution should be used at

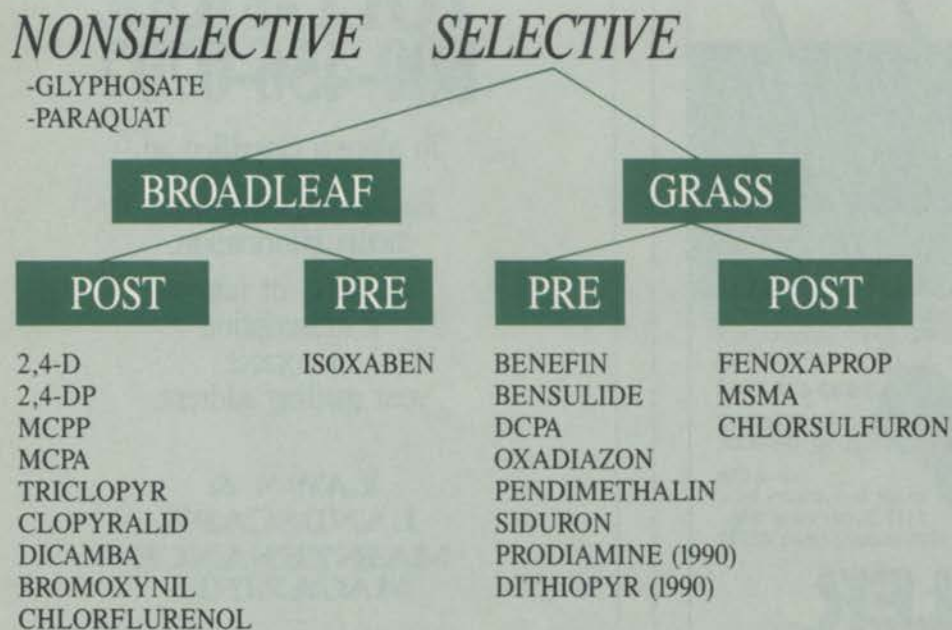


Table 1.



Illustration: Ciba-Geigy Turf and Ornamental Products.

the higher rates because Street and Koski (3) at Ohio State University have observed that some Kentucky bluegrass varieties can be injured at the 3.0 pound AI/A of pendimethalin.

The combination product of benefin plus trifluralin was developed to provide superior residual control as compared to benefin alone. Benefin, when used alone, always requires two applications spaced 45 to 60 days apart to provide season-long grass control. Trifluralin has a longer soil residual, but is too phytotoxic to be used by itself on turf. By combining the two products the effective period of control is lengthened providing a better grass herbicide.

By 1990, two new preemergence herbicides should be in the marketplace, giving maintenance operators an opportunity to re-evaluate and rethink their preemergence program. Proflam, a new dinitroaniline herbicide, has shown ex-

cellent preemergence properties in university testing. Use rates of between 0.5 to 0.75 pounds AI/A should give season-long grass control. In fact, this herbicide has been effectively used in fall applications which give crabgrass control the next spring and summer. A potential drawback of this herbicide is that it may not control some of the summer annual broadleaf weeds such as oxalis and spurge, as does pendimethalin, DCPA and benefin plus trifluralin.

Another new preemergence herbicide which should be labeled for use in 1990 is dithiopyr. This herbicide is a preemergence product providing season-long crabgrass control with rates of 3/8 to 1/4 pound AI/A. This compound also has significant postemergence grass activity. Data shows that on young, single tiller crabgrass, dithiopyr provides very good postemergence control.

Of the other preemergence herbicides tested, only pendime-

thalin shows any postemergence activity, although the postemergence activity of pendimethalin is rather weak. Dithiopyr has another advantage in that its margin of safety to turfgrasses is fairly high. Thus, a two- to three-time application rate will not cause injury to Kentucky bluegrass, perennial ryegrass, tall fescue or creeping bentgrass.

Particularly interesting is the creeping bentgrass which is normally sensitive to many types of herbicides. In many older, metropolitan areas, bentgrass often can be found in large amounts in home lawns. Selecting a preemergence herbicide which does not injure the bentgrass has often limited the available choices to one or two herbicides. Dithiopyr appears to have much better safety on bentgrass than many preemergence herbicides. Results on fine fescues have shown some injury on certain cultivars.

ROOT INJURY. The biggest con-

cern in using preemergence herbicides is whether they reduce rooting of turf. From row crop research, the dinitroaniline (DNA) herbicides have been classified as "root pruning" herbicides. The potential for the DNA herbicides and other preemergence herbicides to reduce rooting has been a concern for many lawn maintenance operators.

Turf researchers have studied this area extensively, but have been unable to draw definite conclusions. Studies in greenhouses and laboratories have often yield-

ed data depicting serious root reduction by preemergence herbicides. Studies in field situations have been less clear cut. Reicher and Christians (2) at Iowa State University studied the effects of the commonly used preemergence herbicides on rooting of Kentucky bluegrass at two locations for three years.

The locations consisted of a high maintenance bluegrass turf, i.e. irrigated with good fertility, vs. a low maintenance turf, i.e. no irrigation and low fertility. The herbicides included in the study were pendimethalin, DCPA,

benefin, oxadiazon and benesulide. The only decrease in rooting observed throughout the entire study was in the low maintenance turf from a pendimethalin application in one of the three years tested. No other treatment gave any root damage. In contrast to this study Dernoeden et al. (1) reported that pendimethalin at 3.0 pound AI/A and prodiamine at 0.5, 1.0 and 2.0 pounds AI/A all reduced the root weight of a perennial ryegrass turf in Maryland.

The root weights were determined in May of 1987 after three

successive herbicide treatments in April and September of 1986 and April of 1987. Thus, the question of root injury from pre-emergence herbicides is still unclear. The potential for root injury has been determined, however, the environmental and soil conditions likely to lead to root injury have not been adequately determined. Maintenance professionals should be particularly observant of the turf under their care and watch for evidence of root injury from preemergence herbicides. This is best accomplished by using some lawns as test areas where different herbicides can be used and the quality of these lawns vs. other lawns can be compared.

BROADLEAF HERBICIDES.

Registration of the preemergence broadleaf herbicide isoxaben for use on turf is expected soon from the Environmental Protection Agency. This is really a whole new class of herbicides for use on turf. In the past, some herbicides such as pendimethalin and DCPA have shown some pre-emergence activity on a narrow range of broadleaf weeds, such as oxalis and spurge, but isoxaben is the first broad spectrum pre-emergence broadleaf herbicide on the market.

Isoxaben has no postemergence broadleaf activity, but controls a broad spectrum of germinating broadleaf weeds. Data on broadleaf weed control shows excellent activity on most broadleaf weeds with the preferred application timing in the fall to control fall germinating weeds such as common chickweed or henbit, and carryover of the herbicide to provide control of the spring germinating weeds. Unfortunately, one weed that tends to escape, or at least needs higher rates for control, is dandelion. The labeled rate range will be in the 0.5 to 0.75 pounds AI/A whereas dandelion suppression will not occur without application rates of 1.0 to 1.5 pounds AI/A.

Postemergence broadleaf herbicide combination products are extremely inexpensive and very effective. The main market for isoxaben may be in the nursery and container-grown ornamentals industry where isoxaben can be combined with an effective pre-emergence grass herbicide to pro-

(continued on page 18)

INJURY RATINGS/KENTUCKY BLUEGRASS CULTIVARS

CULTIVAR ^w	RATE (lbs./A)	1986 RATINGS ^v 2WAT ^x	1987 RATINGS 2WAT
Enmundi	0.12	9.0	9.0
	0.25	9.0	9.0
	0.00	9.0	9.0
Cello	0.12	9.0	9.0
	0.25	8.7	8.7
	0.00	9.0	9.0
Sydsport	0.12	9.0	9.0
	0.25	8.3	8.7
	0.00	9.0	9.0
Cheri	0.12	9.0	8.7
	0.25	7.7	8.7
	0.00	9.0	9.0
Fylking	0.12	9.0	8.7
	0.25	8.3	8.7
	0.00	8.7	9.0
Kenblue	0.12	7.7	8.3
	0.25	6.3	8.0
	0.00	8.7	9.0
Ram-1	0.12	7.3	8.7
	0.25	6.7	7.3
	0.00	9.0	9.0
Barblue	0.12	7.3	8.0
	0.25	6.3	7.0
	0.00	8.7	9.0
Touchdown	0.12	7.7	7.7
	0.25	6.3	6.7
	0.00	9.0	9.0
America	0.12	7.3	7.7
	0.25	5.3	6.0
	0.00	9.0	9.0
^y LSD (0.05)=		0.8	0.6
^z LSD (0.05)=		0.7	0.6

^v Herbicide treatments applied on 11 June 1986 and 1 July 1987.

^w Rated visually on a scale of 9 to 1: 9 = No Injury, 1 = Dead. Above 6.0 = Acceptable.

^x WAT = Weeks after fenoxaprop-ethyl treatment.

^y LSD comparing two Kentucky bluegrass cultivars at one fenoxaprop-ethyl rate.

^z LSD comparing two fenoxaprop-ethyl rates within one Kentucky bluegrass cultivar.

Table 2. Injury ratings for Kentucky Bluegrass Cultivar study treated with Fenoxaprop-ethyl during 1986 and 1987. Hancock Turfgrass Research Center, E. Lansing, Mich.

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sweet move up to TURFLON.



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Its rewards.

"TURFLON did a much better job, particularly on our problem weeds like wild violets, ground ivy and spurge," Bob continues. "Since switching to TURFLON, we've reduced our weed related callbacks and service cancellations by 50% from a year ago." With performance like that, you'll be able to add some sweetness to your bottom line. Call us to find out more. 1-800-373-2DOW (2369).

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Preemergence

(continued from page 16)

vide total weed control. One niche for isoxaben might be in environmentally sensitive areas because most all of the commonly used postemergence herbicides are organic acids which tend to be prone to leaching. Preemergence herbicides generally have a minimal tendency to leach.

POSTEMERGENCE GRASS HERBICIDES. The use of post-emergence grass herbicides in lawn maintenance was fairly negligible until 1987. Prior to that time the only registered post-emergence grass herbicide was MSMA and variants of the active ingredient such as DSMA, CMA or AMA.

These herbicides generally required at least two applications spaced 10 to 14 days apart to provide effective crabgrass control. Thus, MSMA never really fit into a lawn maintenance program because the timing of applications didn't match the normal round structure. The MSMA

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The use of postemergence grass herbicides in lawn maintenance was fairly negligible until 1987. Before then there was MSMA and variants of the active ingredient.

type herbicides also were touchy to use as phytotoxicity could occur if the application rate was exceeded or if environmental conditions favored injury.

In 1987 a new herbicide, fenoxaprop, was introduced to the industry. Fenoxaprop is an effective postemergence grass herbicide generally giving excellent control of crabgrass up to four tillers in size with one application. Fenoxaprop has some disadvantages, but is an excellent herbicide for controlling crabgrass. The primary drawback associated with fenoxaprop is its tendency to injure bluegrasses with late spring applications (i.e. June applications in Michigan).

However, experiments per-

formed in Michigan in 1986 and 1987 showed that the sensitivity of bluegrass cultivars varied. Certain cultivars of bluegrass such as America, Touchdown, Glade and Ram-1 are fairly susceptible to injury from fenoxaprop while varieties such as Enmundi, Sydsport, Cheri and A-34 are tolerant of fenoxaprop applications.

We don't understand the basis for these differences in tolerance which could be related to many factors such as differential uptake (leaf absorption) of fenoxaprop, differential metabolism of fenoxaprop, different leaf morphology which could affect spray droplet retention, etc. But the injury will occur to varying degrees depending upon rate of fenoxaprop us-

ed and the environmental conditions.

Injury can often be seen as a distinct growth regulation with a dullish tan color to the turf. Generally, the maximum turf injury will be seen at two weeks after application and will disappear between three and four weeks after application.

Studies have also shown that fenoxaprop's action is antagonized by several common broadleaf herbicides, with 2,4-D being the most strongly antagonistic. Our research has indicated that the broadleaf herbicides MCPP and chlorfluenol cause no antagonism under any conditions while dicamba, triclopyr and clopyralid caused slight antagonism which was only evident when trying to control large tillered crabgrass. These herbicides can be safely used when broadleaf and grass control mixes are desired. Do not use 2,4-D in combination with fenoxaprop.

Another new herbicide that could be in the market by 1991 is called quinchlorac. This is a

(continued on page 20)



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Preemergence

(continued from page 18)

very interesting herbicide because it really fits into several classifications. This herbicide can control annual grasses both pre and postemergently and has a good spectrum of broadleaf weeds controlled. Since this herbicide is farther away from the marketplace, I won't spend any more space on it, because a good proportion of herbicides under development never make it to market.

Another new speciality use herbicide is called chlorsulfuron. This product has a narrow, but important niche in the turf weed control market. It selectively controls tall fescue in Kentucky bluegrass and fine fescue lawns. Tall fescue and also perennial ryegrass will be injured or eradicated by this herbicide. Tall fescue is often a serious weed problem in home lawns because its bunch type growth habit and coarse leaf blades make it very objectionable in high quality turf.

POSTEMERGENCE BROADLEAF HERBICIDES. Postemergence broadleaf herbicides are widely used in the industry to control weeds such as dandelion, white clover, plantains, etc. The dominant chemical has always been 2,4-D. It has an excellent spectrum of control, is cheap to manufacture and mixes well with other herbicides increasing the spectrum of control and efficacy.

A study out of Kansas which was published in 1986, linked the use of 2,4-D with an increase in the rate of non-Hodgkin's lymphoma. The study was widely criticized for its technique of data collection and the accuracy of its results. Because of the study, the EPA initiated a review of all the toxicological data and basically gave 2,4-D a clean bill of health. However, several other states have begun similar studies of 2,4-D use and cancer. Also, the National Cancer Institute is currently conducting a study of ChemLawn employees to determine cancer risk to these employees.

The detailed company records on herbicides used and amount

of use will make this a very valuable study. The results of these studies will likely determine the regulatory fate of 2,4-D. If 2,4-D is found not to be a cancer risk, it is difficult to imagine other herbicides replacing 2,4-D simply because of its low cost and good efficacy. However, should 2,4-D be removed from the marketplace, then the broadleaf weed control market will change dramatically.

One new herbicide product which appears to be on the way to the market is a combination of triclopyr and a new herbicide called clopyralid. Label use rates will be in the range of 3/8 pound AI/A or triclopyr plus 1/8 pound AI/A of clopyralid. This is a non-phenoxy herbicide product which has shown good control of a wide range of broadleaf weeds. The only question with this product will be can it compete in price with the 2,4-D based products.

In summary, there are a lot of new herbicides that are or will shortly be available for use in turf. Lawn maintenance professionals will need to evaluate these pro-

ducts to see if they fit into their particular programs and operations. University trials should be important in assessing the usefulness of these new products. —
Bruce Branham

The author is assistant professor of Crop and Soil Sciences, Michigan State University, East Lansing, Mich.

REFERENCES

1. Dernoeden, P.H., D.B. Davis, and J.D. Fry. 1988. Rooting and cover of three turf species as influenced by preemergence herbicides. Proc. NEWSS. p. 169-173.

2. Reicher, Z.J. and N.E. Christians. 1986. Effect of Preemergence Herbicides on Rooting of *Poa Pratensis*. Agron. Abstracts. p. 137.

3. Street, J.R. and T. Koski. 1986. Kentucky bluegrass quality as affected by Pendimethalin. 1986 Ohio Turfgrass and Landscape Horticulture Research Field Day Report. p. 30.

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TURFGRASS IS A PERENNIAL GRASS COMMUNITY.

Because of its perennial nature, cultural management programs are somewhat different compared to any other system.

Maintenance practices such as mowing too low, overirrigation, overfertilization, using unnecessary heavy machinery and miss-timed aeration can result in stress conditions that encourage weed infestations. A good management program with both cultural and chemical control will help reduce these stress factors.

A successful management program for turfgrass results from an integration of a recommended cultural practice and a complete weed control program. An effective weed control program uses judicious use of herbicides when necessary.

Producing a dense, healthy stand of turfgrass is one way to control annual grassy weeds and other broadleaf weeds. The proper mowing height and frequency, fertilization and irrigation are part of the management program and should be practiced throughout the growing season.

The most common annual grassy weeds include large crabgrass, small crabgrass, yellow foxtail, green foxtail, fall panicum, barnyardgrass, goosegrass and annual bluegrass. Crabgrass and goosegrass are the most troublesome weeds in turf.

Turfgrass managers should be familiar with the following steps for a successful weed control program: (a) Knowing the specific weed problems, grassy weeds vs. broadleaf weeds, and the life cycle of the weeds, annual vs. perennial; (b) Selection of the right herbicide: in relation to effective weed control and turfgrass tolerance.

HOW DOES IT WORK? The preemergence herbicides are directly applied to the turfgrass. These herbicides act by creating a chemical barrier at the soil surface prior to seed germination. The herbicides should be watered-in so that the chemical can reach the soil surface forming a barrier. This barrier prevents crabgrass seedlings from emerging and developing normally.

Annual grassy weed germination is related to soil temperature. When the soil temperature reaches 65 degrees Fahrenheit for a week, grasses begin to germinate. The peak germination period varies with the local conditions of soil type, rainfall and weather in the spring. Germination in northern regions generally begins mid to late May, while it can occur as early as March in the transition zone and southern regions.

APPLICATION TIMING. Timing is very important for herbicide application. The key point is that preemergence herbicides need to be applied before grasses germinate in the spring. Treatments made too late (i.e. after germination) will not control emerged grassy weeds. If application timing does not coincide with the normal germination period of annual grassy weeds, weed control results may be erratic or poor.

In general, preemergence herbicides should be applied one to two weeks prior to the expected weed seed germination period. Therefore, the application dates of preemergence herbicides will vary from one part of the country to another. Remember the following steps:

.....
The key point is that preemergence herbicides need to be applied before grasses germinate in the spring.



- Apply at the recommended rate.
- The best time to apply is one to two weeks prior to crabgrass seed germination.
- Repeat applications may be necessary to control crabgrass in the transition zone or in southern regions.

An example of a preemergent herbicide controlling germinating weeds and grasses through the shoot. Illustration: Ciba-Geigy Turf and Ornamental Products.

RESIDUAL WEED CONTROL. A complete weed control program aims for controlling weeds for the entire growing season. Season-long control of weed species is dependent upon the activity and longevity of the herbicide in use. Longevity again is based upon the chemical group. Some herbicides may last only four to six weeks, while others may provide 12 to 16 weeks from the time of application (Figure 1). Oxadiazon, pendimethalin, bensulide and a combination of benefin and trifluralin provide long residual weed control, while benefin is of short residual type. On the other hand, DCPA is an intermediate type.

Turfgrass managers should keep in mind that soil residual ac-

tivity is also dependent upon the rate of herbicide being used. The higher the rate of application, the longer the residual control is over the growing season.

Initial application rates determine the concentration in the soil for preemergence activity. It must maintain a critical soil residue level during the growing season for season-long weed control. Turfgrass managers should keep in mind that applications made early in the season may break down in the soil to areas below the threshold level.

When this occurs, one can expect less than desirable control following late germinating weeds. Repeat applications of certain herbicides (short-residual type) may be made 10 to 12 weeks after the initial application for continued control of late germinating weeds over the entire season.

TURFGRASS TOLERANCE.

Turfgrass species vary in their tolerance to preemergence herbicides. Siduron is the only preemergence herbicide that is recommended for newly seeded turfgrass. All other preemergence herbicides are recommended for use on established fine fescues, Kentucky bluegrasses, perennial ryegrasses and tall fescues.

However, bensulide and DCPA can be applied in the spring following a fall seeding of cool season turfgrasses. Warm season grasses include bermudagrass, cenitipedegrass, St. Augustinegrass, zoysiagrass, and bahiagrass.

RESEEDING TIME. The time for reseeding is very important in relation to the application date of preemergence herbicides. In general, preemergence herbicides persist in the soil for a length of time, allowing season-long weed control. Reseeding intervals are dependent upon the herbicide and dosage used.

For example, reseeding should be delayed at least six weeks after an application of pendimethalin at the lower end of the recommended rate (1.5 pound/A). However, when using the highest recommended rate (3.0 pound/A), reseeding should be delayed 12 to 16 weeks after the application. Remember to follow proper cultural prac-



Photo 1. Season-long preemergence control of large crabgrass with pendimethalin (left) at 1.5 pound/A rate compared to the untreated check (right) at the University of Massachusetts Turfgrass Research Center, South Deerfield. Photo taken 12 weeks after application.

tices such as soil cultivation, irrigation and fertilization when reseeding.

PREEMERGENT ACTION. The preemergence weed control program has been a popular and very convenient program for golf course managers and maintenance professionals. The primary preemergence herbicides for grassy weed control in cool season grasses are bensulide, benefin, DCPA, oxadiazon, pendimethalin and siduron. In addition to these herbicides, napropamide and oryzalin are recommended for use in warm season grasses.

For the last five years, the marketplace has been extremely competitive for several preemergence herbicides. Based on the performance and other features such as broad-spectrum weed control, some of the newer compounds have also gained a strong position in the market.

For example bensulide, a good preemergence herbicide used frequently by maintenance profes-

sionals, has developed some performance difficulties in the New England area. Consequently, many Northeastern maintenance professionals switched to pendimethalin for preemergence weed control.

At present, dinitroaniline herbicides, characterized by strong yellow color, are the major preemergence herbicides. This class includes benefin, trifluralin, pendimethalin, oryzalin and prodiamine (expected soon in the market).

Benefin, a premix combination of benefin and trifluralin (Team), DCPA, bensulide, pendimethalin and oxadiazon, control green foxtail, yellow foxtail, smooth crabgrass, large crabgrass and other germinating grassy weeds. DCPA is also effective in controlling common chickweed, carpetweed and common purslane.

In addition, pendimethalin controls goosegrass, barnyardgrass, fall panicum and some annual broadleaf weeds such as hop clover, yellow wood sor-

rel and prostrate spurge. Pendimethalin applied during the late summer to early fall can control common chickweed, mouseear chickweed and henbit. Repeat applications at the recommended rate eight weeks after the initial application may prevent goosegrass and heavy infestations of spurge.

Oryzalin controls crabgrasses, foxtail, goosegrass, chickweed, henbit and other species. It is primarily used for weed control in warm season grasses.

Oxadiazon controls hop clover, prostrate spurge and speedwell. Oxadiazon is more effective in goosegrass control than DCPA. Pendimethalin and DCPA control prostrate spurge, while benefin and bensulide are ineffective in controlling this weed.

Prodiamine, a promising new preemergence herbicide, is expected to be in the market in the near future. It is very effective in controlling most annual grassy weeds such as crabgrass, goosegrass, bluegrass and several broadleaf weeds. It provides long residual control of weeds.

In summary, a successful preemergence weed control program results from selecting the right herbicide and applying it uniformly at the proper time and appropriate dosage. The herbicide selection is dependent upon the weeds to be controlled and the turfgrass to be treated. Choose the most effective herbicide with maximum safety to the turfgrass. For crabgrass and other grassy weed control, maintenance professionals should emphasize a preemergence herbicide program along with a good cultural program. — *Prasanta C. Bhowmik*

The author is an associate professor of weed science at the University of Massachusetts, Amherst, Mass.

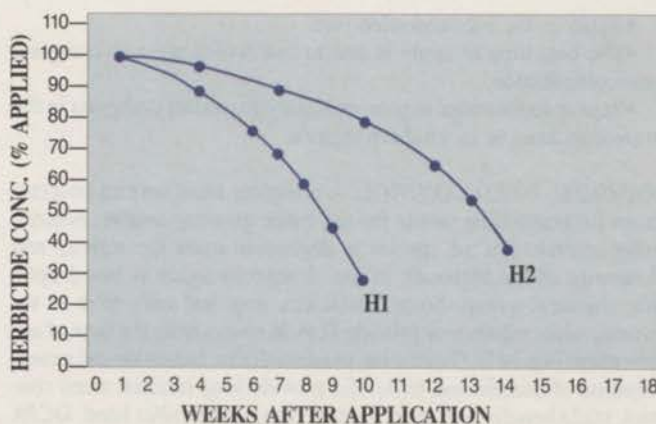


Figure 1. Soil degradation curves for two preemergence herbicides: H1 = short-lived and H2 = long-lived herbicides, respectively.

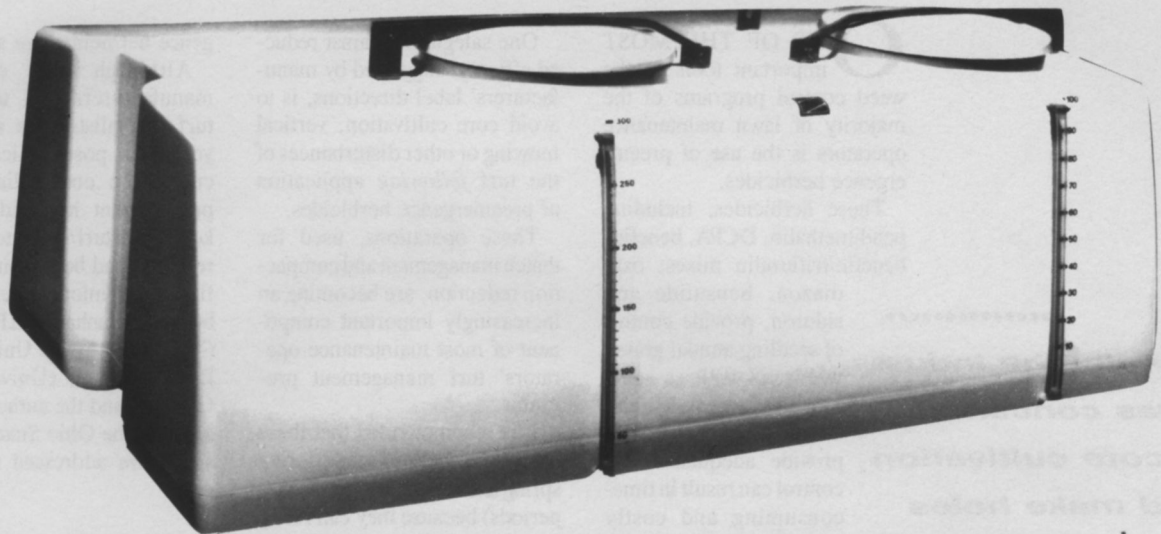
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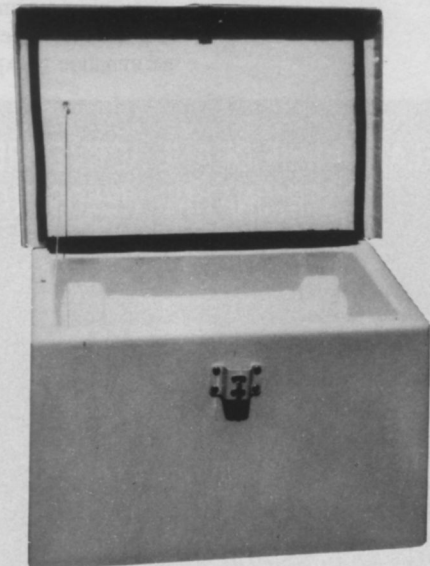
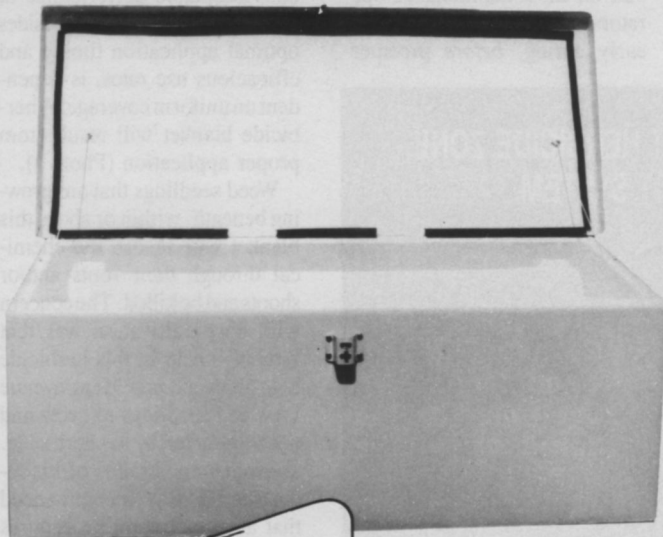
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Core Cultivation Effects After Preemergent Applications

ONE OF THE MOST important tools in the weed control programs of the majority of lawn maintenance operators is the use of pre-emergence herbicides.

These herbicides, including pendimethalin, DCPA, benefin, benefin/trifluralin mixes, oxadiazon, bensulide and siduron, provide control of seedling annual grassy weeds, as well as some broadleaf weeds. Failure of spring applications to provide adequate weed control can result in time-consuming and costly callbacks, or even customer loss.

To reduce the chances of poor performance, maintenance operators generally strive to apply these products uniformly at recommended rates, and comfortably before weed seed germination is expected.

One safeguard against reduced efficacy, suggested by manufacturers' label directions, is to avoid core cultivation, vertical mowing or other disturbances of the turf *following* application of preemergence herbicides.

These operations, used for thatch management and compaction reduction, are becoming an increasingly important component of most maintenance operators' turf management programs.

It is recommended that these procedures be performed during spring and/or fall (cooler, moister periods) because they can result in unacceptable levels of heat and drought-related turf damage when performed during the summer months. The time-consuming aspect of these cultivation procedures makes it difficult for most maintenance operators to perform them during the early spring, *before* preemer-

gence herbicides are applied.

Although both chemical manufacturers and university turf specialists have stated for years that post-applicator core cultivation could disrupt the preemergent herbicide "blanket" at the turf/soil interface, no research had been done to confirm this opinion. Recent studies by Bruce Branham and Paul Rieke (Michigan State University), B. J. Johnson (University of Georgia) and the authors of this article (The Ohio State University) have addressed this concern.

WHY THE CONCERN? In order to understand why there has been concern about post-application cultivation procedures, the concept of how a preemergence herbicide works must be reviewed. Acceptable performance of preemergence herbicides, besides optimal application timing and efficacious use rates, is dependent on uniform coverage. A herbicide blanket will result from proper application (Photo 1).

Weed seedlings that are growing beneath, within or above this blanket will absorb the chemical through their roots and/or shoots and be killed. The concern with core cultivation was that "holes" made in this herbicide blanket would provide an avenue for weed seedlings to grow and not be affected by the herbicide. To avoid the possibility of this occurring, it was recommended that any cultivation procedures be carried out before preemergence products were applied. Interestingly, little research had been conducted to test the validity of this assumption.

TESTING THE ASSUMPTION. In early May of 1987, a study

(continued on page 28)

.....
Originally the industry was concerned that core cultivation would make holes in the herbicide blanket.

RELATIONSHIP OF THE ACTIVE PRE-EMERGENT HERBICIDE ZONE, GERMINATING WEEDS AND TURF ROOT SYSTEM

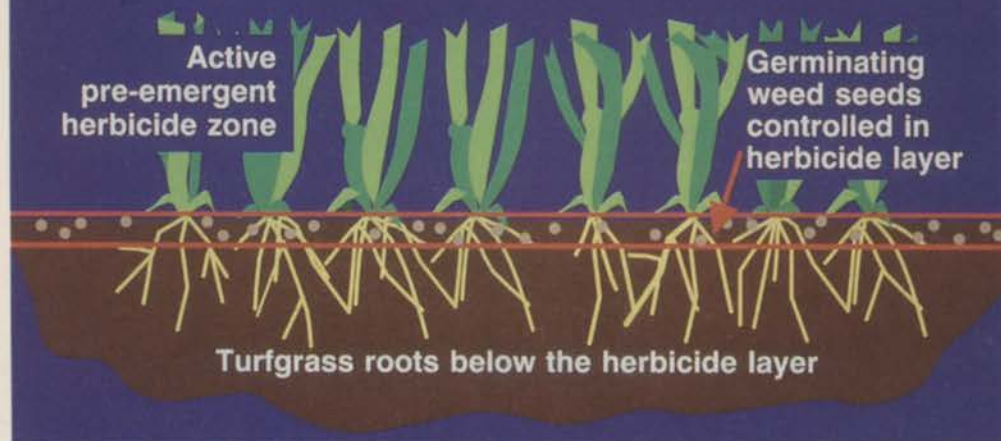
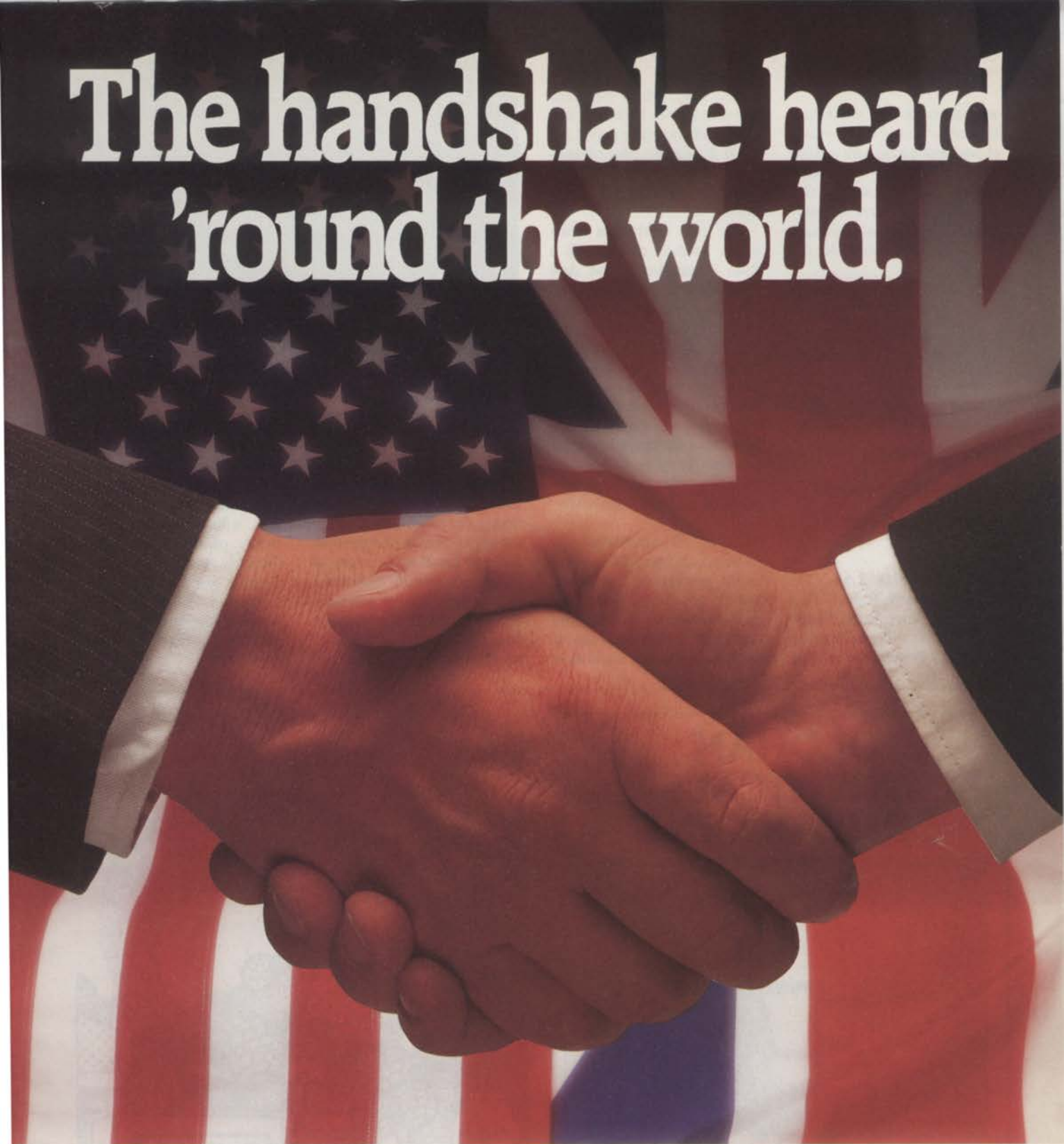


Photo 1. Preemergence herbicides form a "blanket" on the turf surface that kills grass seedlings which grow into contact with it.

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RANSOMES

Core Cultivation

(continued from page 26)

was started at The Ohio State University to examine the effects of post application core cultivation on the efficacy of five commonly used commercially available preemergence herbicides. Those products, with application rates, included the following:

Dacthal 75WP (10.5 pounds

.....
Turf overseeded with large and small crabgrass and a non-treated control was studied.

a.i./acre), Balan 2.5G (2.0 pounds a.i./acre), Team 2G (2.0 pounds a.i./acre), Scotts Weedgrass Control with pendimethalin 1.7G (1.5 pounds a.i./acre), and

PreM 60 DG (1.5 pounds a.i./acre).

The study, which had been overseeded with both large and small crabgrass (one pound per 1,000 ft² of each), also contained a non-treated control. Each treatment was replicated three times.

The core cultivation treatments involved coring with a Ryan Greensaire at five days (May 11), 20 days (May 26) and 40 days (June 15) after herbicide application, as well as a non-cored treatment. The cultivating machine was passed over the plots three times and the cores were not removed from the turf. The study was irrigated frequently to aid in incorporation of the soil from the cores, as well as to encourage crabgrass seed germination and seedling growth.

RESULTS. All herbicides provided excellent control (94 percent to 99 percent) of crabgrass, and did not differ significantly in that respect. Similarly, core cultivation performed at any of the three dates had no adverse

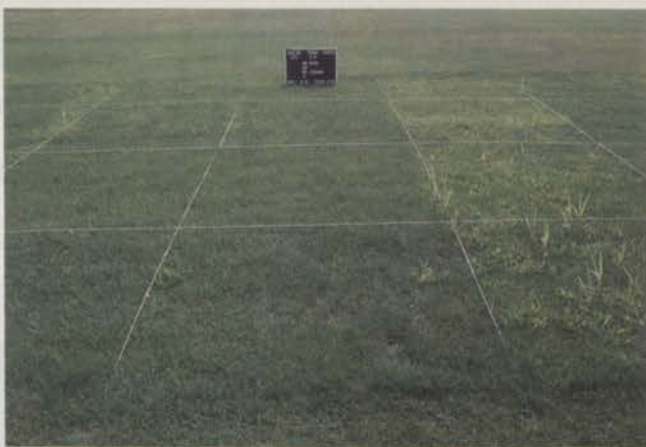


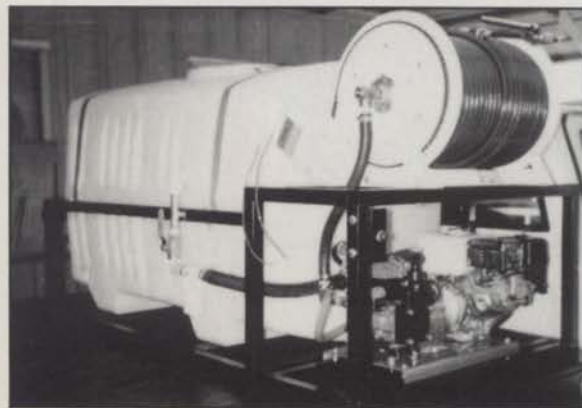
Photo 2. Photo of study (Aug. 1) which shows crabgrass control by Balan (left, top-to-bottom strip), Team (middle strip) and untreated control (right strip). Coring treatments (left-to-right strips) are: five days after application (bottom strip), no coring (second from bottom), 20 days after application (third from bottom) and 40 days after application (top strip).

effect on the efficacy of the preemergence herbicides used in this study (Photo 2). In the non-treated control, there was no apparent increase in crabgrass infestation resulting from any of the core cultivation treatments.

These results agree with those of Branham and Rieke, Michigan State, who concluded that cultivation operations (core cultiva-

tion or vertical mowing) could be performed following pre-emergence herbicide application, without reducing the efficacy of those herbicides. Similarly, Johnson, University of Georgia, found that a single core cultivation following application of oxadiazon did not reduce goosegrass control on putting green turf.

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CONCLUSIONS. It is apparent that, on a healthy turf, post-application core cultivation will not adversely affect the performance of preemergence herbicides. It is likely that any seed brought to the surface in the soil will come into contact with the herbicide if it does germinate. Any seed that germinates within a core hole will likely grow into contact with herbicide at the surface perimeter of that hole. Also, seeds germinat-

failure occurs when post-application core cultivation has been performed, consider some possible causes for such failure. An obvious cause would be misapplication — either the rate was too low, or coverage was incomplete.

Consider that core cultivated turfs require more attention when it comes to irrigation. The "opened-up" turf loses water readily to the atmosphere, thus increasing the potential for drought-related damage. Weed pressure in a damaged turf may become so high as to override the effects of the preemergence herbicide.

Another scenario for preemergence failure could occur as a result of dry weather and/or lack of irrigation. While soil moisture may be adequate to permit crabgrass seed germination, enough rain or irrigation water may not have fallen on the turf to wash the preemergence herbicide off of the foliage it was sprayed on, or off the fertilizer or other granule with which it was applied.

If the herbicide barrier is not in place before the seed germinates, it is likely that the seed-



Photo 3. Prolific root growth in core hole — one week after coring.

.....
In a healthy turf, core cultivation won't adversely affect preemergence performance.

ing in the holes will face stiff competition from new grass roots which flourish in these holes (Photo 3).

In the event that preemergence

lings will not be affected by the herbicide.

In summary, it is apparent that post-application core cultivation will not adversely affect the efficacy of a properly-applied preemergence herbicide to a well-maintained turf. Acceptable preemergence herbicide performance is dependent upon proper timing, efficacious use rate, uniform application and adequate irrigation/precipitation following application.

The ability to perform core cultivation before and after pre-emergence herbicide application will increase flexibility in scheduling springtime lawn maintenance operations. — *Anthony J. Koski and John R. Street* ■

The authors are extension turfgrass specialists at Colorado State University, Fort Collins, Colo., and The Ohio State University, Columbus, Ohio, respectively.

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What Does It Really Cost Your Company to Mow?

WHAT DOES IT really cost to mow? When this question arises in a group of lawn and landscape

maintenance professionals, you get lots of different answers.

Some seem a bit weird and many have very little foundation.

The response will range from reasonably good "guesstimates" to comments such as: "Probably a lot more than I think," "I wish

I knew" and "If I had a better idea of what it cost, I would have a better idea of what to charge for my mowing service."

To begin with, no two lawn and landscape maintenance businesses are likely to have identical mowing costs. Some may be fairly close to others, and many will be significantly different. The detailed costs that comprise total mowing cost, in all likelihood, will vary widely from one lawn or landscape business to another.

This article will provide a process to use in estimating, with reasonable accuracy, what it costs *your business* to mow.

There are two major costs that cover the total mowing cost:

- mower cost
- operator cost

There are also a number of detailed costs that encompass each of these two major costs such as: depreciation, interest, gas and repairs with regard to mower cost; and wages of salary, social security and insurance with regard to operator or labor cost.

Therefore, if mower and operator costs are basically what comprise the total cost to mow, you need a method for doing the best job you can in estimating these costs for your business. Let us first look at a tool for estimating mower cost. With regard to a mower, you are likely interested in arriving at an hourly rate that can be used in estimating the cost of particular mowing jobs. (See Figure 1.)

Next, let's consider the operator cost. Since operator cost or labor cost is often comprised of something more than straight wages such as: the employer's share of social security, unemployment insurance, workman's compensation insurance and perhaps fringe benefits, we need another tool that will permit a

LABOR COST ESTIMATING WORKSHEET

DATE: Jan. 2, 1989

NAME: Joe Handyman

COST ITEM:	COST TO EMPLOYER	INCOME TO EMPLOYEE
<i>Direct wage costs:</i>		
1. Total Regular Hours: (Hrs./wk 40 x No. wks 52) =		2,080 hrs.
Overtime: (Hrs./wk ___ x No. wks ___) =		
2. Cash Wages (line 1 x rate/hr \$6.50) =	\$13,520	
3. Overtime Wages (No. ___ x rate ___) =		
4. Cash Bonuses (\$ ___ or % 4%) =	540	
5. Total adjusted cash wages = (total lines 2 through 4)	\$14,060	
<i>Mandatory Wage Costs:</i>		
6. Employer's share of Soc. Sec. 7.51% =	\$1,056	\$ XXX
7. Federal unemployment insurance =	56	XXX
8. State unemployment insurance =	175	XXX
9. Workman's compensation =	582	XXX
10. Other _____		
11. Total value of mandatory costs = (total lines 6 through 10)	\$1,869	\$
<i>Value of Fringe Benefits:</i>		
12. Insurance — Life =	\$240	
Dental =		
Health =	\$1,128	
_____ =		
_____ =		
13. Retirement (business contribution) =		
14. Uniform (purchase/rental/cleaning) =	120	
15. Educational expense =	150	
16. Transportation (mi./day ___ x No. day ___ x rate ___) =		
17. Other _____		
18. Other _____		
19. Total value of fringe benefits = (total lines 12 through 18)	\$1,638	
20. Total labor costs: = (line 5 + 11 + 19) =	\$17,567	
21. Hours paid for but not worked = Holidays (48 hrs.); Vacation (40 hrs.); Sick leave (96 hrs.)	184 hours	
22. Total hours on the job (line 1 2,080 — total line 21 184) =		1,896 hours
23. Total Costs per hour on the job: = (line 20 divided by line 22)	\$9.27	\$

Figure 2.

JOB COST ESTIMATE FORM

Mowing (Four customers; same street. Lawn = 40,000 sq. ft.)

MACHINERY	COST PER HOUR	HOURS USED ON JOB	MACHINE COST
1. 36" s. prop. mower	\$2.41	x 6	= \$14.46
2. Pickup truck	\$.35 cents/mi.	x 32mi.	= \$11.20
3. Trailer	\$2.81	x 1	= \$2.81
4. Weedeater	\$.70 cents	x 1.3	= \$0.91
5. Total machinery cost (add lines 1 through 4) =			\$29.38

LABOR	COST PER HOUR	HOURS ON JOB	EFFICIENCY FACTOR	LABOR COST
6. Mowing	\$9.27	x 6	x 1.2	= \$66.74
7. Trimming	\$9.27	x 1.3	x 1.2	= \$14.46
8. _____				
9. Total labor cost (add lines 6 through 8) =				\$81.20

MATERIALS	QUANTITY	UNITS	PRICE PER UNIT	MATERIALS COST
10. _____			x _____	= _____
11. _____				
12. _____				
13. _____				
14. Total materials cost (add lines 10 through 13) =				
15. Total direct cost (add lines 5 + 9 + 14) =				\$110.58

OVERHEAD AND CONTINGENCIES	OVERHEAD COST
16. General Overhead (15% of direct costs)	= \$16.59
17. _____	= _____
18. Total overhead cost (add lines 16 and 17) =	\$16.59
19. Total job cost estimate (add lines 15 and 18) =	\$127.17
20. Job cost per hour of mowing (for this job) =	\$21.20
21. Mowing function cost per hour (mower and operator) =	\$11.68

Figure 3.

reasonably accurate estimate to be made of true labor cost per hour. (See Figure 2.)

Now, the sum of the mower and operator costs, as derived through the process shown here, will provide a reasonably accurate hourly estimate of the mowing function. In the example, the mower cost of \$2.41 per hour plus a labor cost of \$9.27 per hour shows a total cost of \$11.68 per hour to perform the mowing function. These numbers are critical to estimating mowing job costs.

To make reasonably accurate and reliable mowing job cost estimates requires additional cost considerations such as: the cost to get men and equipment to the job site, and some share of the

business overhead expenses such as, utilities, advertising and office rent and supplies.

The job cost estimate procedure

in Figure 3 provides a way to pull all costs together to arrive at a cost estimate for a particular mowing job which is, of course, greater

than the cost of the mowing function alone. (See Figure 3.)

CONCLUSION. Factors that impact significantly on the mowing function cost:

- Purchase cost of mower.
- How long mower will last (related to level of use and operator abuse).
- Interest rate used for capital recovery.
- Wages paid (remember that cheap labor can be very costly in other ways).
- Fringe benefits provided labor.

• Actual hours worked per year. Factors that impact significantly on mowing job cost:

- All of the above.
- Distance to job.
- Level of overhead costs.

So, to answer the question, what does it really cost to mow? It is likely different for each lawn and landscape maintenance business, but try the process shown here and estimate your own. — R. K. Reynolds ■

The author is an associate professor emeritus of agricultural economics at Virginia Polytechnic Institute and State University, Blacksburg, Va.

ESTIMATE OF ANNUAL MACHINE COST

36-INCH SELF-PROPELLED MOWER

Line	Amount
1. Purchase cost	\$2,500
2. Salvage value	\$ 0
3. Cost to be recovered (line 1 minus line 2)	\$2,500
4. Estimated years of life	3
5. Units of estimated annual use (hours, acres, miles, etc.)	900 hrs.
Fixed or Ownership Costs:	
6. Cost recovery and (12%) interest factor	0.4163
7. Cost recovery and interest (line 3 x line 6)	\$1,041
8. Interest on salvage value (line 2 x interest rate percent)	0
9. Insurance, taxes, housing (line 1 x 4 percent)	\$100
10. License	0
11. Total fixed cost (add lines 7 through 10)	\$1,141
12. Fixed cost per unit (line 11 divided by line 5)	\$1.27
Variable or Operating Costs:	
13. Fuel (.67 gallon /hour x 900 hours x \$1.00 price/gallon)	\$603
Unit No. Units	
14. Oil, grease, anti-freeze	\$75
15. Repairs (including service labor), tires, etc.	\$350
16. Total variable cost (add lines 13 through 15)	\$1,028
17. Variable Cost per Unit (line 16 divided by line 5)	\$1.14
18. TOTAL ANNUAL MACHINE COST (line 11 plus line 16)	\$2,169
19. TOTAL COST PER UNIT (line 18 divided by line 5)	\$2.41

Figure 1.

Regular Maintenance Prevents Need for Urgent Repair Service

THE DEMAND FOR qualified irrigation maintenance and service contractors is on the rise.

Whether your company currently specializes in landscape contracting, mowing and maintenance or chemical application, the maintenance and service of existing sprinkler systems offers you an opportunity to fill a need in the rapidly growing irrigation industry.

By offering fixed-fee service contracts and service at hourly rates, as well as making replacement parts available for sale directly to end users, the irrigation maintenance portion of your company, if well managed, should be seen not only as an opportunity to expand your company's scope of services, but as a chance to have a positive impact on your bottom line.

In addition, maintenance and service are excellent ways in which to get in on the ground floor for consideration on larger projects and new installations, for it is an industry acknowledged principle that if a contractor performs well in the area of service, he/she is "The kind of person I want on my project."

This article will point out the major factors that are likely to affect an irrigation maintenance division. These include the type of system, geographic area and system wear and tear.

It should be recognized up-front that irrigation maintenance and service require a good basic knowledge of irrigation troubleshooting along with a small but diversified inventory of irrigation products, both whole goods and



parts. Keep in mind that your local irrigation wholesaler will be more than happy to work with you in setting up a division of your company for irrigation maintenance and service.

Most distributors conduct educational seminars on a regular basis covering the topics of basic irrigation design, installation, selling and marketing, as well as service and troubleshooting. Distributors will also be able to advise you concerning any permits or licenses that may be required to do irrigation maintenance in your area. These wholesalers can usually be found in the local yellow pages or exhibiting at a landscape supply trade show.

COMPONENTS OF A SPRINKLER SYSTEM. An irrigation system is a network of pipes, wires, valves and sprinkler heads, the function of which is to move water from a source to a point of consumption (the sprinkler) so that the water may be applied evenly to the soil to compensate for the loss of moisture through evapotranspiration (the combination of evaporation and transpiration).

If it is considered that the controller is the "brain" of the system,

then the water source would be the heart (the pump), the wiring is the nervous system, the piping network the veins, etc. The function of the maintenance and/or service technician is to keep this sometimes complex mechanical system in a state of good repair, finely tuned and working in concert with the needs of the landscape.

This can be quite a challenge because the installation of an irrigation system requires that we take some very sensitive equipment (valves, sprinkler heads, wiring connections, etc.), place them in a very harsh environment (the ground) and expect them to perform flawlessly. We expect much, and we are usually not disappointed. However, the need for regular maintenance and occasional service is always with us.

COMMON PROBLEMS. Many landscape and maintenance contractors are routinely asked to perform what the owner considers to be "very minor" repairs. What to some may seem "minor," to others can at times seem quite baffling. How often have you heard, "Oh, Bill, there's a sprinkler head missing somewhere out in the

.....

Your company profitability can increase through a regularly supervised irrigation maintenance program.



middle of the backyard. Can you have one of your men take care of it before you leave today?" or "One of these valves just won't go off. Do you know what to do?" or "I think the sprinkler system is running too much. Can you do something with that green box in the garage?" These are but a few of the everyday challenges the typical green industry contractor faces on a regular basis.

The number of times you have heard about these problems, or spotted them yourself, is a small indication of the opportunity that awaits your attention. The simple fact is that the irrigation industry has grown so rapidly in the last decade, that there is a real need for qualified, conscientious maintenance and service contractors. It will benefit you to become adept at handling these situations: learn how to replace or install a missing or damaged sprinkler head, repair a broken pipe and flush the repaired pipe, troubleshoot a malfunctioning valve and program an irrigation controller, etc. These are services of value to your clients. Not only that, but it is "your" landscape that is depending upon the sprinkler systems operating properly.



Set all sprinklers to grade from an aesthetic as well as performance standpoint. (p. 20) Adjust sprinklers so the water is distributed only on the landscaped areas eliminating wasted water and runoff. (above) Backflow preventers should be checked once a year for loose connections and leaking seals. (far left) Repair damaged sprinklers as soon as possible to avoid liabilities and wasted water. (left) Photos: David Wheeler and Brian Vinchesi.

TYPES OF SYSTEMS. Regardless of the type of irrigation system, regular maintenance is the best insurance against the need for urgent service. The most common maintenance procedure is to simply do a "walk-through" while the system operates through an irrigation cycle.

To accomplish this, the controller should be set to a minimum time (two, three or five minutes per zone) and allowed to cycle (a hand-held remote control device which can be used to advance the controller will be a great help in speeding up the process).

The technician will walk through the system during the test cycle, flagging or marking problems and adjusting heads for arc and distance. After required repairs are made, the repaired zones should be cycled and checked. The maintenance schedule will vary depending on the type of system. The types of irrigation systems requiring maintenance

include: residential, commercial, athletic field and municipal (highway, park, golf or cemetery).

Athletic fields require the most frequent attention to ensure that no major damage will be done to the playing surface due to the sprinkler system. Broken or damaged sprinkler heads must be replaced or repaired quickly to reduce the possibility of damage to turf areas and to assure a safe playing surface. The importance of athletic field heads being set to finish grade cannot be over-emphasized.

An athletic field irrigation system should be checked on a weekly/biweekly basis for proper operation. Scheduled watering should not take place before mowing as wet grass will hamper mowing operations. If there are qualified grounds maintenance personnel involved, they will probably have their own ideas regarding water scheduling. It is a good idea to see to it that they

GENERAL MAINTENANCE BASED ON AGE, TYPE OF SYSTEM

GENERAL MAINTENANCE OF A system varies with the type of system as previously mentioned. You, the contractor, must decide if the system should be checked weekly, monthly or yearly. Your decision will be based on a number of factors.

1. *Age of the system.* The older the system, the more frequently it may need to be checked for component wear and failure.

2. *How well the system was originally installed.* If the system was designed and installed correctly, it will not require checking as frequently.

3. *Use and traffic.* The more traffic (people, equipment, etc.) the system and area is subject to, the more often the system will require checking.

4. *The customer.* The more particular the customer, the more often the system should be checked. Make sure this is covered in your fee.

During periodic work at the site, al-

ways check to see that the system is operating properly. Additionally, on a yearly basis check that all sprinklers and valve boxes are set to grade, all sprinklers are adjusted properly for arc and distance and all nozzles are clean and free of debris. Should a pipeline require repair or a sprinkler require replacement — especially if the system has cycled since the break — the importance of flushing the entire line must be recognized.

Remove sprinkler internals and flush as though this were the initial filling of the pipelines with water. Verify that the controller batteries, reset contacts and fuses are clean, intact and functioning. Also, check the backflow preventer connections and test the backflow device if required by state or local code. Make sure the rain shut-off is working by filling or wetting it down with a glass of water. Also check for proper operation of moisture and freeze sensors if present.

General maintenance is best perform-

ed by simply observing the system during operation and looking for problems as outlined earlier. As you walk the property pay attention to your footing. Soft areas in the lawn usually indicate leaks or over watering.

To simplify your irrigation maintenance program, keep a small amount of stock of each sprinkler manufacturers' equipment and parts. Proper inventory of various sizes of pipe and fittings will also make intake repairs easier. A small, but diversified inventory will save you the trouble of running to a supply house everytime you come upon a different type of system.

Special equipment should include a voltage meter, wire tracer and a small manual pump. Large pipe installation equipment is not usually necessary for irrigation system maintenance. If needed, it is most cost-effective to rent a small trenching machine on a short-term basis.

are well instructed in the programming of the controller, and that they understand how much water the system is capable of applying to the turf per hour. They should also be advised of the necessity of flagging the sprinkler heads prior to aeration and/or spiking operations.

Commercial systems should be checked at least monthly as these systems are usually set to operate at night when no one is present. Therefore, problems may go unnoticed by the owner. These sites are best maintained by a landscape contractor or landscape maintenance firm who can easily check the system every few weeks after mowing.

Residential systems require the least maintenance from a contractor's point of view. Usually, the homeowner spots a problem with the system and calls for repairs. Service contracts for residential customers can be profitable if sold and handled correctly.

Along with the type of system, the kind of system control is an important factor in the maintenance schedule of the irrigation system. Manual system problems are usually identified immediately as there is someone present to turn the system off should a problem arise. Automatic systems may run damaged for weeks or months without discovery due to their off-hour watering sched-

ules. It is important to check automatic systems on a regular basis to ensure proper operation.

Some irrigation systems have special maintenance considerations built into them. For example, micro-irrigation (drip/trick-

.....

Commercial systems should be checked at least monthly as these systems are usually set to operate at night when no one is present.

le) systems require filtration for proper operation. The filter should be checked, cleaned or changed on a regular schedule. The frequency of cleaning will depend upon the amount of use, the quality of the water and the size of the filter. Systems that operate regularly and with marginal water quality may need cleaning as frequently as once per week.

Drip system emitters should also be checked on a regular basis to see that they are not clogged.

This can be easily accomplished during the day as the emitters are plant specific and located at the surface. Systems employing fertilizer injectors should be thoroughly examined before use to check for proper calibration and leaks as well as for approved backflow prevention.

GEOGRAPHIC FACTORS. Geographic location of a sprinkler system can affect many aspects of system design and influence the maintenance schedule. Three areas and types of irrigation system piping are usually recognized: the North, Middle and South.

In the Northern states (areas subject to hard ground freezing), contractors primarily use polyethylene pipe for residential and small commercial projects.

These systems are seasonal in their use and usually operate from May to September, October or November of each year. Due to the seasonal nature of their operation and the pipes being installed above the frost line, these systems must be "winterized" each year.

Winterization is usually accomplished by evacuating all or at least the majority of the water from the pipes using air pressure generated by a tow behind air compressor.

Adequate volume and proper pressure are important factors in

the use of compressed air. Blow the system out with an air pressure of 60 to 80 psi. High pressures (more than 90 psi) can cause damage to the piping system and equipment and therefore should be avoided. The recommended minimum air compressor volume is 60 cubic feet per minute (CFM). A lower CFM will displace only small quantities of water allowing the air to ride along the top of the remaining water inside the pipe, leaving water to freeze and possibly damage the pipeline.

Depending upon the size of the system, winterization times will vary dramatically. Average residential systems will take 30 to 45 minutes to winterize while large commercial systems may require an entire day. You may have heard of contractors who claim they can blow out 20 or 30 residential systems a day. You can be sure that they are not doing the job properly. Also remember to charge a price that will show a reasonable profit from blowing out 10 to 15 residential systems per day.

Always have one zone on whenever the compressor is operating to protect the system from damage. It is important to recognize that although water is not compressible, air is, and can build up high pressures if not handled correctly. Blow out the farthest

(continued on page 36)

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Irrigation Systems

(continued from page 34)

zone first so that the majority of water in the mainline piping will be evacuated; this may take quite some time on larger systems. Make sure you run through each zone at least twice. This will ensure that maximum water is removed and put less stress on the system. High parts of the system should also be blown out first to keep water from running back into the mainline.

Heat build-up with larger and older compressors is an important consideration. The longer the compressor runs the hotter the air will become. As the hot air enters the system the heat may actually begin to soften the plastic piping. Major damage can occur from too much airborne heat. To help dissipate the heat, use long air hoses even if the distance from the compressor to the blowout assembly is short. Also, using a metal blowout assembly such as a quick coupler and key will help absorb and dissipate more of the heat.

For winterization, in addition to blowing out the system, the controller should be shut off, unplugged and the battery removed. However, if the controller is outside or is installed in an area where moisture is present, leave the controller plugged in so that the heat generated by the transformer will help keep the inside of the cabinet dry. Remember to set the watering times to zero.

Don't forget to shut off the irrigation supply valve before blowing out the system. If the valve is an older brass gate type, make sure that it is tightly closed. Many older brass gate valves will "weep" allowing water to slowly enter the irrigation mainline and backflow preventer. You should consider replacing these valves with new resilient seated ball valves before problems occur.

Remember that it is less expensive to replace the gate valve than the backflow preventer. Do not use the backflow preventer service valve as the shut-off valve. Also, backflow preventer test ports may not be used as blow-out points.

If the system includes a rain shut-off of the catch type make sure the sensor is removed or inverted for the winter.

Manual and/or automatic

drains may also be used to winterize. Some auto-drains, if not installed properly, may clog and become a maintenance problem. Water hammer is also a consideration in systems with auto-drains. Most importantly, in an age of water conservation, irrigation systems with auto-drains may be seen as water wasters because they drain the lateral pipelines after each cycle of the system. While many systems equipped with auto drains need not be blown out, you should be sure to run through all zones for a minimum of five minutes each to en-



All sprinklers need to be adjusted for distance and arc each year.

sure maximum drainage. Check the mainline for manual drains and leave them open for the entire winter.

Some feel that it is not necessary to winterize systems that use polyethylene piping. This is a fallacy. These systems may survive through a few seasons without being winterized but the pipe is being stressed during this time, not to mention the valves, sprinkler heads and fittings. Consequently, damage is being done to all components each year and eventually major problems will develop in the system.

General maintenance is less for Northern systems due to their short operating season. However, snow plowing operations along with sand and salt applications can do substantial damage to the system over the winter months. Spring start-up contracts will ensure that the system is thoroughly checked at the start of each season.

Contractors in the middle states use a combination of both PVC and polyethylene piping.

The middle states have longer seasons which may require more maintenance and, depending on weather, may require winterization. If the below ground irrigation pipes are not subject to freezing, winterization is not required; however, outdoor booster pumps and above-ground components should be drained. In these areas, you should be careful not to operate the system during freezing temperatures. This can be accomplished automatically using freeze sensors. These devices are usually set to inhibit operation when the outside tem-

perature drops below 45 degrees Fahrenheit.

Contractors in the Southern states predominantly install PVC pipe for both mains and lateral lines, and winterization is not required. However, these areas will need more general maintenance due to their year-round operation.

The geographic location of a system as it relates to the need for winterization may be tied more closely to the "hardiness zone" in which it is installed — a designation most landscaping trades are familiar with — rather than to a strict "North/South" reference. Hence, zone seven and the North (areas where temperatures will drop to zero degrees Fahrenheit to 10 degrees Fahrenheit) warrant a full winterization procedure; zones eight and nine (winter lows likely to be in the 10 degrees Fahrenheit to 30 degrees Fahrenheit range) will require freeze sensors, drainage of pumps and drainage of above-ground components. Zone 10 areas and the South should not require

winterization except for changing of the watering schedule.

CONTROLLER PROGRAM CHANGES. As part of any irrigation maintenance schedule the controller operating program requires adjustment as the seasons and weather change. The northern and middle states should have a minimum of three operating schedules; spring, summer and fall (spring and fall may have very similar schedules). As the days grow longer and hotter and evapotranspiration increases, the number of days of operation and/or the run time for each zone should be increased. It is important not to have the same watering schedule throughout the irrigation season. This not only promotes over watering and under watering of lawns and landscapes, but also wastes water. Even Southern areas will have a reduced winter watering schedule as plant water requirements decrease.

When programming the controller it is important to take into consideration soil conditions and the maturity of plant material. Also, use controllers that are designed for maximum flexibility during times of water restrictions and/or bans. If water restrictions are a possibility in your area, you may find a lucrative business opportunity in replacing outdated irrigation controllers with state-of-the-art units. An ideal controller features both *flexibility* and *user friendliness*. The addition of rain shut-down devices or moisture sensors to existing systems is another area to consider.

CONCLUSION. Irrigation system maintenance requirements vary widely depending on the location, age and how well the system was originally designed and installed. However, once you have a basic knowledge of irrigation troubleshooting and a reputation for fast and efficient service, the irrigation maintenance aspect of your business can prove to be a substantial addition to your bottom line. — *Brendan Lynch and Brian Vinchesi* ■

The authors specialize in irrigation consulting with Eastern Irrigation Consultants Inc., in Beltsville, Md., and Pepperell, Mass.

Year-Round Preventive Maintenance Extends Engine Life

THE LIFE SPAN OF engines and related equipment depends on how they've been maintained. Routine maintenance is easy and simple to do and takes very little time. A basic understanding of the engine on your equipment will help you appreciate the importance of periodic maintenance in protecting your equipment investment.

Most engines on outdoor power equipment are either two-cycle or four-cycle designs which operate using gasoline. Do not confuse this with the number of cylinders. Walk-behind rotary mowers generally have only one cylinder. Larger engines powering large riding mowers or garden tractors could have one or two cylinders. Two-cylinder engines are usually referred to as "twins."

All gasoline engines require fuel and proper lubrication to run. They also require air for full power delivery and adequate ventilation to prevent overheating. Any condition which deprives the engine of any or all of these necessities leads to poor performance and possible engine failure.

Lubrication requirements and procedures for both two- and four-cycle engine varieties differ. The literature that comes with your equipment will tell you which engine type is on your equipment. This article will concentrate on engines generally found on walk-behind mowers, tillers, riders, garden tractors and leaf blowers.

Two-cycle engines are lubricated by oil which is mixed with the fuel. Oil-to-fuel ratios vary considerably among different brands. Typical ratios range from 1:16, 1:20, 1:25 and all the way up to 1:50. Four-cycle engines have a crankcase or sump which must contain the proper amount



Keeping the bottom of your mower clear of dirt and corrosion, its filters clean and spark plugs free of combustion buildup adds years to mower life.



of oil to bathe the moving internal parts while running. The engine type used is largely a matter of the equipment manufacturer's choice and is often based on product pricing considerations or application.

Here are some general rules to follow:

1. Lubrication (2-cycle engines). Add the oil to the fuel as recommended by the engine man-

ufacturer. Mix thoroughly. Never use four-cycle automotive oil.

- Lubrication (4-cycle engines). Change oil regularly after every 25 hours of operation. Use a high grade, high viscosity automotive oil—SAE 10W-30 or 10W-40. Nothing should be added to the oil. Fill to the proper level indicated in the maintenance instructions. Check the oil level every time you add gasoline.

2. Fuel. Use fresh clean unlead-

ed gasoline with a minimum octane of 77. Use of lead-free fuels will reduce combustion deposit buildup (an eventual occurrence in any engine). Because of the uncertainty of exact formulation of gasohol and similar fuels, their use is not recommended. Methanol formulations, in particular, are to be avoided because they can easily gum and clog fuel lines and carburetor jets.

3. Air is important too. Clean air mixes with gas in sufficient quantities for optimum combustion and power. The newest innovation for small engines is the larger capacity pleated paper air cleaner. Proven in automotive and industrial engines for years, the use in small engines offers new levels of protection and convenience. Servicing is easy — remove and replace them like your automobile filters. More familiar is the oil-foam air cleaner.

Oil-foam air cleaner elements can also be cleaned:

- a. Wash the foam element in kerosene or liquid detergent and water to remove dirt.
- b. Wrap the foam in a cloth and



Change oil regularly.

squeeze dry.

- c. Saturate the foam in engine oil, then squeeze to remove excess oil.

For convenience, pre-oiled replacement foam elements are also readily obtainable. Either air cleaner element style should be checked and cleaned every 25 operating hours or three months, whichever is less. Dusty or abrasive operating environments require more frequent servicing of the air cleaner. When reinstalling or replacing either air cleaner, make sure that no damage to the outer sealing areas has occurred which would render the filter elements useless.

4. Air to cool. Dirt and debris can enter the blower housing and clog the cooling fins. This causes

internal engine temperatures to rise excessively. The resulting overheating can damage critical engine parts beyond repair. For this reason, prevent grass and debris from impacting fins and corners around the engine by removing the blower housing or garden hose fin area annually and flushing it with air.

5. Check the blade and deck for wear and possible damage. Before looking under the deck, always ground the spark plug wire. Removing the spark plug will prevent accidental starting when checking or removing the blade.

6. An engine requires a healthy spark for complete combustion. A worn spark plug robs the engine of power. Spark plugs should be checked periodically. The gap across the electrodes should be



Keep wheels free from debris.

reasonably free of combustion buildup and should not be burnt away. (A fouled spark plug gap or burnt-away electrodes after only a few hours of operation usually requires the attention of a service technician to determine the cause.)

Plugs worn because of prolonged use are best discarded and replaced with correctly gapped original equipment spark plugs. When removing and replacing the spark plug, always protect the cylinder cavity from dirt or debris entering the spark plug hole.

For a professional preventive maintenance check, see your authorized engine repair or outdoor equipment dealer. A dealer can sharpen the blade, provide a power tuneup and make any adjustments or repairs that might be necessary.

Performing these procedures and checks will greatly increase engine performance and life.—
George Thompson ■

The author is manager of corporate communications for Briggs & Stratton Corp.

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Avoiding Freezing, Crystallization in Spray Rigs

A FUNDAMENTAL principle in urban pest control is the need to apply pesticides to target sites: locations where they will be highly efficacious with no adverse effect on nontarget organisms and the environment.

To accomplish this, chemical and equipment manufacturers have supplied our industry with a wide variety of pesticide formulations and application equipment to satisfy the specialized needs of lawn maintenance and horticultural integrated pest management specialists.

Dusts, granulars, aerosols, emulsifiable concentrates, wettable powders, microencapsulations, etc., are all designed for use under specific environmental conditions, on various substrates (surfaces), directed toward the unique biological and physical features of the target pest, and any specialized requirements the customer may have.

There doesn't seem to be any one perfect formulation that is right for all situations. However, most insect control problems (but certainly not all) can be solved with either a dry or a wet pesticide formulation (Table 1) used as a tool within the context of urban IPM.

With today's modern technology there are many superior wet formulations from which to choose. Historically, though, the most commonly used "wet" formulations are those designed to be dissolved in water (i.e. wettable powders and emulsifiable concentrates). As far as our needs in the urban environment are concerned, water-based formulations are a double-edged sword: their benefits are great, but their deficiencies are often based on the special properties of water.

Because of its unique physical

and chemical properties, water has been called the universal solvent. In the lawn maintenance and horticulture industries, water is an excellent pesticide solvent (or more correctly, a carrier) for several reasons:

1. It's readily available.
2. It's non-flammable and relatively non-corrosive.
3. With minimal precautions it will neither evaporate nor freeze during use.
4. It won't add to the toxicity of the active ingredient.

However, many of the attributes that water possesses are also detriments in our business:

1. Its ready availability (especially as rain or in irrigation or sprinkling use) can degrade residual deposits, or remove them from their target site.
2. If not carefully applied, water can translocate active ingredients away to nontarget sites.
3. If subjected to subfreezing conditions, suspended active ingredients may precipitate out, crystallize and damage application equipment or ice crystals may form and damage the equipment.
4. Active ingredients may stratify or settle out unless proper agitation is supplied.

5. If not used in a reasonable time (defined for each active ingredient on the pesticide label), water may split the pesticide molecule (hydrolysis) rendering it useless.

6. The pH (acidity or alkalinity) of the water is suspected to impact the residual life of some active ingredients.

In urban pest management, water is one of the most commonly used tools, and at the same time, one of the most commonly misunderstood. Its features are seldom discussed in any of our training programs, yet its chemistry has a significant impact on the ser-

vice quality, safety and even the economics of our industry.

For these reasons, a basic understanding of the properties of "the universal solvent" are essential to success in this industry. In this article, I can only describe some basic properties of water which directly impact application equipment and application procedures. With an understanding of these properties, the maintenance specialist can protect his assets while providing his customer with a safe, effective and economical service.

Some properties of water that have caused managers great concern in recent years are those contributing to crystallization of active ingredients in spray rigs and freeze damage. But like most business problems, these issues can only be managed when people are trained to recognize their causes. After describing some of the properties of water that may impact these tank freezing and crystallization issues, I will describe specific preventive measures that will allow you to avoid these expensive and dangerous problems.

WATER-BASED INSECTICIDES. Water is a chemical compound with properties unlike those of any other material. It is the "stuff of life" found in all living organisms, and because of its unusual chemical structure, water has been called the universal solvent. (A solvent is a liquid into which another substance is dissolved, forming a chemical mixture called a solution.)

At standard temperature and barometric pressure, pure water is colorless, tasteless and a poor

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Water is a chemical compound with properties unlike those of any other material.

electrical insulator (meaning it readily transmits electricity). Water is also known as a heat "stabilizer" because it absorbs and releases heat very slowly. This phenomenon is best observed in the moderating effect that large bodies of water (lakes, rivers, etc.) have on the climate.

Any fisherman can tell you that lakes gradually warm in the spring (slow to absorb heat) and gradually cool in the autumn (slow to release heat). This physical feature is important to urban pest management specialists; it allows tank mixes to remain relatively stable (no change in state) under fluctuating temperature extremes.

It's a well known fact that water-based systems are more heat stable than organic solvent systems. Evidence to this fact can be found on many aerosol insecticide labels, for instance, requiring their use away from open flames and storage at temperatures below 130 degrees Fahrenheit. Aerosol formulations and oil solutions have many advantages in their own right, but because of their organic solvent and propellant systems, they are much more sensitive to temperature fluctuations than are water-based systems. With minor attention, water based systems are very temperature stable. Without attention, serious problems can occur.

At any given time, water in the urban environment exists in one of three different states or phases of matter: solid, liquid or vapor (Figure 1). Unlike most other compounds, water has the unusual property of expanding when going from the liquid phase into its solid phase (freezing).

In other words, liquid water ex-

INSECTICIDE FORMULATIONS

WET

1. Oil Solutions
2. Emulsifiable Concentrates
3. Wettable Powders
4. Microemulsions
5. Aerosols
6. Fumigant Gases

DRY

1. Dust
2. Granulars
3. Baits
4. Solid Fumigants
5. Resin/Plastic Strips

Table 1. For the most part, all pesticide formulations used by lawn maintenance operators fall into one of two categories: wet (liquid) or dry. Formulation choice depends on several factors, including the target pest, application site, available application equipment, cost and safety. This classification is greatly simplified for demonstration purposes only. There is a significant overlap between these various categories, and modern science has developed many other sophisticated formulations that fit specific lawn maintenance control situations.

posed to temperatures below 32 degrees Fahrenheit (or air movement which causes a wind chill effect of below 32 degrees) will increase in size to such a scale that few solid vessels (plastic, steel, brass and even solid rock) can withstand the pressure. This is an unfortunate situation since urban pest management specialists, in the course of their work, often encounter temperatures and wind chill conditions sufficient to freeze water-based insecticides, or that force the solidified carrier (ice) to separate from the "suspended" active ingredient.

Another interesting property of water which impacts its use as a solvent/carrier for pesticides is its surface tension. Because of its physical structure, water molecules have a strong attraction for one another, such that at its surface the molecules are so tightly bound together that the surface itself is elastic in nature. Like the bed of a trampoline, it stretches and bends and is relatively im-

pervious to puncturing.

Surface tension makes it possible for small insects to glide on the water surface, and is responsible for the fact that many compounds (talcum powder, oil and some pesticides) float on the surface rather than dissolve.

Finally, an important feature of water that directly impacts its utility as a pesticide solvent/carrier is a phenomenon I call the "Small Droplet Effect." Again, because of the physical and chemical make-up of water, less energy is required to bring about a change in phase for a small amount of water (i.e., one drop) than for a large quantity of water (i.e. a standard spray rig). (Figure 2).

For example, a snowflake requires less heat energy to melt (change phase from solid to liquid) than does a block of ice. And conversely, freezing (heat loss) occurs more easily in a small amount of water (such as that left in a coiled hose, a hose fitting or

a nozzle) than in a large tank full of water. I know this sounds very complicated, but this phenomenon must be understood since it has a direct impact on the efficacy of many pesticides and the integrity of your application equipment. All these points will be further defined in the following sections of this article.

INSECTICIDES IN WATER. As previously noted, water can serve as either an insecticide carrier or solvent, dependent upon the chemical features of the formulation chosen. Many pure, technical grade insecticides (active ingredients) are solid, while others are liquid, some are volatile, corrosive, unstable in light or soluble only in organic solvents.

In other words, all active ingredients have their own physical and chemical peculiarities, and must be processed into a form than can be safely, economically and accurately used. As a result, insecticide formulations designed

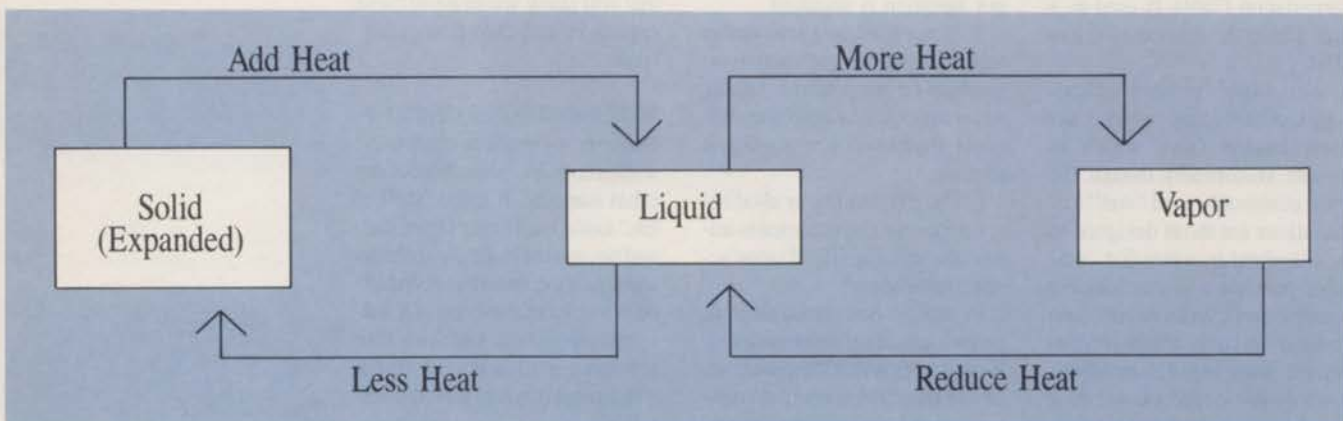


Figure 1. Water can exist in any of three physical states (phases): solid (ice), liquid or vapor. Changes in the state are brought about by the addition or reduction of heat. Lawn maintenance operators use water as a pesticide solvent or carrier inside closed containers (especially expensive spray tanks). Lawn maintenance operators must take special precautions to avoid freezing conditions because water expands with great force with a change in state from liquid to solid. In such instances, the small droplet effect (see Figure 2) must be considered.

to be mixed in water could fall in to one of two broad categories: suspensions or solutions.

As previously noted, water is the universal solvent, meaning it will dissolve more substance varieties than any other solvent known. Unfortunately, water does not readily dissolve any of our commonly used insecticides. It does, however, dissolve (by breaking the surface tension) the emulsifiers and wetting agents that are added allowing the suspension of our insecticides in water.

This is a very important distinction. Our commonly used, water-based insecticides are not true solutions, they are merely suspensions. Wettable powders are nothing more than extremely small dust particles mixed in water, and emulsifiable concentrates are simply minute oil droplets suspended in water. You may ask if this distinction between solution and suspension is really important, and the answer is yes. True solutions are uniform in nature and do not settle out.

Suspensions, on the other hand, react quite differently — they may have to be agitated to remain suspended. They can abrade application equipment (hoses, nozzles, gaskets, etc.), they may not remix if the wetting agent/emulsifier has hydrolyzed and, finally, they may

SMALL DROPLET EFFECT



 TEASPOON	 SPRAY TANK
Requires little energy (heat) input or removal to change phase.	Requires considerable energy (heat) input or removal to change phase.

Figure 2. Lawn maintenance operators should be mindful that a small quantity of water will evaporate or freeze (change phase) much more easily than a large quantity of water. Why? Because freezing will occur in portions of a spray tank (i.e. hoses, valves, nozzles, etc.) under temperature drops that will have absolutely no effect on the water in the tank itself. Furthermore, the "wind chill effect" may cause freezing in these "small droplet zones" at ambient temperatures above 32° Fahrenheit when unprotected spray tanks are being transported.

when particulate matter is present. (Anyone who has ever made rock candy by suspending a string in a saturated solution of sugar water can attest to this fact.)

Particulate matter (minute pieces of active ingredient, dust, dirt or other foreign material) serve as a point of attachment for crystal growth. Once this growth process begins from a "particulate seed," additional crystals can grow using the initial crystal as a substrate or template. In essence, suspended matter can pro-

prevent it from happening in the first place. Most often, a problem can only be prevented by fully understanding its causes, and taking appropriate actions before the fact. Hopefully, this article has given you more insight into the troubling and expensive problems of tank freezing and crystallization.

Armed with this understanding you can devise your own preventive program for the formulations and application equipment you use in your operation. There are no standardized, textbook solutions to these problems, but many urban IPM specialists have been able to almost completely eliminate these problems from occurring by using the following procedures during freeze season:

- Tanks and spray equipment must be cleaned and repaired on a regular basis (no less than weekly during peak seasons). This eliminates excessive particulate accumulations and leaks (leaks are indicative of unwanted openings and fissures in the system) which provide crystal "seeds."

- Where possible, spray rigs are stored inside when not in use, especially on weekends.

- To overcome the wind chill and small droplet effect, freeze-sensitive spray equipment (hose reels, nozzles, pumps and spray wands) can be shielded within the locked compartments of a utility bed.

- Try to prepare only the amount of emulsion/suspension that can be used on each job. This way, you do not leave any chemical

in the tank system at the end of the day to freeze or settle out as "ice seeds."

Others have proposed the addition of antifreeze to their tank residues to prevent freezing. Because of the cost of antifreeze and the possible contaminating effect it may have on your next application, I can't recommend this as a viable solution.

Furthermore, this approach is not a real solution to the problem — it smacks of lethargy and masks the real solution which is to "take care of your equipment." Other techniques that you may need to employ in your specific operation include the use of truck-mounted heaters (available at most recreational vehicle outlets or automotive parts stores) to be placed inside a camper shell, electrical heat tapes to wrap around the pump and other sensitive application equipment, quick release brackets (i.e., installed on the hose reel and pump brackets) and quick hose disconnects installed at several locations throughout the system (i.e., between the pump and hose reel, not just at the hose ends).

This last point is a subtle one that could pay big dividends in your preventive maintenance program. The ability to easily dismantle equipment into manageable pieces will allow you to store critical parts of the system indoors during inclement weather, and make it much easier to blow moisture from sections of the system (remember the "small

(continued on page 94)

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Like any other aspect of running a business, the best way to solve a problem is to prevent it from happening in the first place.

separate (crystallize) from the water carrier if the freezing point of the active ingredient is different from that of the carrier.

This last point becomes extremely important under conditions of the "small droplet effect" and wind chill, and is very important to the prevention of tank freezing and crystallization of active ingredients during cold seasons.

Furthermore, because of its physical nature, a suspension exhibits a very interesting "freezing" property not experienced with true solutions: seeding. Ice, like other crystals, forms more easily in a cooling liquid medium

promote crystalline (ice) formation.

As I have already stated, the water-based insecticides we use are suspensions of "seeds," and as such may be able to promote freezing unless preventive measures are taken. An understanding of this principle (the need to minimize points of attachment for crystals) is essential to solving the problems of tank freezing and crystallization experienced by many urban pest management practitioners.

STRATEGIES TO PREVENT TANK FREEZING. Like any other aspect of running a business, the best way to solve a problem is to

Zoysia Patch: A Destructive Root Rotting Turfgrass Disease

ZOYSIA PATCH DISEASE of zoysiagrass (*Zoysia japonica* L.) causes a perennial patch type disease. The disease can develop in the fall and/or the spring of the year.

The disease has been reported in Tennessee, Arkansas, Illinois, Missouri, Kansas, New Jersey and New York, and may occur in other states as well. It would appear to be limited to those states located in the turfgrass transitional climate zone in the United States. No reports of this disease have been given describing its development in other countries.

While it is perennial in turf, the symptoms may not appear regularly in the fall or spring. The reasons for this are uncertain, but soil moisture and temperature appear to have a major role in disease severity. Zoysia patch has been observed casually for more than 10 years in the St. Louis, Mo., area and has been referred to as "Brown Patch," "Rhizoctonia Patch" and "Winter Brown Patch."

Based on our research into the cause of the disease, which will be discussed in this article, we have named the disease zoysia patch. While *Rhizoctonia* fungi are ubiquitous in soils cultivated to zoysiagrass, there appears to

be no evidence that would support this fungus as the primary causal agent.

WHEN DOES IT APPEAR? In the spring, the symptoms of zoysia patch will appear within about 60 days after green-up has started in the sod. If no symptoms have appeared by that time, symptoms are not likely to develop until the fall at the earliest.

The symptoms of zoysia patch appearing in spring are likely to be quite different than those which develop in the fall. As the grass breaks out of its winter dormancy, patches will appear in which the grass is thin and appears to produce new leaves slower than the surrounding area. A patch is defined as an approximately circular area of turf in which the grass is diseased.

The startling nature of zoysia patch is that a patch can grow to three to four meters in radius. It is unclear how large a zoysia patch can grow. A patch with a radius of four meters is more than 50 mm². This is the largest patch recorded for turfgrass. The zoysia patch remains uniformly blighted within its borders. This is probably due to the fact that the fungus that causes zoysia patch grows very rapidly.

Zoysia patch expansion has been measured as fast as 1.0 meters per year. For comparison, summer patch of bluegrass (*Poa pratensis* L.) will expand at about 0.1 to 0.2 meters per year. The reason for this rate of zoysia patch expansion is discussed below. As the grass greens up in the spring, those areas affected by the disease will have a great number of dead leaves, weakened roots and a slightly sunken appearance.

The disease has never been observed to kill more than 80 percent to 85 percent of the grass

plants in a single patch. It is unknown what percentage of rhizomes and stolons are affected by the disease, but it appears that the disease is most severe on the shoots and roots and considerably less destructive on the rhizomatous and stoloniferous tissues.

This is very important in terms of managing the disease. During the spring, the disease will not appear to increase in severity, but the rate that the living grass within a patch will green-up will fluctuate. With increasing soil temperatures, the disease symptoms will disappear by July or August, depending on where in the transitional climatic zone the grass is grown. Further North, the disease appears in the turf for longer periods of time. **CAUTION:** the loss of symptoms in midsummer does not mean the disease or the fungus causing it has vacated the turf.

During the fall of the year is when active zoysia patch can be seen in a zoysia turf. The disease symptoms that develop in the fall will mainly appear as a ring in the zoysiagrass, but careful inspection will reveal that grass plants throughout the patch within the ring are also affected. The outer ring of the patch will have the greatest number and density of diseased plants and thus be more noticeable.

The appearance of zoysia patch in the fall can develop in as little as two to three days and may last until the grass becomes dormant. The leaves of the zoysiagrass will be yellow-orange to orange. These symptoms generally appear on the older leaves first. In addition to the leaf symptoms, the roots will also be diseased, but the symptoms are inconspicuous. Basically, the zoysiagrass will appear discolored, but otherwise healthy.

Zoysiagrass sod with disease development during one year marked by stakes. Large white stake marks center of patch; small white stakes mark the boundary of the patch and red stakes mark the new boundary of the patch 12 months later.





Root and knitting strength will not be noticeably weaker compared to unaffected sod.

Do not be misled by thinking that this disease is active only in the spring and early fall months. Generally, we have noticed that the development of symptoms in the spring occur after the fungal pathogen has been active during the late winter. In the fall, the symptoms appear as the fungus is becoming active. In short, the fungus that causes this disease is active during the cooler months of the year and may colonize the grass roots mainly during those months when the zoysiagrass is dormant.

In addition, it appears that colonization of the roots must be quite extensive before symptoms will appear. Understanding this page relationship between grass growth and pathogen colonization is paramount in managing this disease (see below).

ZOYSIAGRASS PATHOGEN. The fungus that causes zoysia patch has been isolated and identified

as an ectotrophic, root colonizing similar in a number of respects to that fungus which causes take-all patch of bentgrass (*Agrostis palustris* L.), and may be genetically related to *Geaumanomyces*. The zoysiagrass pathogen will grow on other grass plants including wheat (*Triticum aestivum* L.) and oats (*Avena sativum* L.), but appears very limited in its ability to infect bluegrass, bentgrass or ryegrass (*Lolium perenne* L.).

The pathogen is favored by intermittent periods of wet and dry soil. The fungus has a broad temperature range for colonization of the grass roots. Colonization of the roots may occur without the subsequent development of disease symptoms. Our laboratory is currently finalizing the taxonomic identification of the pathogen. Once known, sources of genetic resistance and methods for prediction of disease development will be refined. Presently, the isolation and verification of this pathogen from diseased zoysiagrass requires considerable

time and cost, however, the symptoms of the disease and the conditions during which they appear are reasonable means of diagnosis. Research is currently being conducted to expatiate diagnosis.

MANAGING THE DISEASE?

Zoysia patch can be managed, but it requires continued attention to the disease even in the absence of symptoms. The key point in managing this disease is understanding how and when it develops. While we are still discovering the pieces of the puzzle that will explain this disease, we know enough to reduce the destruction it causes.

The time to minimize the severity of the zoysia patch is during that part of the year when the zoysiagrass is actively growing. If we look at the calendar, when the disease symptoms are not apparent, you should be pushing the zoysiagrass to grow. This means balanced fertilization and water.

In addition, it has been observed that aeration of the zoysia sod will also reduce disease severity. Aeration with hollow tines has been used successfully, and the simple slicing of the sod with vertically aligned disk blades has also proven effective. The idea of rejuvenating the sod, thus causing it to produce more shoots and roots, is the goal.

The means by which you achieve this are not critical. Will late fall fertilization be better than spring applications? For this dis-

(above) Late spring symptoms of zoysia patch showing recovery of the diseased area. After several months of good sod growth, these patches will nearly disappear. (Above left) Fall symptoms of zoysia patch. The greatest pathogen activity can be visualized by the orange ring. The grass within the ring usually shows no symptoms in the fall and little grass is killed in a fall patch. (Left) Close-up of the disease border showing the orange-colored leaves which make up the fall symptoms of zoysia patch.

ease, we do not know, but we have observed that spring and summer applications were effective in encouraging dense growth of zoysiagrass and reduced disease severity in the fall. These techniques for managing zoysia patch are directed at the grass plant not at the fungal pathogen.

Controlling the pathogen will be a formidable challenge. The use of genetic resistance is likely to be the most effective means of controlling the pathogen, but this will require numerous years of research to develop. Because the pathogen is a natural soil inhabitant and thrives in the dense sod-soil layer, it will be difficult to adequately control using fungicides at reasonably "safe" rates.

No fungicides are presently registered in Illinois for use in controlling this disease. No reports have been received by the authors recommending the use of fungicides in other states afflicted by zoysia patch. Several fungicides are being studied experimentally and some are apparently effective in reducing the severity of the disease. The effec-



Early symptoms of zoysia patch during the spring of the year. Note the incomplete necrosis within the patch.

tiveness of the fungicides and the best method for application and timing are yet to be determined.

While chemicals are of a limited value in controlling zoysia patch, new biological agents have been identified and appear capable of suppressing the disease. It is likely that such microorganisms will not be capable of eliminating the disease symp-

toms, but in combination with the previously described cultural practices, they could safely reduce the disease severity to an acceptable level. Biological control agents are currently being field-tested, but results and recommendations are not expected for several years.

Zoysia patch is a very destructive disease which, if unchecked,

could severely reduce the use of zoysiagrass in the climatic transitional zone of the United States. It occurs on golf course, lawns and sod farms and will not go away. If you have seed disease symptoms that match those described here, please contact us. Working together, a disease like this can be managed. — Henry Wilkinson and Malcolm Shurtleff

Wilkinson is an assistant professor of plant pathology and agronomy specializing in turf-grass pathology and soil-borne pathogens and Shurtleff is a professor of plant pathology and turfgrass extension specialist. Both authors are with the University of Illinois, Urbana-Champaign.

ACKNOWLEDGEMENTS

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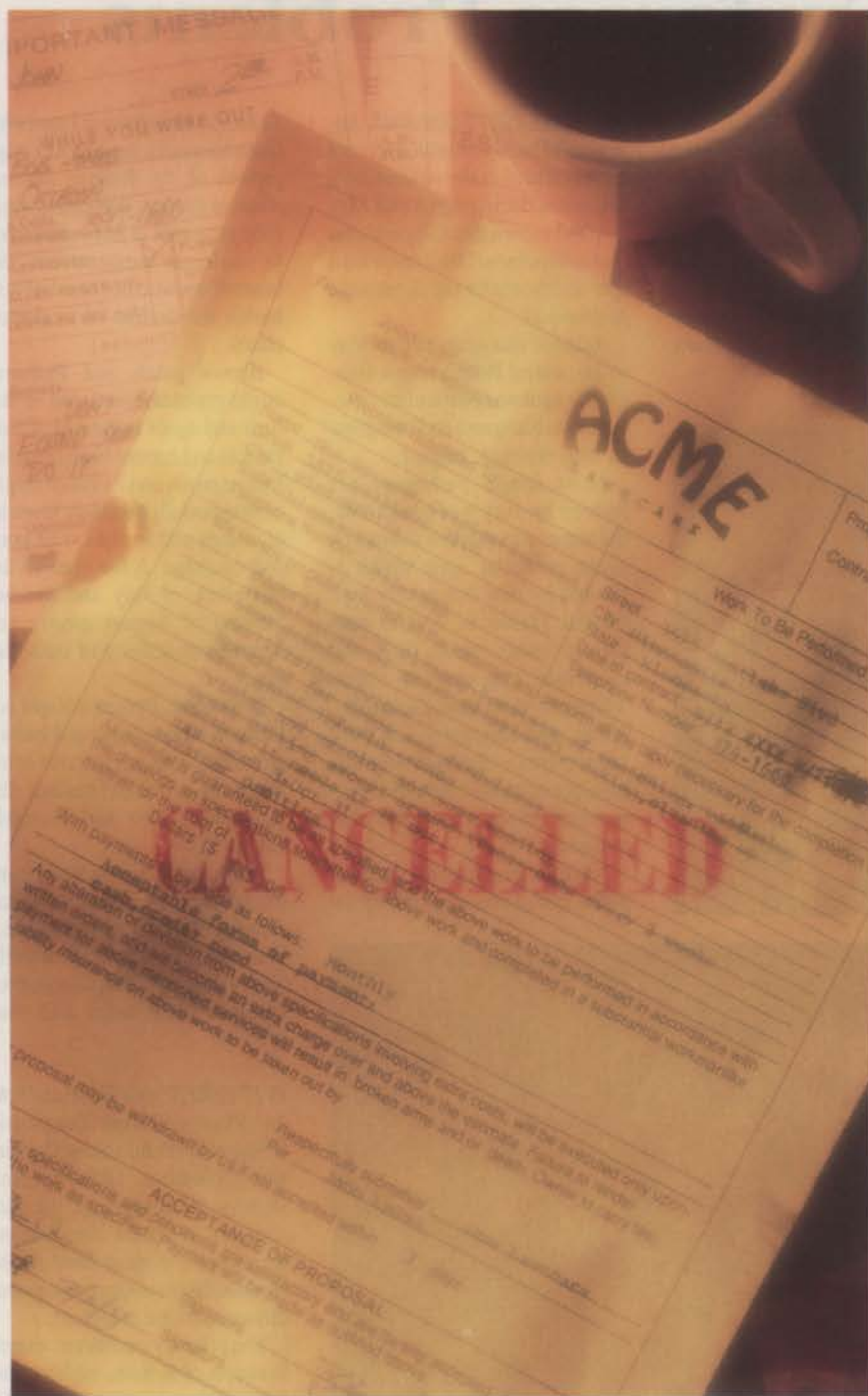
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Rain, Stresses Result in Varied Turfgrass Problems

Melting out symptoms on Kentucky bluegrass caused by *Bipolaris/Drechslera* leafspot (bottom). *Pythium* blight damage on tall cut grass (below).

DISEASE PROBLEMS in any given year are the result of disease pressure, grass susceptibility and environmental conditions. Awareness of the weather conditions that favor plant pathogens allows turf managers to anticipate, diagnose and combat disease problems (Table 1).

1989 DISEASE PROBLEMS. Adequate to heavy rainfall and cool temperatures in the eastern central states during April and May resulted in considerable problems due to *Bipolaris/Drechslera* leafspot and the red thread (*Laetisaria fuciformis*).

Rainfall was sparse up to May in the central Pennsylvania area. Dollar spot was particularly prevalent on bluegrass and bentgrass in May through August.

Most fungal pathogens are favored by very wet conditions; the major exception is the causal agent of dollar spot which is favored by dew but not by high rainfall (Table 1). Dollar spot thrives under warm days and moderate temperature nights which promote dew. Generally, dollar spot severity is low until late summer — the continued disease pressure through the mid-summer months is somewhat unusual.

Necrotic ring spot and summer patch symptoms showed up on

Kentucky bluegrass in June in the Ohio/Kentucky region. Although growth of the fungus, *Leptosphaeria korrae*, that causes necrotic ring spot is favored by cool to moderate temperatures, the onset of warm to hot weather will hasten the decline of weakened plants.

Brown patch and *Pythium* blight problems surfaced in late June and again at the end of July in Ohio and central Pennsylvania. Brown patch and *Pythium* blight were especially prevalent in young plantings and in sites with poor soil drainage. A hot spell in the last week of July and the beginning of August greatly enhanced the activity of both diseases.

In general, *Pythium* blight activity has been less, and brown patch has been very active compared to previous seasons for Kentucky, Ohio and Pennsylvania.

In contrast, lack of water continued to be a problem for some areas of the upper Midwest, i.e., Wisconsin, during much of 1989. The bright side is that disease problems are less under arid conditions.

IS IT STRESS OR DISEASE? At the Plant and Pest Diagnostic Clinic at The Ohio State University, Columbus, Ohio, approximately 50 percent of the turf samples received for disease diagnosis are diagnosed to be stresses due to poor growing conditions (abiotic stresses).

The primary causes are: thatch in excess of $\frac{3}{4}$ inch, highly compressed thatch, poor soil conditions, improper sunlight for the grass type and improper watering practices (too much or too little).

Following the drought of 1988, the number of turf samples from



OPTIMUM CONDITIONS FOR DISEASE DEVELOPMENT

Disease	Temperature			
	Day	Night	Moisture	Fertility
Drechslera/ Bipolaris Leaf Spot	cool	cool	wet	high
Red Thread	cool	cool	wet	low
Yellow Patch	cool to moderate	cool	wet	high
Necrotic Ring Spot	cool	cool	wet	high
Dollar Spot	warm	moderate	dew	low
Summer Patch	warm to hot	warm	wet	?
Brown Patch	hot	warm to hot	wet	high
Pythium Blight	hot	warm to hot	wet	high

cold = below 45F, cool = 45 to 55F, moderate = 55 to 65F, warm = 60 to 75F, hot = over 75F.

Ohio diagnosed as suffering from abiotic stress was uncommonly high. Many lawns did not green up in the spring of 1989 as expected because of stresses received during 1988. In contrast, we see many disease problems that are directly correlated to the overuse of automatic watering systems.

Necrotic ring spot is one example of a disease often found on Kentucky bluegrass lawns where the sod is watered daily by an automatic sprinkling system, regardless of the rainfall.

Turf managers are often puzzled by the irregular distribution of stress symptoms on a grass stand. To many people, a patch symptom indicates that the turf has a fungus or insect problem. Their reasoning may be something like this: "If rainfall, sunlight and air temperature stresses are uniformly distributed over a site, why then do these stresses result in patches of dying grass?"

The reason is that underlying soil conditions, thatch and grass types with different stress and disease resistance properties are usually not uniformly distributed throughout a turf stand, especially in an old lawn. As a result, turf decline due to stress often occurs in patches.

IS IT DISEASE OR INSECT DAMAGE? The well-informed turf manager is aware that insect damage can resemble damage due to fungi (Table 2). The resemblance is closer if the symptoms are somewhat old. For example, severe sod webworm and cutworm damage somewhat resembles melting out caused by *Drechslera* and *Bipolaris* species (formerly called *Helminthosporium*). Chinch bug activity is especially difficult to diagnose because the symptoms caused

Table 1.

by sucking and toxins of this insect have no distinctive appearance. The chinch bug is highly mobile and is easily overlooked.

IDENTIFICATION DIFFICULTY. Some diseases, particularly the patch diseases, have only been recently discovered, are difficult to identify in the field and are not well understood. Many turf managers are still not aware that the diseases summer patch, yellow patch and necrotic ring spot exist.

The name that is most familiar to most turf managers is Fusarium blight — a disease that was identified in 1966. Yellow patch was identified on Kentucky bluegrass fairly recently, around 1978. Summer patch and necrotic ring spot were first identified in the United States in 1984. It will take some time for turf managers to learn which of these pathogens are the primary problems in their areas. Part of the delay is because the techniques for identifying these pathogens are still being refined.

PROFESSIONAL DIAGNOSIS. An important ally of the professional turf manager is a plant and pest diagnostic clinic. Most states have a clinic affiliated with the state extension service.

Before a problem hits, find out the location of a clinic with personnel who are able to diagnose



turf problems. Turf problems are particularly difficult to diagnose because not all clinics are staffed with people experienced in turf problem diagnosis.

The accuracy of any diagnosis

"Frogeye" type symptoms on Kentucky bluegrass can be caused by necrotic ring spot, yellow patch or summer patch.

The well-informed turf manager is aware that insect damage can resemble damage due to fungi, especially if symptoms are old.

depends upon the information provided with the sample, the plant material selected and the condition in which it arrives at the clinic.

Collection of the sample. The specimens should be collected while the symptoms are still fresh and before fungicide treatments are made. The sample should not be soaked with water just before

it is collected.

Samples should contain healthy and unhealthy turf since it's almost impossible to diagnose a grass sample that is nearly or entirely dead. Grass samples should be at least three inches by three inches by two inches deep, and should contain an intact layer of soil to help maintain the sample during transportation. A golf cup cutter or a flower bulb planter works very well.

Delivery of the samples. Rapid delivery of the sample and the plant specimen form to the clinic is essential. Personal delivery of the sample is preferred.

The crucial information to be given to the clinic includes: the symptoms; when they were first noticed; and what, when and how much fungicides, insecticides, herbicides and fertilizers were applied. The information is crucial to proper diagnosis.

If the samples are to be mailed, wrap them securely in several layers of newspaper or aluminum foil. Do not use plastic bags as the samples will quickly deteriorate during shipping. Pack the

DISEASES THAT MAY BE CONFUSED WITH INSECT DAMAGE

Disease	Overall Turf Stand Symptom	Insects that may cause somewhat similar symptoms
Drechslera/Bipolaris leafspot	scattered patches of brown leaves throughout stand	chinch bug, billbug
melting out	shedding of leaves	sod webworms, cutworms
Pythium blight, Brown patch	turf dies in irregular patches	white grub, billbug

Table 2.

samples tightly in the mailing carton with the use of wadded paper. Use overnight mail services if feasible. Mail early in the week to avoid packages remaining in the post office over the weekend.

POSSIBLE PATHOGEN NAME CHANGES. For those of you who like to impress your customers and friends with your ability to spout off the scientific names

of turf pathogens, a new set of names have been proposed for the brown patch and yellow patch fungi.

These have all been labeled *Rhizoctonia* — however it has recently been proposed that *Rhizoctonia cerealis* now be called *Ceratophora cerealis* and *Rhizoctonia solani* be called *Moniliopsis solani* (Table 3).

Again, this change is only proposed, time will tell if the scien-

tific community accepts the new names. You heard it here first.—
William W. Shane

The author is a turfgrass pathologist in the Department of Plant Pathology at The Ohio State University, Columbus, Ohio. He received his master's degree in plant pathology from North Carolina State University and a Ph.D. in plant pathology from the University of Minnesota.

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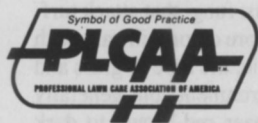
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Mysterious Midwest Fungus Blooms *Pithomyces Chartarum*

THERE ARE SEVERAL fungi that live in turf and produce tremendous numbers of colored spores. Some of these fungi are damaging and others are beneficial. Collectively, these fungi grow on leaves of the grass plants while their spores are spread through the air.

To dislodge the spores from the grass usually takes more force than just a summer breeze. Driving rain, irrigation, dust in the air, animals, feet and mechanical equipment are all effective means of spreading the spores. The lawn mower is especially suited for removing the spores from leaves and sending them on to a healthy grass leaf.

Most of these fungi have adapted themselves to growing in the hot summer leaves of grass plants. They survive as mycelium, inside the grass plant, or spores during the winter.

The spores of these fungi are very resistant to heat and drought and can outlast any grass plant. The spores can float in the air for days or even months, and when they land on a grass plant they will still grow.

These fungi are also capable of reproducing in a matter of days and producing tremendous numbers of spores. This is important because once the spores are airborne there is no guarantee they will land on a grass plant, but because they produce so many spores, they have never been



The rust fungi are one of the best known colored spore producers in summer turf as shown in these three photos.

known to miss in finding at least one plant to start the process again.

For example, there are about 50,000 spores in a rust pustule the size of a pinhead. While the spores are usually colored and aesthetic to a plant pathologist, there is a biological purpose for their color. Because the spores are produced on grass leaves, they are exposed to the harmful wavelengths of sunlight. The pigments found in the outer walls absorb the harmful energy, thus protecting the spores.

The range of colors produced

by these fungi is quite broad and some fungi, that produce more than one type of spore, also produce more than one wall pigment. There are no truly black spores, but some appear black because their walls are very thick and their pigments are dark brown or red.

Like many other fungi that grow in turf, these fungi are affected by the environment. They may develop in turf for only a portion of the growing season and they may not develop every year.

The rust fungi are one of the best known colored spore producers in summer turf. These

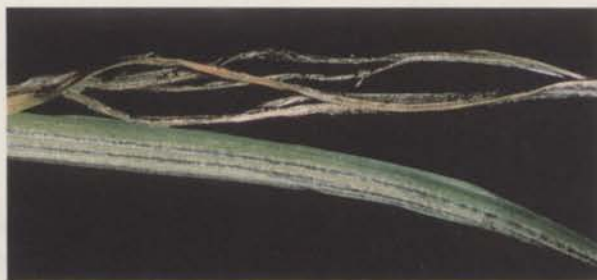
fungi are so named because many produce a red-brown or rust-colored pigment in their spore walls. Turf, equipment and most other objects that brush up against a "rusted" grass plant will carry away the orange rust spores (Figure 1).

While not visible to the naked eye, the rust spore is actually a ball with spines. The rusts are pathogens of the grass plants and can cause serious disease. Rusted turf usually develops in the summer months during periods of stress.

There are more than 40 different rust fungi that attack turf. Their spore color will vary with the specie, the type of grass and the environment, but generally will appear red-brown to dark brown. The smut fungi also grow on grass leaves and produce tremendous numbers of colored spores (Figure 2).

These fungi are highly spec-

(continued on page 52)



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Bluegrass Diseases

(continued from page 50)

ialized and most of their growth is done inside the turf leaves or flowers. Before spores are produced, the fungi will cause the leaves to turn yellow-green then yellow and finally gray-brown. As the leaves turn gray-brown, the spores rupture through the leaf surface and wait to be projected into the wind.

Generally, masses of dark smut spores appear in the spring and fall of the year and should not be confused with rust spores. There are at least seven different smut-causing-fungi and their spore colors are generally dark reddish brown, olive-brown and dark brown.

In any turf, there is a tremendous production of plant debris in the form of leaves and crowns because a grass plantlet only lives six to 18 months. In addition, the older leaves on a plantlet may die sooner due to shading, disease or other stress.

Fungi are thought to be the most effective group of microorgan-

isms that decompose debris and thatch. Saprophytic fungi do not need a living plant to survive, but can grow on dead plant material. These beneficial fungi do not attack living plants; often they will grow on the dead leaves in turf

Recently, a fungal bloom occurred in the Midwest that led to the identification of a new fungus, *Pithomyces chartarum*.

and never be noticed. If conditions in turf allow a lot of leaf debris to be produced, and the turf has been watered and fertilized, these fungi will grow very fast. When moisture becomes limiting, the fungi will remain quiescent,

but alive. When the moisture returns they will produce astronomical numbers of spores that will literally burst through the dead leaves. This rapid production of spores is called a fungal bloom.

Recently, a fungal bloom occurred in the Midwest that led to the identification of a new fungus in bluegrass. In July and August of 1985, 1986, 1987 and 1988, we received a number of telephone calls and specimens of Kentucky bluegrass from residents in Illinois, Indiana and Wisconsin. After mowing, the equipment (Figure 3) and the operators themselves were covered with a sooty black fungus.

Questions were raised over the cause of this condition, leading to concerns that the grass was being attacked by stripe and/or flag smut. Leaf smut diseases, however, are prevalent during the cool months of spring and autumn when the grass is growing rapidly and not during hot summer weather.

The Kentucky bluegrass plants examined in July and August

showed no symptoms of the leaf smut disease on their leaf blades. Staining the grass tissue followed by a microscopic examination also showed no symptoms. The root growth and leaf color of the grass plants were not visibly affected by the presence of the fungus.

After examining blends of Kentucky bluegrass of 50 sod farms, what apparently was the same black fungus was found on seven farms. All seven Kentucky bluegrass sods were less than 18 months old, had considerable amounts of dead leaf tissue and the clippings were routinely returned to the sod.

Samples were collected from the affected sod farms and the same fungus was consistently isolated from all locations, grown on culture medium in the laboratory and later positively identified as *Pithomyces chartarum*. This is the first report of this fungus growing in bluegrass sod in the United States.

The fungus was found only on senescent or dead leaves and clippings. We consider it to be a sapro-

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phyte and not a parasite, thus not damaging to grass.

The brown to dark brown spores (conidia) of the *Pithomyces* fungus, recovered from the dead or dying grass blades and clippings in astronomical numbers, are broadly ellipsoidal with both transverse and longitudinal septa (Figures 2 and 3).

Research in our laboratory has shown that the growth and development of *Pithomyces* and the production of its spores is favored by high temperatures (85 degrees to 95 degrees Fahrenheit, 29 degrees to 35 degrees Celsius), high humidity (85 percent to 95 percent) and abundant water as irrigation or rainfall.

Apparently all Kentucky bluegrasses can be affected as the fungus was found in a variety of blends on the sod farms growing on the following cultivars: Adelpi, A-34 (Bensun), Baron, Barga F, Glade, Julia, Merit, Nassau, Newport, Parade, Park, Rugby, Ram I and Victa.

An examination of the scientific literature turned up reports of *Pithomyces chartarum* dead

plant material in Alaska, Maryland, Oregon and Texas, but no reports of it growing on Kentucky bluegrass. The fungus has only been reported on orchardgrass in Oregon and pasture grasses in Texas and southern Africa. *Pithomyces chartarum* has, however, been isolated from perennial ryegrass in Europe, Australia and New Zealand. In the latter country, it has also been found on prairie grass and several other less common grasses. The same is true of southern Africa.

The sexual stage or teleomorph of *Pithomyces chartarum* has recently been shown to be an Ascomycete — a species of *Leptosphaerulina*. The fungus produces ascospores which are similar to the conidia of *Pithomyces*, but are smooth and nearly transparent (hyaline) to light brown. To date, the sexual stage has been found only in South Africa, but may well be undetected in the United States where *Pithomyces chartarum* has been found.

The *Leptosphaerulina* stage may explain the ability of the fun-

gus to survive the cold winter months and then to produce a flush of *Pithomyces* conidia when the weather changes from warm to hot and becomes wet.

Since *Pithomyces chartarum* is known to produce sporidesmin (a

or livestock, especially young or breeding animals. Otherwise, turfgrass managers have nothing to worry about.

Conditions that support rapid growth of turfgrasses, lush canopies and high relative humidity will promote growth of this fungus. Reducing the amount of nitrogen fertilizer applied plus maintaining a proper mowing height and schedule will reduce fungal growth.

Don't be surprised if you see *Pithomyces* growing on dead or dying Kentucky bluegrass and possibly other turfgrass leaves during hot and muggy weather following irrigation or rainfall. Now you'll know what it is you have. — Henry Wilkinson and Malcolm Shurtleff ■

Wilkinson is an assistant professor of plant pathology and agronomy specializing in turfgrass pathology and soilborne pathogens and Shurtleff is a professor of plant pathology and turfgrass extension specialist. Both authors are with the University of Illinois, Urbana-Champaign.

.....
Conditions that support rapid growth of turfgrasses, lush canopies and high relative humidity will promote growth of this fungus.

mycotoxin), and possibly other toxic compounds, bluegrass clippings covered with a sooty black fungus should not be fed to poultry

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Granular Formulations Continue to Interest Turf Managers

THERE ARE SOME RELATIVELY NEW TURF INSECTICIDES on the market for 1989 and some new formulations expected by the end of the year.

In general there appears to be a continued interest in the development of granular formulations for use on turf. More and more commercial lawn care operations appear to be moving in this direction, and many golf courses are expressing a preference for granular materials.

Most university field trials show that there is no significant difference in performance of liquid applications versus granular applications, at least in controlling white grubs, assuming each is applied in accordance with label instructions at the appropriate rate. (Both application technologies have their own advantages and disadvantages).

Following are comments on some of the turf insecticides available on the market for 1989. For lack of a better way, they are discussed in alphabetical order by trade name.

ASPON (*propyl thiopyrophosphate*) is listed in several states' turf recommendations for use against chinch bugs or sod webworms. The active ingredient (propyl thiopyrophosphate) is apparently particularly effective on chinch bugs, but the material does not seem to be readily available in many parts of the country.

DIAZINON recently underwent a review by the Environmental Protection Agency and its label was changed to reflect the toxicity of diazinon to wild fowl (notably ducks and geese). Diazinon cannot be used on golf courses or sod farms anywhere in the United States. It can be used (at the new application rate of four pounds AI per acre) on home lawns and certain other kinds of turf. It is available in a wide range of liquid (emulsifiable concentrate) and granular formulations from a variety of formulators. It remains a consistent performer and serves a very useful role as a general purpose insecticide for use in lawn and garden settings.

DURSBAN (*chlorpyrifos*) is an excellent insecticide for use against surface feeding insects (chinch bugs, sod webworms). In some instances, the active ingredient (chlorpyrifos) is rapidly adsorbed to thatch. Dursban is available in a wide range of liquid (emulsifiable concentrate) and granular formulations from several formulating companies.

MAVRIK (*fluvalinate*) is a synthetic pyrethroid which has been used for several years on trees and shrubs. More recently fluvalinate has been labeled for use on chinch bugs and other surface feeding insects. Like most pyrethroids, it tends to act quickly, primarily as an irritant, but does not remain active for more than a couple weeks in most cases.

MOCAP (*ethoprop*) has recently been made available in a new formulation, a 5 percent granular. Many turf managers will remember that the former formulation (a 10 percent granular) was very unpopular in home lawn settings because of a strong and unpleasant odor. In addition, the 10G formulation was the most toxic material available for use on home lawns. The new 5G formulation is much safer to handle (dermal LD50s

Insecticides can control such pests as the leafhopper, tent caterpillar, chinch bug and sod webworm. Illustrations: Rhone-Poulenc Co.





Illustration: Rhone-Poulenc Co.

in the same range as most other turf insecticides), generally does not smell and does not release as much dust during the application. While the question has not been resolved in all states, Ethoprop 5G apparently will be suitable for use on athletic fields— as long as the material is watered in and the area dries before athletes return to the field.

OFTANOL (*isofenphos*) has been on the market for several years now. It is available as a flowable formulation and in a variety of granular formulations, some of which are combined with fertilizers. Isofenphos is probably best suited for control of soil insects such as white grubs. Although not known for killing grubs rapidly, it generally remains active for 10 to 12 weeks— longer than many materials currently available.

In some places (often very localized areas) oftanol has been used repeatedly for several years, and its performance has dropped off markedly. In many cases this observed drop in performance was due to problems in application (improper calibration or overlap, inadequate water), but in some cases there has been a natural phenomenon called microbial degradation which leads to a rapid breakdown of the active ingredient before it has a chance to kill the grubs in the soil.

Turf managers should consider alternating use of isofenphos with other insecticides in those areas where it has been used for more than three consecutive years and no longer appears to be working as well as it did in the first years of use.

PROXOL and **DYLOX**, two products with the same active ingredient, are insecticides often used to clean up "hot spots." The active ingredient (trichlorfon) moves through thatch more rapidly than any other

turf insecticide. It also kills insects much more rapidly than other materials currently available. As a result, an applicator may very well see several dead grubs (or sod webworms or whatever the target may be) a day or two after an application is made. Depending on the situation, the product may not always be the most prudent route to insect control.

Dylox is currently under an EPA-mandated review for all commodities, because it moves through thatch and soil so readily. Turf managers sometimes save Dylox for use as spot treatments to clean up infestations which develop unexpectedly.

In some areas of the country, Dylox is available only as an 80 percent soluble powder (80SP). Other areas of the country have reasonably good supplies of a 5 percent granular formulation. Be aware, however, that the shelf life of the granular material is much lower than that of granular formulations of other insecticides. Do not store granular Dylox for more than a few

(perhaps six to eight) months.

SEVEN (carbarly) carries a turf label on at least some of its formulations, and has been used on a variety of insects. Its performance on white grubs may be inconsistent, but it is usually very effective on sod webworms and cutworms. It is available in a variety of formulations, but most commonly is found in a flowable form.

TRIUMPH (isazophos) is the newest turf insecticide, having just appeared on the market last year. The active ingredient (isazophos) has been around in university trials (known as CGA 12223) since the mid 1970s, and it consistently looked very good on a variety of insects. The manufacturer, Ciba-Geigy, finally received a federal label in 1988 for Triumph 4E for use by commercial applicators on home lawns and some other turf. The company anticipates having a 1 percent granular formulation available for use on home lawns by the end of 1989.

Triumph seems to combine the best of both worlds — it works reasonably quickly on grubs and

yet has a fairly long residual. As a result, you can expect to see some dead grubs within two to four days after application, but it will remain effective for six to eight weeks and even longer in some cases.

The main concern about Triumph is that it is extremely toxic to fish. As a result the company is choosing to proceed cautiously in its efforts to expand the label. A number of states have been granted 24-C (state) labels for use on greens, tees and aprons.

TURCAM (bendiocarb) is another relatively new material in the turf world. It is available as a 76 percent wettable powder (76WP) and as a 2.5 percent granular. One of its selling points is that it is a carbamate, whereas virtually all of the insecticides currently on the turf market are organophosphates.

It works reasonably quickly and has a "middle of the road" period of residual activity. Many managers have been using it to replace oftanol in settings where oftanol's performance has been dropping off, and have reported very ac-

ceptable results. It is more expensive to apply than most of its competitors, but apparently has not been subject to many failures.

CONCLUDING COMMENTS.

There are a number of good turf insecticides on the market and most of them are available in liquid and granular forms. Some work quickly, while some persist more than others. It becomes the responsibility of the turf manager to do his homework before he makes an insecticide application — choose the material best suited to do the job at hand.

Most of these materials are available in several formulations, some of which are meant for use in agricultural settings. Be sure that the material and formulation you select are indeed labeled for use on turf — and follow the label instructions. They are there for a reason! — *Patricia Vitum* ■

The author is an associate professor of entomology at the University of Massachusetts Surburb Experiment Station, Walham, Mass.



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IPM Programs Combine Biological, Chemical Controls

FIRE ANTS, BROWN patch, powdery mildew, euonymus scale, the list goes on. Can these overwhelming pest problems be controlled using integrated pest management techniques? The answer is yes.

The first step in getting better control of pests and lowering your pesticide use is to fully understand the biology of the pest. An understanding of the pest's biology usually shows a vulnerable point in the life cycle that allows for better control with less disruption of the environment.

Knowing the biologies of all the pests you confront is an impossible task. Instead, pick your top 10 pests be they weeds, insects or diseases on the basis of what costs your company the most in terms of labor and materials. Develop an IPM program for these pests first. You can later move on to your other pests, but chances are your biggest reductions in pesticide use are to be found in your top 10 pests.

What does IPM mean to the landscape maintenance contractor? IPM means identifying the pest, monitoring its population level and selecting the appropriate pest management tactic.

Identifying the pest may require sending it to the state systematics laboratory at your state university or extension service. You may be able to field classify the pest as an aphid, but have more difficulty determining exactly what kind of aphid. After identifying the aphid pest of Crape Myrtle as the Crape Myrtle Aphid *Tinocallis kahawaluokali*, entomologists at Texas A&M University determined it had no effective natural enemies in Texas.

In this case, identification of the pest changed the control effort for it completely. We now know that we cannot rely on nature to control this pest. Long-term control of the aphid will come from importation of natural enemies from the homeland of the Crape Myrtle Aphid — Pakistan. Not all insect problems are this difficult to solve. This does, however, make a point that identification is important to an IPM program.

Plant diseases are admittedly much harder to correctly diagnose. Most Southwestern lawn maintenance professionals can readily identify pathogens like brown patch and powdery mildew. But what about the many other disease complexities that affect ornamentals?

As with insects, plant diseases are often best identified by a professional laboratory. After a few plant diseases are correctly identified, patterns or associations of certain pathogens and host plants will develop. Good records of these associations are valuable for future field diagnostics. Fungicides are specific for certain diseases. Be sure the disease is listed on the label.

Weeds can usually be identified using books, however, many grasses can be difficult to classify without seedheads. In this case outside help may be needed.

Knowing which species of grass or broadleaf you're dealing with is important for timing your herbicide application. Timing of herbicides such as a preemergent for crabgrass can be determined using measurements of soil temperature. Crabgrass begins to germinate when the soil at 0.5 inches reaches 55 degrees Fahrenheit for three consecutive days. The pre-emergent should be applied two weeks before this date.

Good monitoring is essential to the success of a company's IPM program. Once the pest is identified, everyone (at least to the crew leader level) should be trained to spot the pest in the field. Insects and diseases are associated with certain host plants. Train the monitors to look for the common pest problems where they are likely to occur for that time of year.

In the Southwest, spider mites are likely to occur on junipers, boxwoods and marigolds. If the monitor spots the junipers as taking on a silvery appearance, they break off a branch and shake it over a piece of paper. If they can see small specks walking around on the paper they know the plant has mites.

Monitoring also includes good record keeping. Records of pesticide usage and biological data such as pest type, location and date can predict pest outbreaks next year. Use these records to determine your top 10 list discussed earlier in this article.

Selecting the appropriate pest management tactic is perhaps the most difficult part of an IPM program. Several alternatives exist for managing each pest problem. By themselves they may not be adequate for the level of control you desire, however, the use of different methods together, in an integrated manner, generally

Predators, like lady beetles, can reduce aphid damage as seen on the ornamentals below.



brings the best results.

Good IPM programs get to the root of the problem. Treating symptoms of the problems produces dramatic, but short-term results. A colleague in the landscape maintenance business once said, "When a crew leader reports a chinch bug outbreak we first suspect an irrigation failure." In his case, eliminating the drought stress was the first step for control of the chinch bugs. The second step was an insecticide application. Third was continued monitoring of the irrigation system and the chinch bug population.

IPM control tactics fall into these categories: cultural, plant selection, biological regulatory and chemical control. The above example using irrigation as a control measure is a cultural control. Other cultural controls are pruning out disease-infected or insect-infested plants or limbs, turf aeration and raising mowing heights. Plant selection is only an option during installation of a landscape, renovations or color change-outs.

Commercial landscapes often use plants that are well-adapted. However, residential landscapes, making use of a greater variety of plant materials, are often stuck with plant materials that are not adapted to local conditions. The stress these unadapted plants endure makes them susceptible to disease, insects and weed problems. Xeriscape is a type of landscaping that reduces irrigation inputs by using native or locally adapted plants. These xeriscape plants generally have a natural resistance to pests.

Regulatory controls are imposed by the U.S. Department of Agriculture or state departments of agriculture. Pests can be quarantined out of a state or locale



Monitoring pest populations with traps helps in timing pesticide applications.

by inspection of incoming plant materials. Certain palms are excluded from sale to Texas to prevent the disease Lethal-Yellows from infecting Texas palms. The spread of fire ants is being slowed by inspection of sod farms and nursery stock to be sure it is fire ant free.

Biological control is usually associated with insects. There are cases where it has been used for weeds and disease, but this is not common. Biocontrol of insects takes on two forms: conservation of naturally occurring beneficial insects and introduction of beneficials.

To conserve natural enemies use pesticides that have the least impact on them. Summer oils, soaps and selective insecticides like B.t. and Dimilin are just a few. Pests like aphids often have predators like lady beetles and lacewings that reduce their populations. They are easy to see on the leaf actually consuming the pest aphids.

Besides predators there are highly effective parasitic wasps that kill the aphid by injecting their eggs into the aphid. As the wasp hatches and feeds on the aphid, it causes the aphid to swell up like a mummy. Looking for these mummies among the pest aphids tells you if you have these parasitic wasps present. Broad spectrum insecticides are very hard on parasites. The question is how many of these mummies would tell you that you don't have to spray. This comes from ex-

perience as a monitor, but if half the aphids are mummified you don't need to spray. Follow up monitoring will tell you if the percentage of mummies is decreasing over time.

Insects like the Crape Myrtle Aphid do not have good natural enemies. This aphid is a recent import that develops into large populations on the tree causing formation of black sooty mold and reduced flowering. Unfortunately, the natural enemies were not imported at the same time. A privately funded proposal from industry seeks to send a trained entomologist to Pakistan, the aphids' home, to collect the aphids' natural enemies. The natural enemies are returned and evaluated under strict quarantine procedures and then released in the field. If all works well, the aphid is eliminated permanently as a major pest.

An IPM program is successful if the total chemical usage is lowered. You may find through monitoring that a scheduled cover spray is not needed. In selecting a pesticide you should consider: the safety of the applicator, the client's safety and the impact on the environment. Generally, many different products are labeled for a particular pest. Pick the product that is the safest. The Material Safety Data Sheet has the best information regarding the toxicological or environmental concerns of the product.

Let's go over some specific IPM programs for certain key

pests of Southwestern landscapes.

DISEASES. Brown Patch—a new approach to this disease of mainly St. Augustine turf involves a cultural control, changing irrigation practices. This method was developed by Joe Vargas of Michigan State University. Vargas believes that weekly watering schedules often let the top layer of soil dry out causing destruction of the beneficial microbes that fight brown patch.

His tests show a moist soil favors the beneficials over the rhizoctonia, thus lowering the incidence of disease. It is also known that fertilization in late summer and early fall also favors brown patch. The lush new growth of St. Augustine is susceptible to the disease.

Powdery Mildew — IPM for this disease starts with winter pruning. Crape Myrtles are pruned so as to allow for good air circulation through the branches. When fertilizing the turf, avoid getting high nitrogen turf fertilizer into the tree well. Nitrogen rich, new growth is susceptible to powdery mildew and promotes aphid population. This polymer covers the leaf and the mildew suffocating the fungus. The new growth must be retreated. For new landscapes or renovations check with your nurseryman for resistant varieties of Crape Myrtle.

Phytophthora Aerial Blight of Periwinkles. This is a major problem of the past few years in the sunbelt. Periwinkles, once a carefree drought tolerant summer annual, became plagued with this disease. According to Texas A&M pathologist Larry Barnes, the disease cycle begins when the seed is grown in South America.

The inoculated seed is grown in greenhouses and later transplanted into landscapes where the disease takes off. Part of the problem is planting the flowers before it fully warms up for spring. Nights below 70 degrees Fahrenheit predispose the plant to the blight.

Since the phytophthora spp. has a mobile swimming zoospore, overwatering and excessive wetting of the foliage quickens the spread of the disease. A preventive application of a copper-based fungicide like Kocide 101 is recommended.

WEEDS. Turfgrasses have a number of different grassy and broadleaf weeds. Sheila Daar from the *IPM Practitioner* suggests surveying the client as to how many weeds can be tolerated. If the turf is used as a playground, sticker burrs will likely be the weed they want controlled. If this is the case, treatments for other weeds may not be needed.

Commercial turfs, on the other hand, want an even look. Broadleaf weeds and grass seedheads detract greatly. In many of the commercial turfs, the majority of the weeds occur near the perimeter where pavement or concrete begins. The increased heat and drought stress favors grassy weeds such as crabgrass and dallisgrass. Try banding your preemergent around the perimeter, skipping the middles. You will be surprised how far this will stretch your preemergent while still getting good weed control.

Culturally, aeration is very important for a strong vigorous turf. A compacted soil limits the grass while promoting certain weeds. Compaction often occurs when the lawn is mowed. If the soil is wet from rain or irrigation, even the weight of a walk-behind mower will compact the soil. The vigorous grass will out compete many weeds by shading them out. Raising the mowing height upward to three inches also allows for less sunlight to reach the soil, stimulating weed seed germination.

WEEDS IN BEDS. Mulches can do a great deal of work preventing weeds, not to mention the benefit to the shrub or tree. Thick applications, three to four inches, of hardwood mulch such as cypress will last a full year con-

trolling weeds. Applying a pre-emergent under the mulch increases the weed control.

The National Park Service is using a portable flame weeder for spot treatment of weeds. This may sound unusual, but is quite effective on a broad spectrum of weeds — with immediate results in many cases. From the design end, look for situations that you know are going to harbor weeds. Park benches should be placed on pads to prevent the constant regrowth underneath. Watch for areas where grass grows directly up to a building or fence. Permanent barriers like curbs and edging prevent encroachment of weeds into areas where it is difficult to mow.

INSECTS. Aphids (many spp.) Monitor populations for predators and parasites. Look for aphid mummies. If an application of insecticide is necessary, use one that is less harmful to beneficial insects. Try soaps or the new low phytotoxic horticultural oils. These oils show good promise as contact insecticide on insects such as aphids, caterpillars, leafhoppers, mites etc. The refining takes out the sulfur impurities and allows it to be used on sensitive plants at higher temperatures than the standard oils.

Thrips. Western flower thrips are normally a problem in late spring when all the wildflowers have dried out. Large populations abound looking for more green. Yellow sticky traps can tell you when they arrive in your landscape and when their cycle is over. Monitoring their populations with traps allows you to time your application precisely when it can help you. Once the deformed growth of plants like photinia appears it is usually too late for

control.

Mites. Spider mites can be a problem throughout most of the year. Junipers, boxwoods and marigolds can all be severely affected. Normally their populations reach a peak in August. By that time, control is difficult and their damage is already done. Applications of horticultural oils in late spring will kill many overwintering mites and eggs. In late season, if an application is still necessary on marigolds, for example, try a release of spider mite predator *Phytoseiulus persimilis*. This predator mite has a life cycle twice as fast as the spider mite and consumes mite eggs.

Predators can be purchased from insectaries such as Rincon-Vitova in Oak Vista, Calif. If the spider mite population is very large, a cleanup application of soap is recommended a day before predators are released.

Fire Ants. Much has been written about controlling this insect. Scores of products are on the market which attack the ants mound by mound. Treating the population as a whole is a more efficient way to control fire ants.

Broadcasting the baits over the entire turf area is the first step. This should be done with fresh bait on a warm humid day in spring before the temperature is above 90 degrees Fahrenheit on dry ground. These techniques optimize your chances that the bait will be picked up by the ants.

Scale Insects (many spp.). Monitoring for the immature stage of the scale, the crawler pinpoints the vulnerable part in the scale life cycle. Different scales send out crawler stages at different times in the spring, summer and fall. This is where identification plays a key role in an IPM program. Make an application of horticultural oil when the crawlers appear in late March or April. Parts of the plant that are severely infested should be pruned out as a cultural control.

Tent Caterpillars. Monitor host plant oaks for signs of small first instar worms. Chemical control is more efficient now before the worms reach their nuisance stage and are more difficult to control. — John Goolsby ■

The author is manager of quality control at Pampered Lawns, Austin, Texas.



Properly identifying the pest leads to appropriate management tactics.

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White Grubs: The Most Troublesome Turfgrass Pest?

WHITE GRUBS ARE the larvae of scarabaeid beetles, the adults of which are known as May or June beetles. Several species of white grubs can be found throughout the United States.

In the East and Midwest, the most troublesome species is the Japanese beetle, *Popillia japonica* Newman (Tashiro 1987). Other pestiferous species can also be found such as the European chafer, *Rhizotrogus majalis* (Razoumowsky); the Oriental beetle, *Maladera castanea* (Arrow); the Northern masked chafer, *Cyclocephala borealis* (Arrow); and the black turfgrass ataenius, *Ataenius spretulus* (Haldeman).

In contrast, the white grub complex in the West is composed of several species in the genus *Cyclocephala*. Among those are *C. hirta* Le Conte, *C. pasadenae* Casey, *C. longula* Le Conte, *C. melanocephala* (F.) and *C. immaculata* (Oliver).

The pestiferous status of white grubs is of a dual nature. First, the perennial turfgrass ecosystem is conducive to pest population buildup and perpetuation especially in mild climates which allow for turfgrass growth throughout the year. This undisturbed habitat with a continuous supply of food has the potential of sustaining grub populations on a seemingly year-round basis.

The second aspect contributing to the grubs' pestiferous status is the nature of their life cycle and feeding damage. When adults emerge in May and June, they mate and lay eggs in the turfgrass root zone. First instar grubs hatch and start feeding on the roots, they molt twice, and by late summer third instars cause the majority of the above ground damage symptoms. The problem, therefore, stems from the discrete

feeding by the younger instars. This damage is usually inconspicuous and tends to go unnoticed until it is too late to rectify the situation.

At present, white grubs are controlled with insecticide applications once, and often twice, per season. In 1985, approximately 40,000 pounds (18,200 kg) of pesticides were applied on turf in California alone.

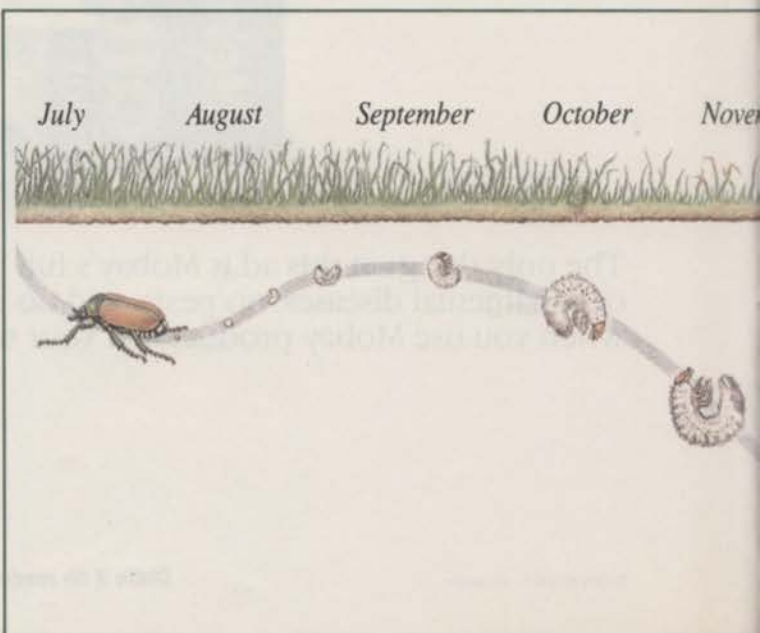
Despite one recent introduction of an insecticide for grub control, the overall availability of effective insecticides is continuously diminishing due to the slow rate at which new commercial products reach the market.

The development of resistance to both old and new insecticides is also an issue of major concern. The older chlorinated hydrocarbon insecticides such as aldrin, dieldrin, chlordane and DDT have become obsolete partly because of environmental concerns, and partly because of resistance development.

Several epigeal pests such as webworms, *Crambus sperryellus* (Klats) and *C. bonifatellus* (Hulst.); billbugs, *Sphenophorus parvulus* (Gyllenhal); and chinch bugs, *Blissus leucopterus hirtus* (Montandon) and *B. insularis* (Barber), have developed resistance to the chlorinated hydrocarbons (Reinert 1982; Reinert and Niemczyk 1982). Other pests such as the greenbug aphid have been shown to possess resistance to yet another extensively used class of insecticides, the organophosphates (Reinert 1982).

Fortunately, insecticide resistance has not developed as widely in white grubs or in other hypogean insects.

According to Harris (1982), the ideal turfgrass soil insecticide has to be moderately persistent, moderately soluble in water and moderately volatile. None of our commercially available insecticides at present possess all three qualities. Additional factors responsible for inconsistent results



with turf insecticides include short residual activity, inadequate distribution of deposits, soil pH, moisture and temperature. Even under optimum conditions of low thatch and high soil moisture, Sears and Chapman (1979) reported a rapid degradation of a commonly used insecticide after two weeks, resulting in a soil concentration less than 1 percent of the initial amount applied.

Biological control of white grubs may be accomplished through the use of parasites, predators or pathogens. The majority of studies addressing this subject have been conducted on Japanese beetle populations.

A parasitic fly, *Hyperecteina aldrichi* Mensil, has been reported to cause substantial reductions in Japanese beetle populations in Japan; however data is unavailable regarding its current distribution and impact in the U.S. (Klein 1982).

The use of predators to control white grubs can provide adequate

results inasmuch as a predator, unlike a parasite, can consume large amounts of grubs in a relatively short period of time. An example of this is the successful introduction of the giant toad, *Bufo marinus*, into Puerto Rico for June beetle and mole cricket suppression (Coppel and Mertins 1977). This approach to controlling grubs is limited, however, by the fact that the majority of vertebrate predators are considered pests in landscape settings. Birds, skunks and racoons usually tear up the sod while excavating for grubs, thus resulting in damage that is much more serious than that by grubs.

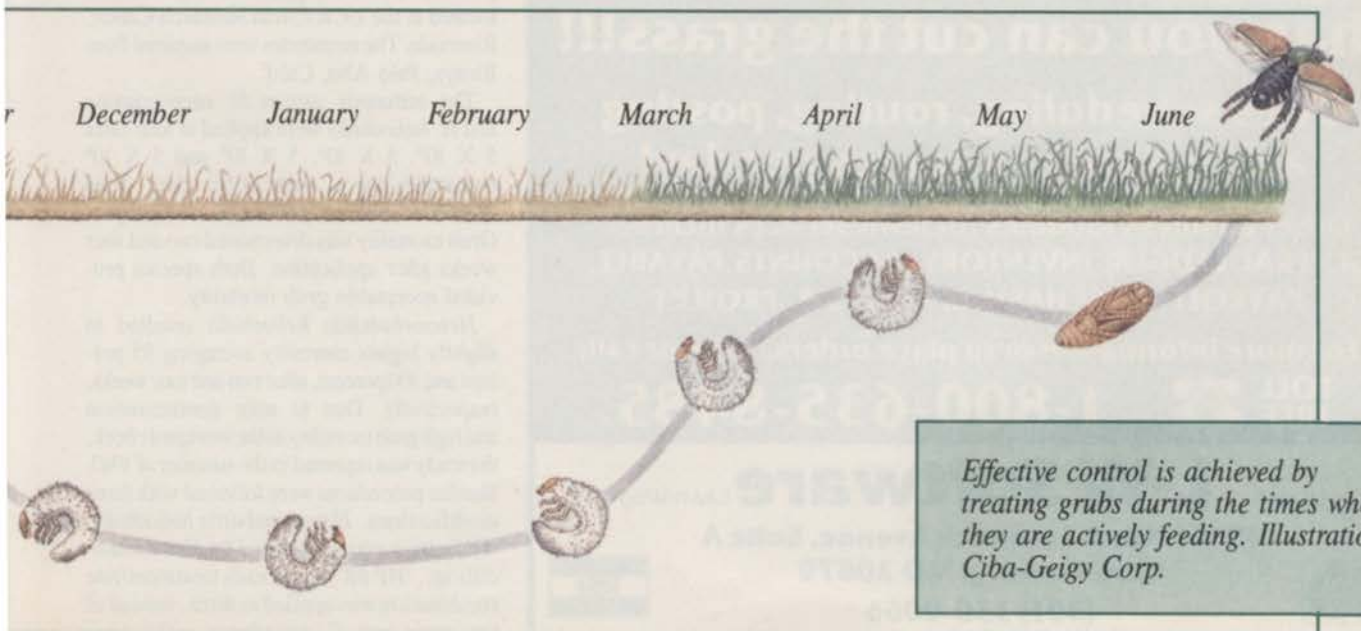
Two potentially promising biological control agents of white grub populations are the bacterium *Bacillus popilliae* and the entomogenous nematodes. Pursuant to passive injection by the grubs, the bacteria reproduce and release a toxin which kills the host. Nematodes, on the other hand, actively seek their host



Illustration:
Ciba-Geigy Corp.

(pest insect) and penetrate the body either through natural openings (mouth, respiratory openings, anus) or through the cuticle (skin). The nematodes kill their hosts through the action of their symbiotic bacteria such as *Xenorhabdus nematophilus* and *X. luminescens*.

Two nematode families seem to offer the greatest potential for biological control (Kaya 1985). The first is Steinernematidae with the species *Steinernema glaseri* and *Neoplectana carpocapsae* (= *S. feltiae*), and the second is Heterorhabditidae with species in the genus *Heterorhabditis*.



As with other biological control agents, once successfully established, the bacteria and nematodes should continually sustain their numbers on the white grub populations. Since moisture is the most critical factor to nematode survival (Moore 1973), it is unlikely that the optimal edaphic moisture levels in well-maintained landscapes and golf courses will be conducive to nematode persistence.

Therefore, a single timely application of either bacteria or nematodes, properly conducted may result in multi-season control of white grubs. This, in turn, will lead to a reduction in labor and maintenance costs as well

as reduced exposure hazards to people and

The bacterium *B. popillae* is the causal agent of milky spore disease in Japanese beetle grubs.

These bacteria are commercially available and have been used in the East and Midwest (USDA 1973, 1976). The high degree of specificity between the bacterium and its host incurs an added benefit through the elimination of exposure hazards to non-target organisms.

The earliest work reported on the use of nematodes for grub suppression was by Glaser and Farrell (1935). These authors reported

successful control of Japanese beetle grubs with the nematode, *Neoaplectana glaseri*, both in small and large field plots in New Jersey. Additionally, they reported that burying the nematodes at depths of three to four inches provided a better method of introduction and resulted in longer persistence than spraying them on the soil surface.

Wright et al. (1988) reported greater than 90 percent control of third instar Japanese beetle grubs with *Heterorhabditis* spp.

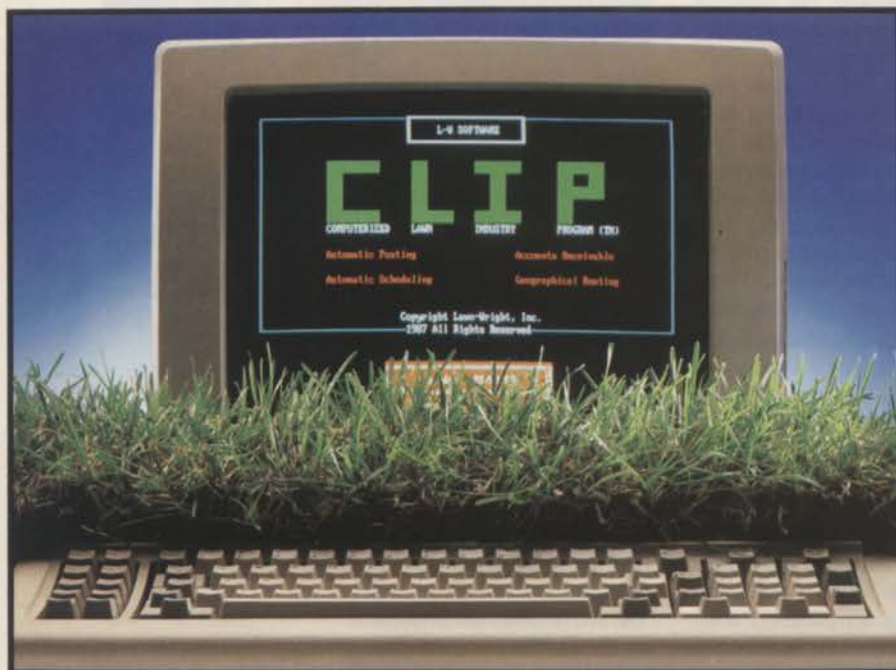
A recently completed study by the author documented the field efficacy of nematodes against thatch-inhabiting insect pests of turfgrass (Ali et al. 1988). Cutworms infesting a sod farm were treated with selected rates of *N. carpocapsae* and *H. heliothidis*. Evaluations conducted four days after treatment revealed up to 70 percent cutworm mortality due to *H. heliothidis*. The significance of this is twofold. First, control levels achieved with the nematodes were comparable to those by currently registered insecticides. Second, and more importantly, is the safety aspect which renders these biological control agents a superior and more desirable alternative to insect pest management.

GREENHOUSE STUDIES. Studies were conducted in the spring and summer of 1987 at the University of California, Riverside, to determine the influence of selected nematodes on white grub mortality in the greenhouse. The nematodes investigated were *Neoaplectana carpocapsae*, 'All' strain; *Heterorhabditis heliothidis*, 'NC' strain; and *Heterorhabditis*, sp., 'Hp 88' strain. One gram of tall fescue 'Hound Dog' seed was sown in individual six-inch (15.24 cm) pots filled with stream sterilized soil containing 1:1, UC mix: sand.

Third instar grubs of *C. pasadenae* were collected from a golf course and held for seven days to establish their nematode-free status. Ten grubs were then placed in each pot. The pots were placed in a greenhouse located at the UCR Citrus Research Center, Riverside. The nematodes were acquired from Biosys, Palo Alto, Calif.

The nematode species *N. carpocapsae* and *H. heliothidis* were applied at four rates 5×10^3 , 5×10^4 , 5×10^5 and 5×10^6 nematodes/pot to each of six pots. Total drench volume was 500 ml (17 oz.) per pot. Grub mortality was determined two and four weeks after application. Both species provided acceptable grub mortality.

Heterorhabditis heliothidis resulted in slightly higher mortality averaging 95 percent and 100 percent, after two and four weeks, respectively. Due to mite contamination and high grub mortality in the untreated check, the study was repeated in the summer of 1987. Similar procedures were followed with three modifications. *Heterorhabditis heliothidis*, 'NC' strain was substituted by *Heterorhabditis* sp., 'HP 88' strain; each treatment/rate combination was applied to three, instead of two pots; and *C. pasadenae* grubs were



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substituted by *C. hirta*.

Heterorhabditis sp., 'HP 88' strain, provided greater control than *N. carpocapsae*. There were highly significant ($P < 0.001$) linear relationships between percent grub mortality (Y) and the concentration of *Heterorhabditis* sp. (X). These relationships can be illustrated by the regression equations: $Y = 74.5 + 29.8 X$ ($R^2 = 0.78$), and $Y = 76.9 + 35.9 X$ ($R^2 = 0.61$), for the two- and four-week counts, respectively.

Results from these studies in California confirm the superior performance of *Heterorhabditis* species in controlling grubs as shown by Villani and Wright (1988) in New York state. Studies are planned to document the practicality of using those nematodes in actual field situations for white grub control.

Results from those studies as well as from similar studies by researchers in Ohio and New York will be used to economically incorporate the use of entomogenous nematodes into an overall integrated pest management strategy for white grubs in turfgrass. — A. D. Ali

The author was formerly an extension entomologist at the University of California, Riverside.

REFERENCES

1. Ali, A.D., J.M. Garcia and R. Georgis. (1988). Cutworm control with entomogenous nematodes in hybrid bermudagrass, California, 1987. Insecticide & Acaricide Tests, 13: (In Press).
2. Bedding, R.A. and L.A. Miller. 1981. Use of a nematode, *Heterorhabditis heliothidis*, to control black vine weevil, *Otiorynchus sulcatus*, in potted plants. Ann. Appl. Bio. 99:211-216.
3. Cheng, H.H. and G.E. Bucher. 1972. Field comparison of the Neoplectanid nematode DD-136 with Diazinon for control of *Hy-lemia* spp. on tobacco. J. Econ. Entomol. 65:1761-1762.
4. Coppel, H.C. and J.W. Metins. 1977. Biological insect pest suppression. Springer-Verlag, Berlin. 314 p.
5. Georgis, R. and G.O. Poinar. 1984. Field control of the strawberry root weevil, *Nemocoetes incomptus*, by Neoplectanid nematodes (Steinernematode: Nematoda). J. Invert. Pathol. 43:130-131.
6. Glaser, R.W. and C.C. Farrell. 1935. Field experiments with the Japanese beetle and its nematode parasite. J. New York Entomol. Soc. 18:345-371.
7. Glaser, R.W., E.E. McCoy and H.B. Girth. 1940. The biology and economic importance of a nematode parasite in insects. J. Parasitol. 26:479-495.
8. Harlan, D.P., S.R. Dutky, G.R. Padgett, J.A. Mitchell, Z.A. Shaw and F.J. Bartlett. 1971. Parasitism of *Neoplectana dutkyi* in white-fringed beetle larvae. J. Nematol. 3:280-283.
9. Harris, C.R. 1982. Factors influencing the

- toxicity of insecticides in soil. pp. 47-52 In: H.D. Niemczyk and B.G. Joyner (eds.), Advances in Turfgrass Entomology. Hammer Graphics, Inc., Piqua, OH. 150 p.
10. Kain, W.M., R.A. Bedding and C.L. Van Der Mespel. 1982. Preliminary evaluation of parasitic nematodes for grass grub (*Costelytra zealandica* White) control in central Hawke's Bay of New Zealand. N.Z.J. Exp. Agric. 10:447-450.
 11. Kaya, H.K. 1985. Entomogenous nematodes for insect control in IPM systems. In: Joy, M.A. and D.C. Herzog (eds.), Biological Control in Agricultural IPM Systems. Acad. Press, N.Y. 589 p.

12. Klein, M.G. 1982. Biological suppression of turf insects. pp. 91-97 In: H.D. Niemczyk and B.G. Joyner (eds.), Advances in Turfgrass Entomology. Hammer Graphics, Inc., Piqua, OH. 150 p.
13. Moore, G.E. 1973. Moisture requirements of the DD-136 strain of *Neoplectana carpocapsae* (Nematoda: Rhabditida) as related to host infection. Exp. Parasitol. 33: 207-211.
14. Ng, Y.-S. and S. Ahmad. 1979. Resistance to dieldrin and tolerance to chlorpyrifos and bendiocarb in a northern New Jersey population of Japanese beetle. J. Econ. Entomol. 72:698-700.

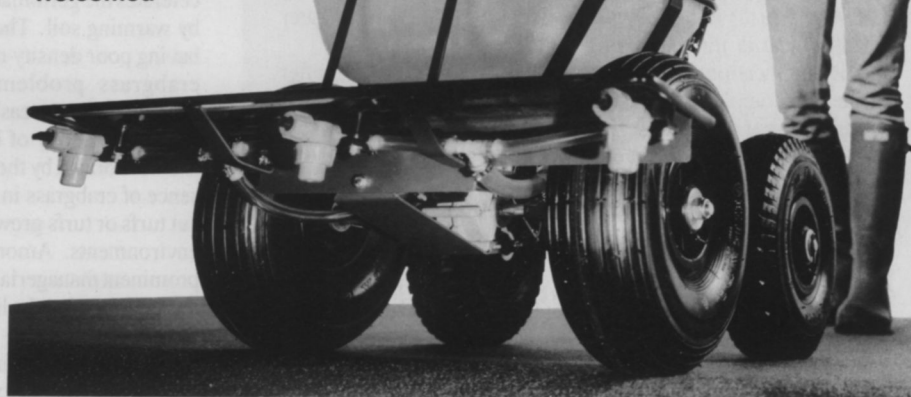
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Success and Failure in Controlling Crabgrass

CRABGRASS (*DIGITARIA SP.*) IS ONE OF THE MOST troublesome weeds in turf.

The success of crabgrass, as a weed, can be attributed to several factors including the following: the ability of each plant to produce large numbers of seed; the ability of plants to persist through hot, dry environmental conditions, the same conditions which induce summer dormancy in many cool season turfgrasses; an efficient metabolism that enable plants to increase photosynthate production during periods of high temperature and high light intensities, while the capacity of cool season turfgrasses to produce photosynthate decreases; and the ability to rapidly colonize open areas in turf created by the injurious effects of disease, insects, compaction, wear and environmental stress.

Any discussion of weed control should be prefaced by a consideration of how weed problems develop. Perhaps the most significant factor contributing to crabgrass encroachment in turf is poor management, which causes a reduction in turf density.

Sunlight is required for germination of crabgrass seed, and also accelerates the germination process by warming soil. Therefore, turf having poor density may develop crabgrass problems because sunlight will more easily penetrate a thinned canopy of leaves. This is corroborated by the general absence of crabgrass in dense, high cut turfs or turfs grown in shaded environments. Among the most prominent managerial abuses are: mowing too closely, light and frequent irrigation and late spring/early summer fertilization.

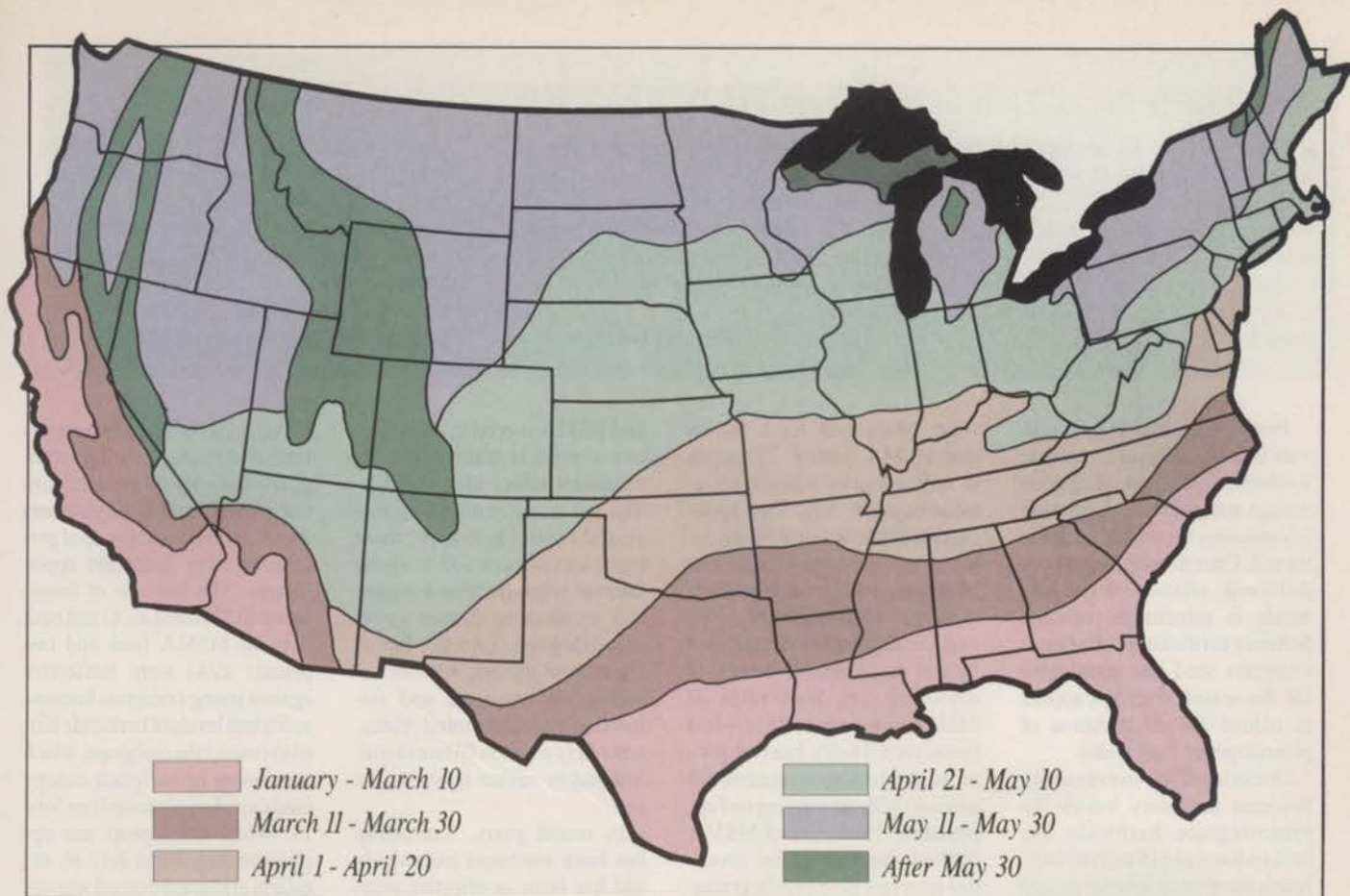
Mowing a turf too closely leads to deterioration of stand density. Observations in a University of Maryland study have shown that tall fescue plots mown at one inch contained 70 percent weeds, whereas, plots mown at three inches had only 12 percent weeds. Hence, by increasing mowing height, weed encroachment can be greatly reduced. Light and frequent irrigations enhance crabgrass seed germination by ensuring that soil remains moistened for extended periods. By allowing soil

PROCEDURES FOR APPLYING PREEMERGENCE HERBICIDES

- APPLY AT THE RECOMMENDED RATE AND BE aware of sensitive turfgrass species.
- Apply one to two weeks prior to crabgrass germination — early spring, when soil temperature rises to about 60 degrees Fahrenheit. Consult extension specialist from your region for best timing.
- For uniformity of coverage, apply half the needed material in each of two directions at right angles.
- Apply prior to a rainstorm or irrigate with 1/4-inch water within two to three days of herbicide application.
- Re-application of some products five to seven weeks after the initial application, may be necessary to provide season-long control of crabgrass in transition and southern regions. This may also apply when a two- to four-week drought follows a herbicide application.

MAJOR REASONS FOR FAILURE OF PREEMERGENCE HERBICIDES

- HERBICIDE APPLIED AFTER WEED SEED HAD begun to germinate.
- Herbicide was not watered in within 72 hours of application, and efficacy was reduced by light or microbial decomposition of the active ingredient.
- Failure to re-apply short residual herbicides six to seven weeks following the initial application in transition of southern regions.
- Spring drought which delays weed seed germination, followed by rain in late June, July or August after herbicide residual has dissipated.
- Disruption of the soil surface, especially divots.
- Improper sprayer or spreader calibration, and poor uniformity in herbicide application.



Map indicates periods during which crabgrass seeds germinate in different parts of the country. Map: O.M. Scott & Sons Co.

to dry out between irrigations, crabgrass seed germination is inhibited.

Application of fertilizer during late spring and early summer provides nutrients that may benefit weeds more at this time than the turfgrass. Also, application of high levels of nitrogen during this period may predispose turf to injury from heat and drought stress during summer. Other factors such as disease, insects and stress, which cause or contribute to loss of density, promote crabgrass encroachment.

In spite of hard work and strict adherence to sound cultural practices, crabgrass frequently becomes a serious problem. For this reason, use of preemergence herbicides often becomes a necessity. Spring application of a preemergence herbicide is an effective and easy approach in controlling crabgrass. Postemergence control involves repeated applications of methanearsonates, e.g., DSMA and MSMA, on critical five- to 10-day intervals. These compounds can be phytotoxic, especially when applied during hot weather. A new alternative to the methanearsonates is the herbicide fenoxaprop. Siduron also provides postemergence control, but only when crabgrass plants are seedlings in the one- to three-leaf stage. These herbicides will be more thoroughly discussed below.

PREEMERGENCE CRABGRASS CONTROL. Crabgrass seeds begin germinating when soil temperatures rise above 60 degrees Fahrenheit, and when air temperatures rise above 65 degrees Fahrenheit for five consecutive days. Germination in northern regions generally begins in mid to late May, however, in the transition zone, it can occur as early as mid-March. For a preemergence herbicide to be effective, it must be applied one to two weeks prior to germination.

Most crabgrass seeds germinate during a six- to eight-week period in late spring and early summer, but germination may continue in open or disturbed sites as late as September. Preemergence herbicides kill crabgrass seedlings shortly after germination of the seed. Once substantial populations of seed have germinated and first leaves have emerged, it is too late to apply most preemergence herbicides.

OBTAINING EFFECTIVE CONTROL WITH POSTEMERGENCE HERBICIDES

- ADEQUATE SOIL MOISTURE IS necessary before and after herbicide application.
- The weeds in the turf must be actively growing.
- The first application should be made when weed leaves are above the turf canopy.

- Apply methanearsonates on seven- to 14-day intervals.
- Be sure no rainfall is to occur, and do not irrigate for 24-hours after applying a methanearsonate. Do not irrigate before fenoxaprop dries on the leaf surface.
- Do not mow 48 hours before or after

herbicide application.

- Herbicides will not provide effective control when weeds are under heat or drought stress or in late summer after weeds have matured and have begun to produce seed.
- Properly calibrate the sprayer, and never exceed the recommended rate.

Preemergence herbicides provide effective control for several weeks or months, depending upon dosage and product, by forming a continuous herbicide barrier in the soil. Once the barrier has been disturbed, efficacy of the herbicide is sometimes reduced. Summer aeration after most crabgrass seed has germinated for the season does not appear to reduce the effectiveness of preemergence herbicides.

Occasionally, overseeding becomes necessary before the preemergence herbicide has broken down and its activity lost. In this situation, it is better to seed into grooves using a slicer seeder than to broadcast the seed. The grooving operation will help disrupt the herbicide barrier and place the seed below, and out of contact with the herbicide. Some manufacturers recommend applying powdered activated charcoal seven days prior to overseeding to help deactivate the herbicide.

All preemergence herbicides have been reported by several university researchers to provide good to excellent season-long control of crabgrass, using a single application. In Maryland, however, crabgrass seed germinates three to six weeks earlier than in more northern regions. For this reason, preemergence herbicides must be applied weeks earlier than in many other regions, and higher use rates or a second application are often recommended.

POSTEMERGENCE CRABGRASS CONTROL. Test results

from Maryland have shown that MSMA controls crabgrass at reduced rates when applications begin in July. Two applications of MSMA on a 14-day interval at the recommended rate of two pounds active ingredient per acre (ai/A) effectively controlled crabgrass (99 percent), but caused unacceptable levels of discoloration. Half rates of MSMA (one pound ai/A) applied twice on a 14-day interval provided good crabgrass control (99 percent) without injuring turf appreciably. Half rates of MSMA applied three times on seven-day intervals gave excellent control (99 percent), but turf was badly discolored following the second application.

The one-fourth rate (0.5 pound ai/A) applied three times on seven-day intervals gave excellent control (99 percent), but turf was badly discolored following the second application. The one-fourth rate (0.5 pound ai/A) applied three times on seven-day intervals provides a fairly good level of control (79 percent) without causing an objectionable level of discoloration. Overall, the half rate (one pound ai/A) applied three times on seven-day intervals was just as harmful to turf as the recommended rate applied twice on a 14-day interval.

Experience from other studies has shown that MSMA or DSMA applied twice at one-half rate beginning the first week of July is generally very effective because crabgrass is younger and more susceptible to these herbicides. Performance of MSMA

and DSMA is erratic, and effective control is many times the exception rather than the rule. The key factor in obtaining successful control is to apply these herbicides twice on a 10- to 14-day interval when there is adequate soil moisture to sustain vigorous crabgrass growth. Ignoring control factors, such as ensuring soil moisture and following recommended rates, will likely result in failure to control and/or severe injury to the turf.

In recent years, fenoxaprop has been evaluated extensively and has been an effective post-emergence crabgrass and goosegrass herbicide. An important attribute of fenoxaprop is that complete control of tillered crabgrass can be obtained in a single application as long as weeds are actively growing. The methanearsonates normally control only immature, non-tillering crabgrass in a single application.

In most years in the transition zone and northern regions, most crabgrass seed that is going to germinate in a given year has done so by the first week of July or a few weeks earlier in southern regions. It is conceivable that a well-timed herbicide application after most crabgrass seed has germinated, may eliminate crabgrass as a problem for the remainder of the season. To test this possibility, single applications of MSMA and fenoxaprop were made on three dates in 1984.

When fenoxaprop was applied on June 13, the 0.18 pound

ai/A (i.e. 23 fluid ounces per acre) rate controlled existing crabgrass, but only 62 percent control (determined in September) shows up because more seed germinated after herbicide applications. The low rate of fenoxaprop (0.12 pound ai/A) and both rates of MSMA (one and two pounds ai/A) were ineffective against young crabgrass because sufficient levels of herbicide failed to contact the crabgrass, which was below the turfgrass canopy (and therefore protected) on June 13. When fenoxaprop was applied on July 2 and July 16, excellent crabgrass control was obtained (91 to 100 percent) when plots were rated in September. This showed that no significant levels of crabgrass seed had germinated after July 2, despite frequent periods of rain in July and August of that year.

Other tests have shown that single applications of fenoxaprop will control crabgrass in August if there is adequate soil moisture. MSMA applied only once on July 2 or 16, rather than in multiple applications, did not effectively control crabgrass. Fenoxaprop has reduced effectiveness on heat- and drought-hardened crabgrass, and effective control is dependent on the control factors—*Peter H. Dernoeden* ■

The author is an associate professor in the Department of Agronomy at the University of Maryland, College Park, Md. The preceding study was reported at the 1988 Michigan Turfgrass Conference.

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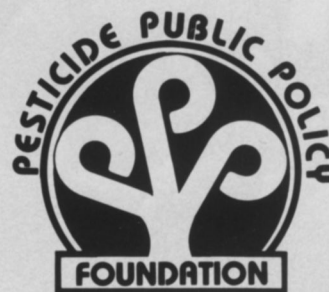
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Expanding Services Through Ornamental Weed Control

LAWN CARE COMPANIES looking for a way to expand their services might want to examine the option of offering ornamental weed control and maintenance as part of their total lawn care program.

Many companies are taking a serious look at ornamental care, not only from a weed control standpoint, but also from a maintenance standpoint, which includes insect and disease control. Some companies also have commercial or residential clients who request this service on a spot treatment basis or in a bid specification.

What makes going into this aspect of lawn care desirable for lawn care operators? John Buechner, director of technical services for Lawn Doctor, Matawan, N.J., said his company is examining ornamental care as

a possible option in the future for several reasons.

"I think it will give the customer the perception that we're a full-service company that they can call on to have both their shrubs and lawn taken care of," he said. "It's something that we've contemplated for a number of years, but weighing the pros and cons, it was never in our best interest to do it. But things change and we're taking another look at it."

James Hardin, president of J.H. Landscape, Cypress, Texas, said he's been taking care of landscape ornamentals for about seven years as part of his company's total maintenance package. He applies a preemergent to ornamental beds in early spring to control white clover and rough meadowgrass (*Poa trivialis*). Occasionally, he'll also app-

ly a tank mixture which provides both pre- and post-emergence weed control.

Tom Hofer, president of Spring-Green Lawn Care Corp., Plainfield, Ill., said his company began controlling ornamental weeds last year. Although the company hasn't approached the concept aggressively, he said, they have put together some programs for their franchisees to offer residential customers.

"It's not a service that we've really pushed corporate wide," he said. "We've dabbled in it a little bit and made it available to our franchisees. The decision to offer this is usually based on the individual franchisee's preference. We're always looking for the kinds of additional services that fit nicely with the services we already offer, and that are profitable."

Hofer said he expects to see some geographic differences in customer receptiveness and that some areas of the country will probably be more "leading edge" in their receptiveness than others. He also said that targeting the service to specific neighborhoods, especially the more affluent ones, will be a factor in the success of this program.

"As residential customers become more aware of this alternative to pulling weeds on their own, they might become more interested in the benefits of the service," he said.

Hofer's advice to lawn care operators who are thinking about adding this service is to enter ornamental weed control cautiously and to avoid being overanxious about the service generating big revenue immediately. He said that most maintenance operators will have to actively market the service to their customers.

MARKETING THE SERVICE. The idea of providing one-stop lawn and ornamental care is not new. In fact, most landscape maintenance companies have included ornamental weed control in their maintenance contracts for some time. For them, taking care of ornamentals simply comes with the territory.

However, for people in the chemical application business, the concept of marketing ornamental weed control and maintenance services is rather new, and is mostly in the exploration stage. As with anything new, a boost in a company's full-service image with the possibility of increased revenue is exciting. However, there are some maintenance operators who prefer to take the "wait and see" approach before spontaneously adding a new service.

Probably the biggest concern maintenance operators may have is that they are dealing primarily with a segment of the population — homeowners — that does not have a weekly gardener or a weekly mowing crew maintain their property. The majority of homeowners mow their own lawns and weed their own ornamental beds. With this in mind, the ability to market ornamental weed control services becomes a key factor.

As Nate Robinson, vice president of Leisure Lawn, West Carrollton, Ohio, said, "Marketing ornamental weed control to this group will require an educational process that focuses on the fact that this is, indeed, a viable alternative to getting on your knees and pulling out the weeds by hand. And I think the idea will go over pretty well with a lot of people who actually get out there and do this on Saturday mornings."

Although Robinson's com-



Maintaining ornamental beds is a logical add-on service.



pany is basically a lawn care application firm dealing specifically with fertilization, weed, insect and disease control in turf, the company is seriously examining the possibility of becoming more involved with ornamental weed control as a way of providing an additional service to customers.

FACTORS TO CONSIDER. The following are some factors to consider if you are thinking about adding ornamental weed control to your service repertoire:

- If your primary function is lawn care, be sure you're established in this area before trying to diversify your options or your services. In other words, if you're not strong in basic lawn care, you are probably not going to be strong in ornamental care.

- Be aware that you must stay on top of your ornamental bed maintenance — you cannot let weeds get out of hand. Keep beds as clean as possible. This may require using a combination of mechanical control such as mulches, landscape fabrics or some hand weeding, as well as chemical control.

- Keep in mind that taking care of ornamental beds can often take more time than mowing or other turf maintenance tasks.

- If your employees have never been responsible for ornamental care, make sure they are properly trained to handle and apply chemicals. Require them to read and understand all label directions and precautions.

BASIC WEED CONTROL STEPS.

The following are three basic

steps in controlling ornamental weeds.

1. Eliminate perennial weeds at the site by hand weeding or using a postemergence herbicide. When using a postemergence herbicide on existing ornamental beds, be sure to keep all herbicide spray and drift off desirable plants. Read the label directions before using any herbicide.

2. Prevent new weed seed germination after you have controlled existing weeds. This can be accomplished using a mechanical method such as applying mulches, or by using a preemergence herbicide.

One drawback, however, is that it often takes a thick layer of mulch to effectively control weeds. This thick layer can decrease the amount of oxygen available to the plant, leading to fungus. In ad-

Caring for ornamental beds can often take more time than mowing or other turf maintenance tasks. Photos: Elanco Products Co.

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dition, some weed seeds can germinate in the mulch.

3. Control any weeds that escape the herbicide application. Do this by hand weeding or spot treating with a postemergence herbicide labeled for grasses and ornamentals present in the bed. Again, follow the label directions.

Preemergence herbicides need water to become activated. After an application, irrigate the area to achieve the most effective control. If you do not expect rain to come soon, rake the herbicide into the soil to minimize loss of activity.

cent chemical control and 70 percent mechanical control. He said he does a considerable amount of weeding to stay on top of the ornamental beds at all times.

Some preemergence herbicide failures could also be due to the following reasons.

- The weeds that have germinated are perennial weeds.
- The weeds were already germinated and emerged when the preemergence herbicide was applied.
- The herbicide was not incorporated or activated in a timely manner.
- The herbicide was applied at



Stay on top of ornamental bed maintenance or weeds can get out of hand.

PERSISTENT WEED PROBLEMS. Despite efforts to chemically control weeds in ornamentals, a few weeds can occasionally pop up even after you've sprayed an area. This may be due to an influx of new seeds carried by wind or birds. Or it could be that you simply missed a spot due to the expanse of the area that you have to cover.

"If you take care of commercial properties, you quickly discover that your clients want the property to look like Disneyland 24 hours a day with no weeds ever," Hardin said. "For example, I take care of some model homes that have to look good all the time. It can be a week before I get results from what I've sprayed, and sometimes I have to explain this to the customer so he understands why he's not getting immediate, same-day results with the herbicide."

Hardin said his ornamental weed control program at such locations involves about 30 per-

cent of the area. (Be sure your sprayer is properly calibrated to apply the correct amount of herbicide.)

ADDING THE SERVICE. Ornamental areas that are natural additions to your weed control program include ornamental beds; areas under fences; areas around trees, signs and poles; and in gravel drives and walkways. Caring for these areas of your customers' lawns can provide additional income to your business without increased capital investments for you.

The intent of this article is not to include everything you'll need to know about starting an ornamental weed control program. Rather, it provides some answers to many of the initial questions lawn care operators have about entering this program. — Sean Casey ■

The author is technical chemicals representative for Elanco Products Co., Indianapolis, Ind.

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Winter Weed Control In Warm-Season Turfgrasses

UNLIKE AN ANNUAL crop, such as most vegetables, turfgrasses are subject to weed infestations during the entire year. As a result, turfgrass managers learn early that a healthy, actively growing dense stand of turfgrass is the first line of defense against weed infestations.

Good weed control comes with education. Warm-season turfgrasses such as bermudagrass, centipedegrass, St. Augustinegrass and zoysiagrass enter a state of suspended growth called dormancy during the winter months. As growth slows with the onset of cool fall temperatures, warm-season turfgrasses become less competitive with weeds.

It's during this slow-growth period—late summer to early fall—that a group of plants called winter annuals exhibit a major period of seed germination. This

peak period of winter annual seed germination coincides with the time that warm-season turfgrass growth is declining. As a result, warm-season turfgrasses are readily infested with a wide variety of winter annual weeds.

After germinating, winter annuals tend to grow slowly during the late fall and early winter months, but initiate rapid growth and development as temperatures warm in the early spring. After the rapid growth period, winter annuals produce seed and die with the onset of high summer temperatures.

Warm-season turfgrasses are dormant during a large portion of the time that winter annuals are present. Aside from the fact that winter annuals are unsightly in dormant turfgrasses, is there a bona fide reason to control winter annual weeds? The answer is definitely yes.

A dense infestation of winter annuals can be extremely damaging to warm-season turfgrasses during spring green-up (transition from winter dormancy to active turfgrass growth). Competition for sunlight, soil moisture, growing space and, perhaps, plant nutrients can be intense during this time period.

Shade produced by winter annual weeds impairs turfgrass photosynthesis at a time that carbohydrate production is needed for rapid spring growth. Additionally, winter annual weeds consume large amounts of the available soil moisture that is needed by warm-season turfgrasses during the spring green-up process.

As dense infestations of winter annual weeds die in the late spring, turfgrass cover may be severely reduced or have large openings that are easily infested

by summer annuals such as crabgrass and goosegrass. Therefore, a failure to control winter annuals usually leads to increased summer weed problems.

Winter weeds may be classified into two categories that are based on their life cycle. Winter annuals complete their life cycle in less than one year and reproduce only by seed. Examples include annual bluegrass, common chickweed, henbit, parsley-piert, lawn burweed and corn speedwell.

Winter perennials live for more than two years and reproduce by seed and underground vegetative structures. Examples include wild garlic and wild onion. Regrowth from underground bulbs is the primary means of reproduction by wild garlic and wild onion in turfgrasses.

PREEMERGENCE WEED CONTROL. In warm-season turf-

Common Name	Trade Name (s)	Formulations ¹	Company
Atrazine	Aatrex Purge II	80W, 90DG, 4L 2L	Ciba-Geigy Security
Benefin	Balan 2.5 Benefin Granular	2.5G, 60DF 2.5G	Elanco LESCO
Benefin + Oryzalin	XL	2G	Elanco
Benefin + Trifluralin	Team	2G	Elanco
Bensulide	Betasan Lescosan Weedgrass Preventer Royan Bensumec 4LF	2.9E, 4E, 3.6G, 7G, 12.5G 4E, 7G, 12.5G 8.5G 4E, 12.5G 4E	ICI LESCO Scotts Royalgard PBI/Gordon
DCPA	Dacthal Dacthal	75W 5G	SDS Biotech LESCO
Napropamide	Devrinol	50W, 2G	ICI
Oryzalin	Surflan	4AS	Elanco
Oxadiazon	Ronstar	50W, 2G	Rhone-Poulenc
Pendimethalin	Southern Weedgrass Control Turf Weedgrass Control Weedgrass Control PRE-M Pendimethalin	 2.45G 1.71G 60DG 60DG 60DG	Scotts Scotts Scotts LESCO Clean Crop
Pronamide	Kerb	50W	Rohm-Haas
Simazine	princep	80W, 90DG, 4L, 4G	Ciba-Geigy

Table 1. Directory of preemergence herbicides that may be used for winter annual weed control in labeled warm-season turfgrasses. ¹W = Wettable powder; DG = Water dispersible granule; L = Liquid; E = Emulsifiable concentrate; G = Granule.



Winter perennials such as wild garlic (above) live for more than two years. Winter annuals like annual bluegrass (left) live less than one year.

grasses that are not fall-over-seeded, numerous herbicides can be used to control winter annuals (Tables 1, 2).

Depending upon the geographical location, late summer to early fall applications of preemergence herbicides will control certain winter annual weeds. Common chickweed, henbit and annual bluegrass are easily controlled with atrazine, benefin, benefin plus oryzalin, oryzalin, pendimethalin and simazine.

Additionally, common chickweed can be controlled with DCPA, napropamide and pronamide. Preemergence herbicides that have effectively controlled parsley-piert are atrazine, bensulfide, oxadiazon and simazine. Atrazine, napropamide and simazine are effective for lawn burweed control. Good to excellent corn speedwell control has been obtained with atrazine, benefin, DCPA, napropamide, pendimethalin, oxadiazon, pronamide and simazine.

Of the preemergence herbicides, atrazine and simazine provide the broadest control spectrum of winter annual weeds. Additionally, atrazine and simazine have good postemergence activity on winter annual weeds. Pre-



emergence and postemergence activity enable these herbicides to be applied over a wide time period.

Research conducted in Georgia has shown that atrazine or simazine applied from October through February will control winter annual weeds in bermudagrass. Current label restrictions for atrazine allow applications at 1.0 pound a.i./acre to hybrid bermudagrass from Oct. 1 to April 15. Simazine is labeled for applications from Sept. 1 to June 1 on hybrid bermudagrass at 1.0 pound a.i./acre.

In our work, 1.0 pound a.i./acre

of atrazine or simazine applied in the fall has occasionally failed to control winter annual weeds. However, when the fall application was followed with an additional 1.0 pound a.i./acre application in February, winter annual weeds were effectively controlled. Atrazine and simazine may be used as a split application at 1.0 pound a.i./acre or as a single 2.0 pound a.i./acre application in centipedegrass, St. Augustinegrass or zoysiagrass for winter annual weed control.

Another preemergence herbicide that has postemergence activity on certain winter annuals

is pronamide. Postemergence applications of pronamide will control annual bluegrass, common chickweed and corn speedwell. Pronamide is labeled only for bermudagrass.

POSTEMERGENCE WEED CONTROL. Postemergence herbicides that contain 2,4-D, dicamba, MCPP, MCPA or dichlorprop, or combination products that contain two or more of these herbicides can also be used for winter annual broadleaf weed control.

Similar to preemergence herbicides, postemergence herbicides vary in their effectiveness for winter annual control. For example, at recommended rates, a single application of dicamba will provide excellent control of common chickweed. In contrast, two applications of 2,4-D plus MCPP plus dicamba at recommended rates are required to achieve a level of control similar to dicamba.

The best results with phenoxy- or dicamba-containing herbicides are when applications are made to small, actively growing weeds at temperatures above 60 degrees

Common Name	Trade Name(s)	Formulations ¹	Company
2,4-D	Numerous	Numerous	Numerous
MCPP	Turf Herbicide MCPP Mecomec 4 LESCOpx	2.0 lbs./gal. 4.0 lbs./gal. 2.5 lbs./gal.	Rhone-Poulenc PBI/Gordon LESCO
dicamba	Banvel Dicamba 4	4.0 lbs./gal. 4.0 lbs./gal.	Sandoz PBI/Gordon
2,4-D + 2,4-DP	Weedone DPC Amine Weedone DPC	1.85 + 1.85 lbs./gal. 1.85 + 1.85 lbs./gal.	Rhone-Poulec
2,4-D + dicamba	Eight-One Phenaban 801	3.1 + 0.4 lbs./gal. 3.0 + 0.4 lbs./gal.	LESCO PBI/Gordon
2,4-D + MCPP	LESCOpar Turf Kleen Phenomec 2+ 1	1.0 + 2.0 lbs./gal. 1.0 + 1.0 lbs./gal. 1.0 + 2.0 lbs./gal.	LESCO Rhone-Poulenc PBI/Gordon
2,4-D + MCPP + dicamba	Trimec Classic Three-Way	2.0 + 1.1 + 0.2 lbs./gal. 2.4 + 1.3 + 0.2 lbs./gal.	PBI/Gordon LESCO
2,4-D + MCPP + dichlorprop	Weedestroy Triamine	1.3 + 1.3 + 1.3 lbs./gal.	Riverdale
2,4-D + dichlorprop + dicamba	Super Trimec	2.0 + 2.0 + 0.5 lbs./gal.	PBI/Gordon
imazaquin	Image	1.5 lbs./gal.	LESCO American Cyanamid
MCPA + MCPP + dichlorprop	Weedestroy Triamine II Sabre	1.3 + 1.3 + 1.3 lbs./gal. 1.3 + 1.3 + 1.3 lbs./gal.	Riverdale Royalgard
MCPP + 2,4-D + dicamba	Southern Trimec	2.8 + 1.5 + 0.3 lbs./gal.	PBI/Gordon
metribuzin	Sencor 75 Turf	75 WP	Mobay

Table 2. Directory of postemergence herbicides that may be used for winter annual weed control in labeled warm-season turfgrasses. ¹WP = Wettable powder.

Fahrenheit. Metribuzin, which is chemically related to atrazine and simazine, will control most winter annual broadleaf weeds and annual bluegrass in bermudagrass. When wild garlic/onion is present, herbicides that contain 2,4-D or dicamba will need to be included in the winter weed control program.

Alternatively, imazaquin may be used to control wild garlic/onion in warm-season turfgrasses (except bahiagrass). In addition to wild garlic/onion control, imazaquin has shown good to excellent control of annual bluegrass, common chickweed and parsley-piert in experiments conducted by the authors in Georgia.

TURFGRASS TOLERANCE. The ideal time to control winter annuals with postemergence herbicides is when the warm-season turfgrass is completely dormant. Applications prior to spring green-up will minimize the possibility of temporary turf injury.

Postemergence herbicides such as 2,4-D plus MCPP plus dicamba have been shown to slightly decrease the quality of "Tifway" bermudagrass when applications were made three to four weeks prior to or during the period of active green-up. Although a decrease in quality occurred, the decrease in quality was temporary. In addition, better turf growth occurred in treated than in non-treated turf due to the elimination

of winter annual broadleaf weeds.

Another reason to control winter annuals while warm-season turfgrasses are dormant is that the weeds will be small and better control will be achieved. At the advanced weed growth stages that usually occur in the latter stages of green-up, the effectiveness of most postemergence herbicides decreases.

Similar to phenoxy- and dicamba-containing herbicides, imazaquin can cause slight to moderate delays in green-up if applications are made during the spring transition. As previously discussed, all postemergence herbicide applications should be avoided during the spring transition of warm-season turfgrasses.

The warm-season turfgrass species vary in their tolerance to preemergence and postemergence herbicides. Reduced, or often, only one-half rates of most phenoxy- or dicamba-containing herbicides are approved for use on dormant centipedegrass and St. Augustinegrass. The individual product label should be consulted to determine the rate and any application precautions prior to using any herbicide on a warm-season turfgrass.

FALL OVERSEEDED TURFGRASSES. Weed control in warm-season turfgrasses which are fall overseeded with a cool-season species, such as perennial ryegrass,

differs from non-overseeded situations in that the turfgrass manager must consider the tolerance of the cool-season as well as the warm-season turfgrass to herbicides.

With most preemergence herbicides, three to four months must elapse between the last application and any reseeding efforts. Therefore, preemergence herbicides should not be applied in the fall to areas that are scheduled to be overseeded.

Two herbicides are available that will control annual bluegrass in bermudagrass that is fall-overseeded with perennial ryegrass. Ethofumesate (Prograss) may be used on dormant bermudagrass 15 to 30 days after overseeding for preemergence and early post-emergence control of annual bluegrass. Delays in spring green-up can occur if bermudagrass is not completely dormant at the time of the ethofumesate application.

Fenarimol (Rubigan), a commonly used turfgrass fungicide, has preemergence activity on annual bluegrass. Two to three applications, with the last application two weeks prior to overseeding, will control annual bluegrass in bermudagrass that is overseeded with perennial ryegrass.

Broadleaf weeds such as common chickweed and henbit may be controlled with 2,4-D, dicamba, MCPP, MCPA and dichlor-

prop or mixtures that contain two or more of these herbicides. Applications should be delayed until the perennial ryegrass has been mowed three to four times. Delaying the application significantly improves the tolerance of perennial ryegrass to postemergence herbicides.

SUMMARY. Winter annual and perennial weeds can be effectively controlled in warm-season turfgrasses.

As the competitive ability of warm-season turfgrasses with weeds decreases during the dormancy period, herbicides will be needed to control winter weeds. The use of a preemergence herbicide in non-overseeded areas combined with supplemental applications of postemergence herbicides will enable the professional turfgrass manager to limit the appearance and harmful effects of winter weeds on warm-season turfgrasses. — Tim Murphy and B.J. Johnson ■

The authors are an extension agronomist/weed science and professor, respectively, at the Extension Agronomy and Agronomy Departments, The University of Georgia, The Georgia Station, Griffin, Georgia. Trade names are used only for information. Mention of a trade name does not imply approval of any product to the exclusion of others which may also be suitable.



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Reducing Nitrogen Loss, Increasing Efficiency in Soil

NITROGEN (N) IS ONE OF THE MOST IMPORTANT elements required for plant growth. It's part of many of the organic substances in the plant including chlorophyll, amino acids, proteins and vitamins. Even substances that do not have N in their structures require N somewhere in the reactions by which they are formed.

Nitrogen is one of the most abundant of the essential nutrient elements. It composes 78 percent by volume of the air we breathe and can be found in a variety of other forms in the environment:

Atmospheric	Nitrogen N_2
Nitrate	NO_3^-
Ammonium	NH_4^+
Ammonia	NH_3
Nitrite	NO_2^-
Oxides of Nitrogen	N_2O
Organic Nitrogen	C-N

Atmospheric N is not directly available for plant use, although it can be converted to these forms through naturally occurring processes such as lightning or through fixation by bacteria in the soil. Most of the N that is used for turfgrass fertilization, however, is produced synthetically by combining natural gas (methane), steam and air under controlled conditions to form ammonia (NH_3).

This NH_3 , derived from the atmosphere, is then used to produce the wide variety of fertilizer products available on the market. Nearly all of the fertilizers used on lawns, with the exception of the natural organic materials, are derived from this synthetic N.

The total pool of N on the earth is in continuous transition through a variety of processes known collectively as the "nitrogen cycle." Nitrogen from the atmosphere is fixed in forms that can be used by living organisms, while at the same time, plant available forms are converted back into atmospheric N or are lost through leaching below the root systems of plants.

Even synthetic N fertilizers do not remain in that form indefinitely, but are in a continuous state of transformation that may lead to reduction in their effectiveness as fertilizer materials. An understanding

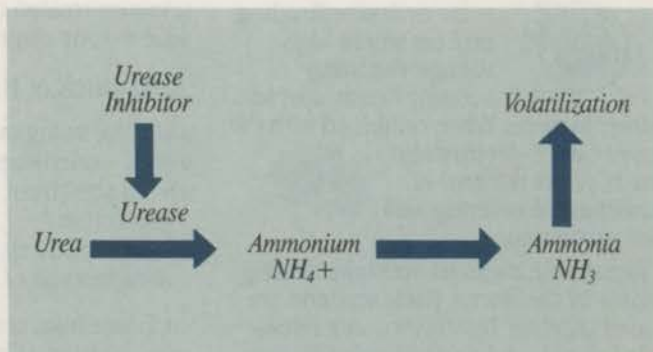
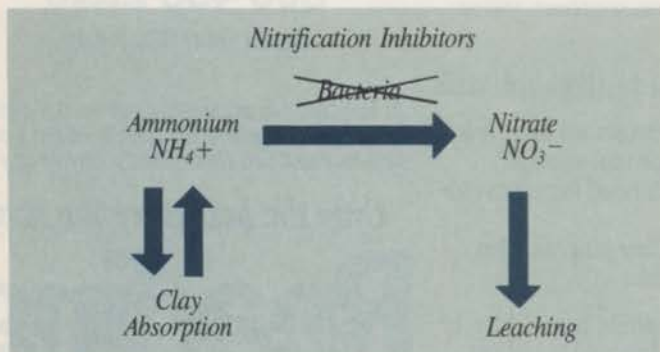


Figure 2. Nitrification inhibitors block the conversion of ammonium to nitrate (left). Figure 3. Urease inhibitors slow the conversion of ammonium to ammonia and can reduce the volatile loss of nitrogen (right).

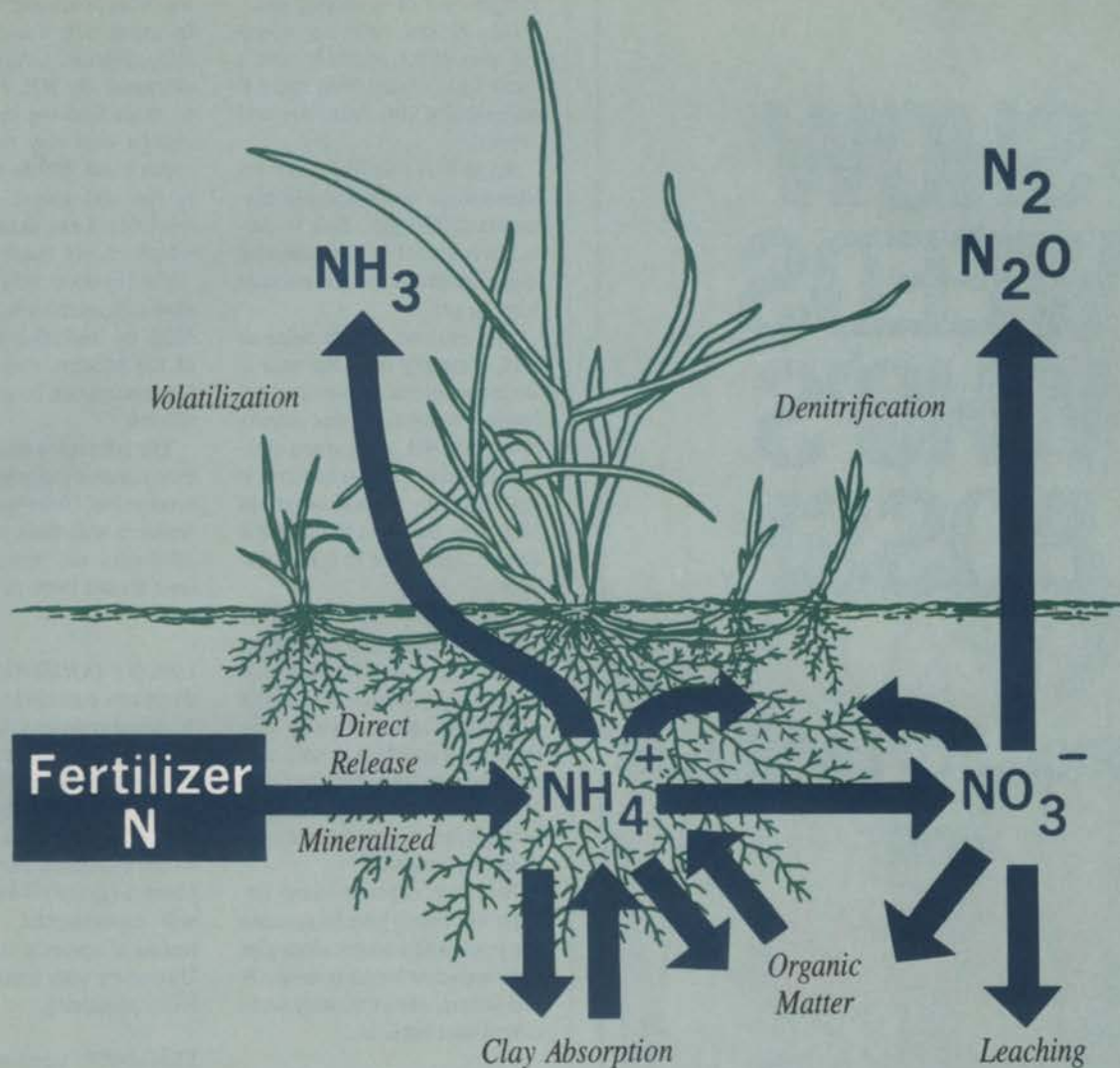


Figure 1. Understanding these transformations can also help lawn maintenance specialists design techniques to improve N use efficiency.

of these transformations has led scientists to the development of techniques to reduce N loss. Understanding these transformations can also help lawn care specialists to design techniques to improve N use efficiency.

NITROGEN FERTILIZERS. Transformations of N fertilizer begin almost immediately after they are applied to a turf area (Figure 1). If the fertilizer material is inorganic, such as ammonium nitrate, it is released directly into the soil solution in the ammonium (NH_4^+) and or nitrate (NO_3^-) forms. If the fertilizer materials are of a controlled release, organic form, they are released as NH_4^+ by soil microbes through a process called mineralization.

Nearly all N used by grass plants is taken up by the root system in either the NH_4^+ or NO_3^- form. These two materials are equally suitable for root uptake, however, NH_4^+ is rapidly transformed through the process of nitrification to the nitrite (NO_2^-) and then into the NO_3^- form.

The NH_4^+ and NO_3^- have important chemical differences that affect their availability. The NH_4^+ is a cation (positively charged ion) that can exchange with the negatively charged cation exchange sites on soil clays and organic matter, whereas the NO_3^- is an anion (negatively charged ion) that is repulsed by the negative charges in the soil and readily leaches from the root zone.

Both NH_4^+ and NO_3^- can be removed from the soil solution

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by soil organisms and converted into organic N form through the process of immobilization.

This N can later be released into plant available forms again by mineralization, but it is temporarily lost from the soil solution.

Some N is volatilized into the atmosphere in the form of ammonia (NH₃) gas. This is particularly a problem where the urea is applied to coarse-textured soils high in pH.

The enzyme urease releases NH₄⁺ rapidly from the urea in these conditions, ammonium carbonate is formed, that breaks down into NH₃ and carbon dioxide. Estimates of how much N is lost through volatilization of NH₃ vary, but it is evident that it can be significant in some situations.

Finally, NO₂⁻ and NO₃⁻ can be converted back into atmospheric N (N₂) or oxide forms of N such as N₂O through the process of denitrification. This is particularly a problem in soils that are low in oxygen, such as poorly drained, waterlogged soils or in turfgrass areas that are excessively irrigated.

Fertilizer chemists have understood these transformations for years and various strategies have been developed to reduce N loss through the previously mentioned mechanisms.

SLOW-RELEASE N. Among the most effective of these strategies for turfgrass areas has been the development of slow-release forms of urea.

Nitrogen release rates can be slowed by reacting urea with other organic materials, similar to how it's done in the formation of methylene ureas and IBDU or by coating urea with slowly soluble substances, much the same as is done in the production of sulfur-coated urea and plastic-coated urea.

The net result of both methods is that N is released slowly into the NH₄⁺ form as the plant can use it. Nitrogen is used in the NH₄⁺ and NO₃⁻ forms by the plant, but the bulk of the applied N is held in the organic form to slow loss through leaching, volatilization and denitrification.

NITRIFICATION INHIBITORS. A second strategy to reduce the

loss of N from applied fertilizer is based on an understanding of the process of nitrification by which NH₄⁺ is converted to NO₃⁻ (Figure 2). As was already discussed, the NH₄⁺ is prevented from leaching by cation exchange with clay surfaces and organic substances and is held in the soil longer in a plant available form than the NO₃⁻ which readily leaches.

Nitrification inhibitors that slow the conversion of NH₄⁺ to NO₃⁻ by inhibiting the activity of the bacteria responsible for the process can be added to fertilizers.

The concept is sound and it is used commercially in grain-crop production. Unfortunately, most research with these nitrification inhibitors on turfgrass areas have shown them to be ineffective.

UREASE INHIBITORS. A relatively new concept in controlling N transformations is the use of urease inhibitors that slow the activity of soil urease and keep urea from rapidly converting to NH₄⁺ and then to NH₃ gas, which volatilizes into the atmosphere (Figure 3). This process is still experimental, but initial results of research at Iowa State University with these materials looks promising.

SUMMARY. Understanding N transformations can help turfgrass managers develop strategies to reduce N loss and to increase N use efficiency. The application of proper rates of fertilizers and the watering in of these materials is an important step.

The proper use of slow-release N sources can also help. Be careful not to overwater. Too much irrigation can increase leaching of NO₃⁻ in coarse-textured soils and increase denitrification in heavier, saturated soils.

The proper use of N fertilizers is one of the more difficult aspects of lawn maintenance, and only through a clear knowledge of the transformations that N undergoes can an effective strategy for N fertilization be developed. — Nick Christians ■

The author is a professor of horticulture at Iowa State University.



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Preparing a Balanced Diet For Turf and Ornamentals

Interest in the plant nutrient iron has grown dramatically in the last few years. More and more turf management specialists are realizing that this element, long overlooked, can be a vital part of growing as well as providing the dark green quality turf that consumers demand.

In order to understand how to use iron, one must first realize that it is *one* of the essential elements for turf and ornamental growth. We have long recognized the three primary elements: nitrogen, phosphorus and potas-



A quality Northeast lawn using a Kentucky bluegrass, perennial ryegrass mix.

sium, as essential. And while every book ever written about turf management goes into great length about frequency, rates and methods of applications of these elements, we are still several years away from understanding the full use of the secondary and micronutrient elements in the role of total plant nutrition.

As a turf manager, have you ever thought about *why* you apply nitrogen to turf? Is it because:

- Everyone else is doing it?
- It is a part of a total plant nutrient diet?
- It makes turf a dark green color?
- It is one of the cheapest materials available?

To carry our questioning one step further, what do our customers want from us as turf management specialists? Do they want:

- A balanced plant food diet applied to their lawns?
- Freedom from applying fertilizers and chemicals to their lawns?
- Dark green, weed-free turf?
- Status of having someone else take care of their lawn?

All of these reasons are true to one degree or another, but two things stand out:

- The customer *demand*s a dark green turf.
- We have always utilized nitrogen to provide that color.

While one of the basic reasons for lawn care is to provide a dark green weed-free turf, the means to achieve this goal are changing.

Discriminating turf managers are beginning to realize that a balanced plant nutrition approach can deliver the quality dark green turf that the consumer desires with fewer nitrogen applications. Iron has been one of the least understood elements in this balanced plant nutrition approach, and some fallacies need to be explained.

1. All, or most all, soils contain more than enough iron for healthy plant growth. This is true, almost all soils contain amounts of iron far in excess of normal plant growth requirements, but it is in a form that is unavailable for plant use. Soil tests will seldom, if ever, show an iron deficiency, but plants grown on these soils will show a very strong response to iron applications. Deficient? No. Unavailable? Yes.

2. If the soil has an acid pH then the natural iron will be available. Again, this has some truth, but for every unit increase in soil pH above 4.0, there is a

1,000-fold decrease in iron solubility. The turf grown on acid soils may never exhibit the classical iron chlorosis, but almost always will respond to an application of iron.

3. Most turf will not respond to an application of iron. False. While the rates required to show a turf color response vary, in almost every case that no response occurred, it was demonstrated that either the turf was unable to respond due to lack of moisture, or that the iron rates were too low.

Most plants have an iron response threshold and if this rate is not met or exceeded, then indeed there is *no* response. Applications of the needed rate, or in excess of it, will produce an almost immediate color enhancement.

4. The only time iron should be applied is early in the year. False. Optimum iron responses occur when temperatures are either too low or too high for optimum soil microorganism growth. These microbes help to solubilize available iron, and if their growth is retarded by low or high temperatures, then iron availability also decreases.

Research in Virginia showed that early winter is one of the best times for iron applications because it improves color through the winter and into the spring. Iron may be applied when temperatures are too warm for application of conventional nitrogen sources, and will generally give significant color responses.

Can iron be substituted for nitrogen to enhance color? And if so, to what degree? While there has not been a lot of research into these questions, an article "Foliar Application of Nitrogen and Iron to Kentucky Bluegrass" by A.K. Yust, D.J. Wehner and T.W. Fermanian of the University of Il-

COLOR RATINGS OF KENTUCKY BLUEGRASS

DATE (Days after application)

Treatment †	1980					1981				
	3 Oct (1)	8 Oct (6)	15 Oct (13)	22 Oct (20)	1 Nov (30)	7 Nov (36)	14 Nov (43)	6 Dec (65)	4 Apr (184)	13 Apr (193)
Check	5.7	6.0	6.0	6.0	6.0	6.3	5.0	5.0	4.3	6.7
1 FeS	7.3	6.7	6.3	6.3	6.0	6.0	5.0	5.0	4.3	6.7
2 FeS	7.7	7.0	6.0	6.3	6.3	5.7	5.3	5.0	4.0	6.3
4 FeS	7.3	7.7	8.0	7.0	7.0	7.7	7.0	7.0	6.0	8.3
1 FeC	7.3	8.0	6.0	6.3	6.0	6.0	5.7	5.3	4.3	7.0
2FeC	7.7	7.7	7.3	7.3	7.3	7.3	7.0	6.7	5.0	7.0
4FeC	8.3	8.7	8.3	8.0	8.0	7.7	7.0	7.0	6.0	8.0
25 N	6.0	6.3	6.3	7.0	7.0	7.0	6.3	6.0	5.0	7.3
25 N/1 FeS	7.7	7.3	7.0	7.3	7.3	7.3	6.3	6.3	5.7	7.7
25 N/2 FeS	7.7	7.7	7.3	7.7	7.7	7.7	7.3	6.7	6.0	7.7
25 N/4 FeS	8.0	8.0	8.0	8.0	8.0	8.0	7.0	6.7	5.7	8.0
25 N/1 FeC	7.7	8.3	8.0	7.7	7.7	7.3	6.7	7.0	5.7	7.7
25 N/2 FeC	7.7	8.3	8.0	8.0	8.0	8.3	7.7	6.7	6.3	8.0
25 N/4 FeC	8.3	8.7	9.0	9.0	8.3	8.7	8.3	8.0	6.7	8.0
49N	6.3	7.3	7.3	7.7	7.7	7.7	7.7	7.3	5.7	8.0
49 N/1 FeS	7.0	7.7	7.3	7.3	7.7	8.0	7.0	7.7	6.0	8.0
49 N/2 FeS	7.3	7.7	7.3	7.0	7.3	7.7	7.0	7.3	5.7	7.7
49 N/4 FeS	7.7	8.0	7.0	7.3	7.7	8.0	8.3	8.0	6.0	8.0
49 N/1 FeC	8.3	8.3	8.0	8.0	7.7	8.0	8.3	8.0	6.0	8.0
49 N/2 FeC	8.3	9.0	8.7	8.3	8.7	8.3	8.3	8.0	6.3	7.7
49 N/4 FeC	8.7	9.0	8.7	8.7	8.7	8.7	8.7	8.0	7.0	8.3
CV (%)	7.2	6.7	8.5	7.2	7.4	7.0	8.0	8.2	9.4	6.9
NL †	NS	**	**	**	**	**	**	**	**	**
NQ†	NS	NS	*	**	**	**	NS	NS	**	NS
No Fe vs. Fe treatments	**	**	**	**	**	**	**	**	**	NS
Chelate vs. Sulfate	**	**	**	**	**	**	**	**	**	NS
FeSL	NS	**	**	NS	*	**	**	**	*	**
FeSQ	NS	NS	NS	NS	NS	NS	NS	NS	NS	*
FeCL	**	**	**	**	**	**	**	**	*	**
FeCQ	NS	NS	NS	NS	*	*	NS	NS	NS	NS

*** Significant at 0.05 and 0.01 levels, respectively. †Treatment code FeS = iron sulfate; FeC = iron chelate; 1, 2, 4 = 1.1,2.2,4.5 kg Fe ha. 25, 49 = 25, 49 kg N ha. †L = linear component, Q = quadratic component, CV = coefficient of variations. Reprinted from Agronomy Journal Vol 76 Nov-Dec 1984. Yust et al: Foliar app. of N & Fe to Bluegrass.

Color rating of Kentucky bluegrass treated with Fe and N fertilizer combination on Oct. 2, 1988. Color rating is the mean of three replications rated on a 1 to 9 scale with 9 = to dark green and 1 = to light yellow.

linois, Urbana-Champaign, provided some excellent data for cool season grasses. On a soil with a pH of 5.9, they demonstrated that substantial increases in color were achieved with applications of iron, both as single additives and as combined with nitrogen (urea). The combination of iron with the nitrogen gave a color and length of response basically equal to almost twice the nitrogen levels when the nitrogen was applied alone.

It was demonstrated that iron can elevate color while lowering nitrogen levels. However, care should be taken in substituting iron for nitrogen because if conditions exist for sustained rapid turf growth, the plants may exhaust the quantities of available iron as a result, the color may fade permanently.

On warm season turf, even

less data has been published than for cool season turf. A recent article on "Centipede Response to Foliar Application of Iron and Nitrogen," by R.N. Carrow, B.J. Johnson and G.W. Landry Jr., of the University of Georgia was published in the Agronomy Journal, Vol. 89, pgs. 746-750(1988). The observations in this article parallel those found by Yust, Wehner and Fermanian on cool season grasses, although the centipede did show much more inclination to phytotoxicity than did the bluegrass.

It is interesting to note that the phytotoxicity found on the centipede was the exception rather than the rule. Rates far in excess of that used on the centipede have been demonstrated on other turf and ground covers with little or no toxicities.

More research is planned on both warm season as well as cool season turf, and it is hoped that substantial data will soon be available concerning iron substitution for nitrogen while maintaining acceptable color levels. Research will be broadened to include other iron sources and color duration with these sources.

As more information becomes available, it is hoped that iron will provide an increased role in balanced plant nutrition, and will assist in maintaining the turf color and quality that the turf management profession demands. — Neal Howell

The author is product manager of specialty fertilizers for LESCO Inc., Rocky River, Ohio. He was formerly plant nutrition product manager in charge of iron products for PBI Gordon.

Mediocre Growing Conditions Accentuate Need for Fertilization

THE NEED FOR SUPPLEMENTAL care of landscape trees and shrubs becomes evident when we consider the growing conditions these plants are faced with.

Subsoil is the all too common growing medium and even that is usually compacted. Other problems include poor drainage, restricted root zone area, air pollution, deicing salts, competition from turfgrass for water and nutrients and poor soil fertility. Fertilization is not a panacea, but is one of the most important tools available for maintaining healthy landscape plants.

Forest trees are perceived to thrive without the addition of fertilizer (not necessarily true), which can give the erroneous impression that trees do not require fertilizer. Forest soils are rich in humus which is replenished by the decay of plant residues.

Leaves are relatively high in accumulated nutrients, and their decomposition is an important source of returning nutrients to

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Most arborists fertilize all trees and shrubs with a complete fertilizer.

the soil. Organic matter increases the retention and availability of most plant nutrients and improves the soil structure by "cementing" or aggregating soil particles.

In contrast, urban soils are usually very low in humus and fertility. Leaves and other debris are removed, thus interrupting nature's recycling program for nutrients and preventing the accumulation of organic matter. The

soil elements which were absorbed and used in the formation of plant tissues are not returned to the soil and should be replaced with supplemental fertilization.

Benefits of fertilization include:

- better resistance to insect and disease pests,
- improved plant appearance,
- increased growth, and
- improved tolerance of stressful growing conditions such as drought.

Most arborists fertilize all trees and shrubs with a complete fertilizer containing nitrogen, phosphorus and potassium. Since arborists are concerned with the health of trees and shrubs growing in a wide variety of soil conditions, the most practical approach is to provide an effective fertilizer formulation that satisfies the needs of most plants rather than tailoring a fertilizer program for each individual plant.

Specific soil or plant deficiencies, such as extremely acidic or alkaline soil or the unavailability of micronutrients, can be addressed on an individual basis.

RATE AND FORMULATION. Research has shown that a fertilizer ratio of 3:1:1, such as a 30-10-10 analysis, produces the best growth response for trees and shrubs.

This ratio indicates the relative importance of nitrogen over phosphorus and potassium for stimulating plant growth. What the ratio doesn't tell you is the rate or type of nitrogen that should be used for tree and shrub fertilization. Don't assume that every fertilizer with a 3:1:1 ratio is the same.

Nitrogen should be applied at the rate of three pounds per 1,000 square feet of root area per year or six pounds every other year. For stressed, declining or generally unhealthy trees and shrubs, use

a rate of five to six pounds per 1,000 square feet per year until plant growth and appearance improve.

Consider using half of these amounts for fertilizer-sensitive plants and broadleaf evergreens if using a quick-release fertilizer or, instead, use a slow-release, low-burn fertilizer at full rate.

The amount of fertilizer to be applied per 1,000 square feet of root area can be calculated by dividing the nitrogen analysis into the desired nitrogen per 1,000 square feet. For example, to determine the amount of 30-10-10 fertilizer required to apply six pounds of nitrogen per 1,000 feet, divide six by 0.30, which equals 20 pounds.

There aren't many fertilizers available that can safely apply the previously indicated rates without causing the plant injury. A fertilizer's salt index and water-insoluble nitrogen (WIN) content are the best indicators of fertilizer quality and safety. The salt index is an indicator of the burn potential of a fertilizer. The lower the salt index, the lower the burn potential.

The percentage of WIN determines nitrogen residual in the soil. The higher the percent WIN, the longer the nitrogen remains in the soil. Ureaformaldehyde nitrogen sources offer the desired combination of low-burn and slow-release properties.

APPLICATION TIMING. Although the roots of woody plants may elongate throughout the growing season, active root growth most often occurs in early spring and late fall when soil temperatures are relatively cool and there is little competition from leaves for water and nutrients.

Fertilization is most effective when supplemental nutrients are

available during these periods of optimum root growth. Soluble nitrogen fertilizers, because of their short residual in soils, should be applied between October and December and/or between February and April.

Slow-release nitrogen ensures availability in the root zone for a relatively long period, depending upon the solubility of the nitrogen source. The application timing of these fertilizers may not be a major concern.

APPLICATION TECHNIQUES.

Fertilizer for trees and shrubs basically involves either a surface or a subsurface application.

Surface application. Nitrogen fertilizers can be applied to the soil surface because nitrates are highly mobile in soil solution and will move downward in the root zone. This method of fertilization is still frequently recommended despite the fact that it's based upon university research under nursery conditions.

This technique is not recommended for those practicing commercial fertilization under landscape conditions. Turfgrass within the application zone may be injured or respond with undesirable succulent growth.

Also, surface applications of phosphorus provide no benefit to the tree or shrub because phosphorus is bound tightly to soil particles and doesn't move downward to contact the absorbing roots. If you decide to use this method, apply no more than three pounds of nitrogen per 1,000 square feet from a slow-release source.

Drill hole. Fertilizer can be placed in the root zone by drilling holes in the ground and dividing the recommended amount of fertilizer equally among the holes. For trees, the holes should be drilled in a grid pattern 12

inches deep and 18 to 24 inches apart using a two-inch diameter drill bit or auger. Begin two to three feet from the trunk and extend two to three feet beyond the drip line.

To prevent turfgrass injury the fertilizer level should be at least four inches below the soil surface. The holes can be left open or filled with sand, pea gravel or perlite. In quality lawns, a plug of grass can be removed before drilling and replaced after adding fertilizer.

Soil Injection. Liquid soil injection is a fast, economical alternative to the drill hole technique for applying nutrients within the root zone.

The injection equipment consists of a hydraulic sprayer operated at 150 to 200 psi and an injector probe that inserts about 12 inches into the soil. The injections are normally in a grid pattern about three feet apart within and slightly beyond the drip zone. The nutrients are distributed throughout the root zone, providing maximum root contact while aerating the soil.

Oxygen is necessary for root growth and is often limited in compacted urban soils. Soil injection helps alleviate compaction and improves oxygen penetration into the root zone.

Soil injection provides more thorough nutrient distribution than the vertical hole technique and generally can be done in about one-fourth the time. Either a soluble or suspension fertilizer, or a combination of the two, is necessary for this method. Unfortunately, many soluble fertilizers have a relatively high burn potential and soluble nitrogen may be leached from the root zone before it is used.

Soluble methylol and methylene ureas have a lower burn po-



Liquid soil injection is a fast, economical alternative to the drill hole technique. Photo: The Davey Tree Expert Co.

tential than urea or other soluble nitrogen sources, but will last for only about six to nine weeks in the soil.

Because of limitations of liquid soluble fertilizers, suspension fertilizers are the best choice for soil injection use. Suspended in water, powdered ureaformaldehyde can be injected into the soil and dispersed laterally by hydraulic pressure. At least 60 percent of the total nitrogen in these sources is water-insoluble nitrogen and becomes available over a one- to two-year period.

Since the nitrogen salts are released gradually as the compounds degrade, suspension-type ureaformaldehydes have a significantly lower burn potential than soluble nitrogen sources and can safely supply the recommended annual rate of three to six pounds of nitrogen per 1,000 square feet in a single application.

Other methods of nitrogen, phosphorus and potassium fertilization such as spikes driven into the ground, trunk injections or foliar sprays are of minimal value because inadequate amounts of

nutrients are supplied.

The type of fertilizer and application technique that you choose should reflect the quality of service that your customers pay for and expect. Soil injection of a complete fertilizer with a high WIN content and low salt index is clearly the best choice for maintaining vigorous and beautiful trees and shrubs in today's landscapes. — David Whitworth ■

The author is a horticulturist with The Davey Tree Expert Co., Kent, Ohio.

Regular Soil Analysis Eliminates Contaminants

QUITE OFTEN, LAWN and landscape maintenance is geared toward the needs of management and its customers more so than the ultimate recipient — the plant. By analyzing the soil environment, plant care professionals can better bridge the gap between available resources and actual plant needs.

The primary goal of soil testing is to assure that soil factors don't become limiting growth factors. However, as concerns swell over groundwater contamination, soil analysis has become a standard operating procedure for minimizing fertilizer consumption while maximizing plant benefits.

GENERAL CONSIDERATIONS.

As with any grounds maintenance operation, soil testing represents an expense in both time and money. Therefore it's desirable to maximize the benefits of this technology through efficient use. The soil test user must first identify the objectives of a testing program then select the appropriate sampling methods, test parameters and testing frequency.

With the advent of simplified test kits, in-house soil testing provides the plant care professional

with an alternative to private or university operated labs. Both options have certain advantages and disadvantages, depending on the nature of testing requirements.

Independent labs may offer certain tests not readily adaptable to kits, i.e., organic compounds and actual sodium, and have already established high confidence levels for test accuracy. These labs are also the most advisable option when only periodic soil assessment is required. However, using a private lab may not be economical when a large volume of tests are involved or when quick turnaround is necessary.

Aside from the initial investment for equipment, in-house testing affords a minimal cost per test with immediate results. Initially, there are also costs in time and labor needed to master test procedures. As a result, high confidence in test results may not come immediately.

However, quality control for in-house tests can be maintained by submitting a sample duplicate to an independent lab. The reagents and extractants in

some kits can also expire and lose potency if not consumed within a specified time. Consequently, investing in a kit may not be feasible if testing needs will be minimal.

TESTING BASICS. Most soil tests generally involve the use of a fluid medium to extract the various constituents from a dried, prepared sample. Depending on the test element, selected extractants range anywhere from distilled water, to solutions comprised of special acids, bases, neutral compounds or chelates.

Before purchasing a soil test kit, make certain that the manufacturer can accommodate regional soil discrepancies with the appropriate extractants, i.e., bicarbonate for phosphorus tests in calcareous soils, and reagents.

Once extracted, the sample is filtered to produce a clear liquid

filtrate which is treated in a manner similar to an ordinary water sample. In fact, many soil tests are easily adapted to water analysis. Test results usually correspond to a color change or precipitate in the test solution. Upon comparing the sample to the manufacturer's reference standard, the concentration of the parameter, usually in parts per million, can be determined.

In addition to "wet" analysis, a diversity of instruments are available to quickly measure such parameters as soil pH and electrical conductivity (total dissolved salt). These range in size from digital bench top models to pocket-sized pH meters.

The most important aspect of any test is the user's ability to interpret the data and use it in a practical manner. It's suggested that guidelines supplied with the kit be augmented with regional in-

TYPICAL SOIL TEST PARAMETERS

pH (lime requirement)	Sulfur (Sulfate)
Electrical Conductivity (salts)	Chloride
Nitrate Nitrogen	Carbonate
Nitrite Nitrogen	Bicarbonate
Ammonia Nitrogen	Sodium (Actual)
Phosphorus	Sodium (estimated)
Potassium, Calcium	Sodium Adsorption Ratio (calculated)
Magnesium, Aluminum	Base Saturation (calculated)
Iron	Organic Matter
Zinc	Humus
Manganese, Copper	Texture (percent sand, silt & clay)
Boron, Molybdenum	Cation Exchange Capacity



formation provided by a local extension service or university. However, the most valuable soil test interpretations are those developed by the user through experience and astute observation over time.

TEST OBJECTIVES. Determining the purposes for which soil is to be tested starts with selecting the most applicable equipment and/or procedures to be used. Soil test objectives can be generally classified as: screening, suitability, fertility and soil characterization.

Screening tests seek to identify soil conditions which are potentially lethal to plants. It's the most rudimentary, non-specific test routine and is typically measured quickly with one of two instruments (meters).

The objective is to categorize the soil with respect to detrimental thresholds of pH and total dissolved salts. Although these two parameters alone provide only non-descript information, they often reveal the evidence or "fingerprint" of a specific imbalance. As an economical tool, these tests can either justify or eliminate the need to investigate a soil further.

Enhanced forms of soil screening additionally include sodium adsorption ratios (SAR), anion speciation (chloride, sulfates, carbonates or bicarbonates) and toxic nutrient levels. In its most simple form, the screening test is a useful first step when accessing a large number of diverse soil situations. This test is of particular importance for diagnosing general plant disorders and for assessing the safety of soil amendments prior to their incorporation.

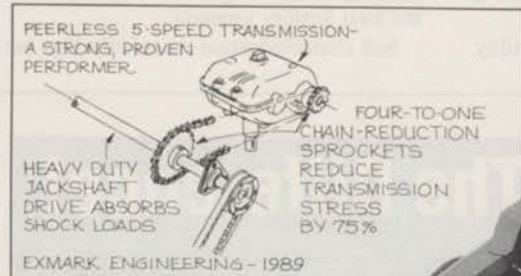
Suitability tests, much like screening tests, determine general soil conditions, but can additionally measure other parameters important to a specific plant group or species. These other test parameters may include various nutrient elements, ion species, soil texture, etc.

Suitability tests can indicate which plants will do well at a specific site, or which sites will be conducive to a specific plant type. For example, suitability tests are used to select appropriate plant species for a natural landscape situation, such as a right-of-way area. Also, the suitability test is helpful in locating a congenial, low maintenance site based on the needs of a predetermined plant species.

Fertility tests represent the majority of all soil tests performed. Virtually all fertility tests determine basic phosphorus, potassium and nitrogen (as soluble nitrate). In addition, the secondary nutrients (sulfur, calcium and magnesium) and the micro-nutrients (iron, zinc, manganese, copper and boron) are included as the expense and sophistication of the test increases. Certain test routines may further include the elements: aluminum, molybdenum, ammonia nitrogen and nitrate nitrogen.

There is no doubt that fertility programs become more precise as more test param-

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ters become known, however, the relative value of a planting and its sensitivity to nutritional variation essentially determines the extent to which each fertility parameter will be used.

Because of leaching, volatilization and plant use, the nutrient complex within a soil is quite dynamic. To keep abreast of these fluctuations, fertility assays are typically desired at more frequent intervals than those of other test routines. Nutrient determinations are also useful in evaluating the efficiency of fertility programs or the efficacy of a fertilizer product.

Besides their function in plant fertility,

the nutrient elements can become factors in soil screening or suitability as soil concentrations approach detrimental levels. For example, elevated copper levels are toxic to a great many plants, and excessive nitrogen, while not necessarily toxic in itself, can raise the total dissolved salts to hazardous levels.

Soil tests for the nutrients sometimes fail to account for actual availability to the plant. It is therefore advisable to consider soil pH, nutrient ratios (balance) and soil character as either antagonists of synergists in the total fertility scenario.

Soil characterization essentially logs the

more stable properties of the soil. Soil character can have both direct and indirect bearing on nutrient behavior, as well as salt concentrations and pH. Unless soil is radically altered, the character of a soil should remain relatively constant over a considerable period of time.

Soil can easily be classified by its texture through sedimentation tests or sieving. The relative percentages of sand, silt and clay comprise the texture of any soil. Texture assays permit better approximations of such phenomena as: nitrate leaching, ammonia volatilization, gravimetric water loss, wetting characteristic (saturation percentages), longevity of soil-bound chemicals and nematode infestation.

Of all soil character assessments, the percent organic matter, and its reduced form Humus, is the least permanent. Although some organic matter has a long decay series, it nonetheless remains the only soil characteristic subject to ongoing biological degradation. Organic matter content affects soil compaction, water and nutrient holding capacity, gas exchange, soil pH, preemergent herbicide application rates and contributes to overall soil fertility via mineralization of nutrients.

The cation exchange capacity (CEC) indexes the extent to which any dominant cation, i.e., calcium, aluminum, iron, potassium, etc., will adsorb to the soil. Some cations are considered beneficial as buffering agents or nutrients, while others can contribute to excess alkalinity or acidity, calcium, iron, aluminum, etc. CEC is also an important consideration in determining the application rates of preemergent herbicides and pesticides.

Although a fairly extensive test procedure is available for exact CEC measurement, CEC is directly related to soil texture, percent organic matter, and the presence of amendments such as vermiculite. CEC is also essential for determining the sodium hazard of a soil (sodium adsorption ratio), the percent of base saturation and rates at which soil amendments such as lime, gypsum, vermiculite, sand or clay need be applied. Although some kits offer CEC tests, independent labs are often used for the relatively complex CEC determination.

SAMPLING. The usefulness of a soil test is directly related to how the samples are collected. The key to sampling is representation — with respect to both of the study sites and the plant types present.

Virtually any test site will contain variations which will to some extent produce disparities in the final test result. Theoretically, no two cubic inches of soil will be 100 percent identical, therefore, sampling always involves judgment and compromise to produce the best overall soil representation.

Up to a point, the accuracy of a soil assessment increases in proportion to the number

(continued on page 91)

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| 3 | 11 | 19 | 27 | 35 | 43 | 51 | 59 | 67 | 75 | 83 | 91 | 99 | 107 | 115 | 123 | 131 | 139 | 147 | 155 | 163 | 171 | 179 | 187 | 195 |
| 4 | 12 | 20 | 28 | 36 | 44 | 52 | 60 | 68 | 76 | 84 | 92 | 100 | 108 | 116 | 124 | 132 | 140 | 148 | 156 | 164 | 172 | 180 | 188 | 196 |
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| 4 | 12 | 20 | 28 | 36 | 44 | 52 | 60 | 68 | 76 | 84 | 92 | 100 | 108 | 116 | 124 | 132 | 140 | 148 | 156 | 164 | 172 | 180 | 188 | 196 |
| 5 | 13 | 21 | 29 | 37 | 45 | 53 | 61 | 69 | 77 | 85 | 93 | 101 | 109 | 117 | 125 | 133 | 141 | 149 | 157 | 165 | 173 | 181 | 189 | 197 |
| 6 | 14 | 22 | 30 | 38 | 46 | 54 | 62 | 70 | 78 | 86 | 94 | 102 | 110 | 118 | 126 | 134 | 142 | 150 | 158 | 166 | 174 | 182 | 190 | 198 |
| 7 | 15 | 23 | 31 | 39 | 47 | 55 | 63 | 71 | 79 | 87 | 95 | 103 | 111 | 119 | 127 | 135 | 143 | 151 | 159 | 167 | 175 | 183 | 191 | 199 |
| 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 | 88 | 96 | 104 | 112 | 120 | 128 | 136 | 144 | 152 | 160 | 168 | 176 | 184 | 192 | 200 |

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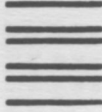
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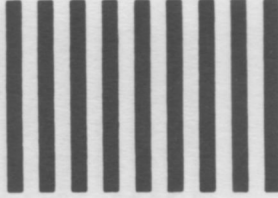
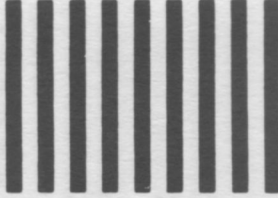
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Soil Contaminants

(continued from page 88)

of samples analyzed. The optimum sample volume for a given situation will depend upon the following considerations:

- the criteria used to delineate the sample site,
- the degree of discrepancy between site delineations,
- the distribution and variation of plant species within the site,
- the growth morphology of the plants involved, and
- the intensity with which the plants will be managed.

Common site delineations to be aware of include: variations in slope, soil cover, vegetation aspect, use or function, irrigation coverage, soil texture and proximity to physical objects. Separate tests may also be desired with respect to plant species, varying stages of development within the same community of plant types and the relative value of the site or plantings involved.

Although accuracy will be somewhat diminished, combining soil into a composite sample can provide a good, average soil representation for the site. The percentage of soil from each site represented in the composite sample should roughly correspond to the relative square footage of each delineated area. Composite sampling is particularly applicable to large, fairly homogeneous areas of a single species, such as turfgrass.

For more expansive areas with little visible evidence of site delineation, composite samples should include several randomly selected sample points throughout the entire area. The exact number of samples is not critical, however three to four samples per 1,000 square feet is suggested for smaller areas while 12 to 14 samples per acre should suffice on larger sites.

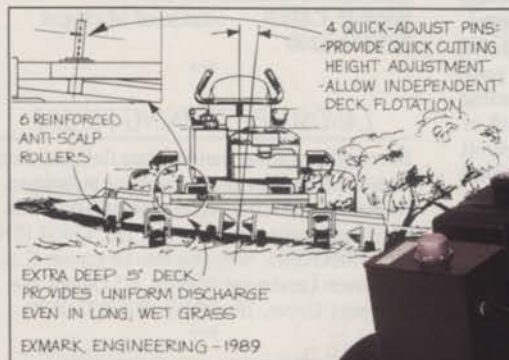
The depth at which soil samples are extracted should correspond to the rooting depth of the plant(s) involved. In this manner a soil test approximates a "plant's eye view" of the prevailing soil conditions. In general, sample turfgrass between three to six inches deep (depending upon species and root development).

For annuals and non-woody perennials, sample depths can range from four to 16 inches, while sample depths for woody shrubs and trees can extend from a few inches to several feet below the surface (depending upon age and rooting depth of specimens).

It's important to eliminate any straw or debris on the soil surface prior to sampling. The use of a regular sampling device — such as an Oakfield apparatus — is highly recommended. These devices vary in length and diameter, according to the intended sampling need. Specialized sampling devices are available for golf course greens, deep-rooted trees and for soil profile studies. An ordi-

(continued on page 94)

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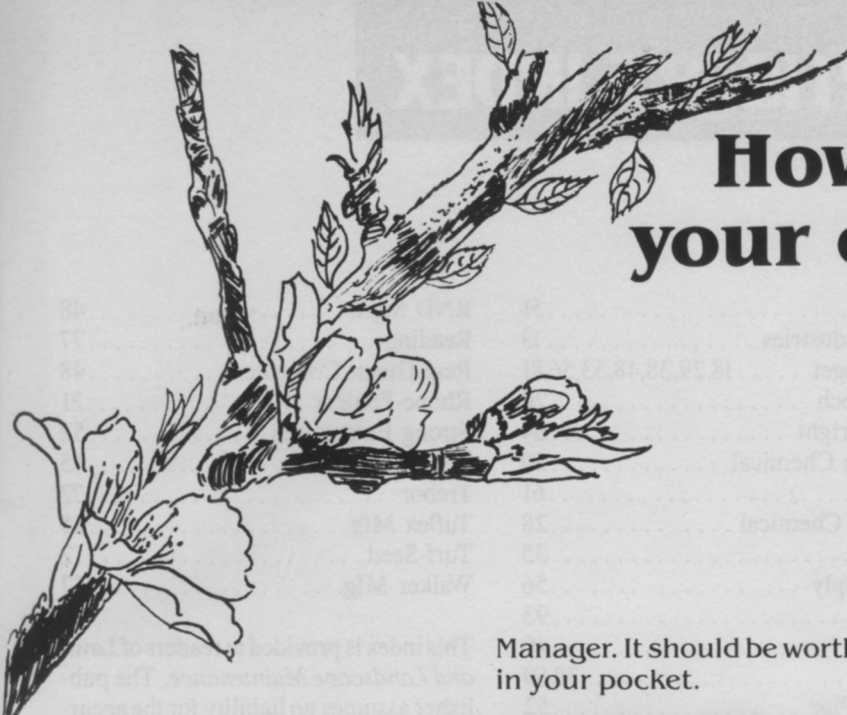
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Spray Rigs

(continued from page 41)

droplet effect") with a compressed air blower.

SUMMARY. Many urban pest management practitioners have experienced serious problems with tank freezing, and in recent years, tank crystallization in their spray equipment. In this article I have tried to share some of my understanding of the dynamics of these problems, and some of my philosophy with respect to problem solving.

With the winter season just around the corner, now is the time to review your cold season operating procedures. Like any other business problem, tank freezing and crystallization are manageable, but you must be proactive in your approach.

Armed with the knowledge of why these problems occur will put you in a much better position to prevent their occurrence. You owe it to your customers, your employees and to your bottom line to solve these problems before they occur. — *Mike Holcomb*

The author is an urban and industrial entomologist in Decatur, Ala.

Soil Analysis

(continued from page 52)

nary garden spade can be used if no other device is available, however, any sampling device should be free of rust, foreign soil or any other residue.

It's also important to minimize handling

of the soil as not to contaminate the sample with body oils or other material. Avoid using metallic cans or previously used containers for soil samples. Most test kit manufacturers offer regular sample containers or new plastic food-type bags can be used. Samples should be analyzed as soon after collection as possible so that volatilization of certain constituents is minimized.

CONCLUSION. Using soil test technology to its full potential might entail using every available test parameter to analyze every square foot of a test area on a daily basis. While such a notion is of course preposterous, it does provide a starting point from which a practical testing strategy can be developed.

Basic fertility tests are well adapted to frequent soil monitoring in high-intensity management situations. Consistent plant nutrition is better guaranteed, fertility trends can be documented, waste and contamination can be curtailed and maintenance budgets can be streamlined.

To the other extreme is the characterization of the soil which essentially establishes a permanent record of soil properties. Soil suitability can assist the landscape designer or installer in diverting future maintenance problems, while screening tests expedite the diagnosis of plant disorders.

Suffice it to say, any professional involved in the lawn and landscape industry has much to gain and little to lose with soil testing. — *Jim Ware*

The author is an agronomic consultant from Hobbs, New Mexico.

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