Seeders for planting. Our seeders plant, not scatter seed, at a controlled and constant depth. Which means that more seed grows, even where you’ve never been able to grow grass before. So you grow more for your seed investment. In less time. With less effort. And achieve rich, luxurious lawn and turf. Two models available: the self-propelled Rogers Model 524-100 with 21” seeding width, and the big 3-point hitch mounting Rogers Model 548-100 with 4’ seeding width.

Sub-Air for deep aeration. Designed to relieve those heavy compaction areas such as greens and heavy traffic locations. An exclusive method sinks 3 special tilling blades as deep as 7”. These blades oscillate well under the turf to give underground aeration without disturbing the surface. Sod Master Sub-Air. For deep compaction problems.

Sweepers for cleaning up. Our sweepers pick up wet or dry leaves, grass clippings, bottles, rocks, paper, branches and other debris to keep turf looking the way turf should look. Patented rubber pick-up fingers work with gentle sweeping action. Six models of Rogers Sweepers available to meet your cleaning up requirements.

Utility truck for all those chores. A real workhorse that goes everywhere and does everything. It carries tools, and with a variety of attachments it aerates, spikes, sprays and dumps. And the heavy duty P.T.O. can also provide an auxiliary power source. The Rogers Model 12 Truck. Designed for turf maintenance.
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GAME!
IN GOLF IT'S
Warren's® A-20
Bluegrass

by Dr. James B. Beard
TURFGRASS
RESEARCH REVIEW

How pollution affects turfgrasses

Response of turfgrass cultivars to ozone and sulfur dioxide in the atmosphere. E. Brennan and P.M. Halisky. 1970. Phytopathology. 60:1544-1546. (from the Department of Plant Biology, Rutgers State University, New Brunswick, N.J. 08903).

The relative ozone ($O_3$) and sulfur dioxide ($SO_2$) sensitivity of seven species and 11 cultivars of the common turfgrasses were evaluated in this investigation. Used were mature sods of creeping bentgrass (Penncross); bermudagrass (Kansas P-16); red fescue (Pennlawn and Highlight); perennial ryegrass (Manhattan and Lamora); annual bluegrass; Kentucky bluegrass (Merion and Delta); and Japanese lawngrass (Meyer and Common). Four-inch diameter plugs were transplanted to pots in May and placed in the greenhouse where they were watered daily and maintained at a two-inch cutting height. After reaching equilibrium, four replications of each species and cultivar were exposed to controlled fumigation with 0.3ppm of ozone for six hours. The temperature in the fumigation chamber was in the range of 24 to 27 C. with a relative humidity of 30 per cent. The fumigation treatments were applied in June, and the same series was repeated in August. A visual evaluation of ozone phytotoxicity to the leaves was made after seven days. Daily observations were also made concerning ozone phytotoxicity symptoms.

In a second experiment, three bentgrass species ($A. palustris$ Huds., $A. tenuis$ Sibth. and $A. canina$ L.) and seven cultivars (Kingston, Cohansay, Penncross, Seaside, Astoria, Highland and Hollfior) were evaluated for ozone sensitivity. Five-year-old plugs of each species and cultivar were transplanted to the greenhouse in October. The experimental procedure was the same as previously described except that two levels of ozone fumigation were used: 0.23 and 0.30ppm $O_3$.

In the third experiment, the relative sulfur dioxide sensitivity was determined for the same seven species and 11 cultivars used in the first experiment. The procedure was the same except that the fumigation treatments involved six hours exposure to each of three levels of sulfur dioxide (0.75, 0.85 and 1.80ppm $SO_2$). The temperature conditions in the fumigation chamber ranged from 27 to 30 C. with a relative humidity of 50 per cent.

Results: Substantial variability in sensitivity to ozone occurred among the seven turfgrass species utilized in this experiment. The general rankings are presented in Table 1. Within

Table 1. Relative sensitivity of 8 turfgrass cultivars to controlled ozone fumigation.

<table>
<thead>
<tr>
<th>High sensitivity</th>
<th>Intermediate sensitivity</th>
<th>Low sensitivity</th>
<th>Minimal sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penncross creeping bentgrass</td>
<td>Merion Kentucky bluegrass</td>
<td>P-16 bermudagrass</td>
<td>Meyer zoysiagrass</td>
</tr>
<tr>
<td>Annual bluegrass</td>
<td>Manhattan perennial ryegrass</td>
<td>Highlight chewings fescue</td>
<td>Pennlawn red fescue</td>
</tr>
</tbody>
</table>

(Continued on page 35)
The only work car as good as our golf car...Harley-Davidson.

And you know how good that is. You see more and more Harley-Davidson golf cars on America's top courses. We build Utilicars with the same care, the same idea that only "perfect" will do. The same way we've been putting power on wheels for over 67 years. That's why they're such hard-working, long-lasting cars. So economical to own and operate. And why they're so widely accepted for industrial uses. Choose from six body styles, cabs and other options to match your jobs. Choose gasoline power with simple, reliable automatic transmission plus instant ignition starting that ends wasteful idling. Get a demonstration today from your Harley-Davidson dealer...the place to go for fast, dependable service, too. And be sure to look closely at our brand new high strength industrial bumper (not shown). It's tough. Or write: Manager, Commercial Car Division, AMF | HARLEY-DAVIDSON, 3700 West Juneau Avenue, Milwaukee, Wisconsin 53201.
NO OTHER HERBICIDE STOPS AS MANY WEED VARIETIES AS MALLINCKRODT'S

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That's because TREX-SAN™ is a unique combination of 2,4-D, MCPP, and DICAMBA that provides the safest most effective mixture for the control of broadleaf weeds, while maximizing chemical safety to turf and ornamental plantings. Spring and Fall applications will control:

BEDSTRAW, BLACK MEDIC, BUCKHORN, BURDOCK, CHICORY, CHICKWEED, CLOVER, DANDELION, DOCK, GROUND IVY, HEAL-ALL, HENBIT, KNOTWEED, LAMBSQUARTER, LESPEDEA, MALLOWS, MORNING GLORY, PEPPERGRASS, PIGWEED, PLANTAINS, POISON IVY, POISON OAK, PURSLEY, RAGWEED, SHEEP SORREL, SHEPHERD'S PURSE, SPEEDWELL, SPURGE, THISTLE, WILD CARROT, WILD GARLIC, WILD LETTUCE, WILD ONION, and YARROW!

Cost is comparable to other broad spectrum herbicides!

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Beard

species, Delta Kentucky bluegrass was less sensitive than Merion whereas no visible differences were evident between (a) Manhattan and Lamora perennial ryegrasses and (b) Meyer and common zoysiagrass.

Typical symptoms of ozone toxicity in bentgrass and bermudagrass involved necrosis and bleaching of the leaf tips. Ryegrass exhibited a glossy, dark-brown necrosis of the entire leaf. A third type of ozone toxicity symptom observed on red fescue leaves consisted of minute, dark-brown stipples. No visible injury symptoms were evident on zoysiagrass under these conditions.

All seven bentgrass cultivars utilized in the second experiment were highly sensitive to a six hour exposure with 0.30ppm O$_3$. However, intra- and inter-species differentials were evident among the Agrostis species when exposed to a lower ozone concentration. Kingston and Highland proved the least sensitive, Holfior and Penncross intermediate and Astoria, Seaside and Cohancey the most sensitive to six hour exposure to 0.23ppm O$_3$.

The relative tolerance of the seven turfgrass species and four cultivars to sulfur dioxide was different from that found for ozone. A summary of the relative sensitivity of these turfgrasses is given in Table 2. Within species, Manhattan perennial ryegrass was slightly less sensitive than Lamora while no visible differences were evident between (a) Delta and Merion Kentucky bluegrass and (b) Meyer and common zoysiagrass.

Sulfur dioxide injury symptoms involve immediate development of a dull, water-soaked appearance in the interveinal areas of the leaves. Subsequently this affected tissue dries and bleaches to an ivory color. Characteristically the symptoms develop at the terminal portions of the leaf blades.

Comments: Turfgrass injury from atmospheric pollutants is of increasing concern to professional turfmen and turfgrass users. Three basic types of pollutants occur: (a) toxic gases, (b) minute solid particles and (c) aerosols of small water droplets containing high concentrations of acids or salts. The injurious effects of atmospheric pollutants on plants may be through direct toxicity or indirectly through the screening of incoming solar radiation. Turfgrasses which are injured or weakened by atmospheric pollutants are more prone to serious damage by wear, diseases, insects and nematodes.

Artificial pollutants are the most frequent cause of direct toxic injury to turfgrasses. The most common types are (a) sulfur dioxide gas, (b) fluoride containing gases and (c) toxic gases associated with smog.

**Sulfur dioxide**

Sulfur dioxide has been a major pollutant for a long time. It evolves from the burning of coal and oil having a high sulfur content as well as from the smelting of sulfide ores. Sulfur dioxide is most commonly a problem in Europe and certain industrialized urban regions of the United States. Sulfur dioxide injury to plants is characterized by the des-

Table 2. Relative sensitivity of 8 turfgrass cultivars to controlled sulfur dioxide fumigation.

<table>
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<td>Manhattan perennial ryegrass</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on page 38)
When you put in something as critical as underground sprinkling, you get only one chance to do it right. And on hundreds of courses since 1961, that has meant Toro equipment. Toro’s Vari-Time® Control System has set the standard.

We’ve been leaders in sprinkler head design for years. The first Valve-In-Head, the first sealed gear drive, the first 2-speed heads for fairways and greens. A few reasons great championship courses are choosing Toro.

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TORO
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A Toro Vari-Time* Central Control System keeps the turf here at Oak Ridge Country Club and over 300 courses installed in the last two years.

*Exclusive Trade Name Toro Mfg. Corp.
Beard
continued from page 35

The construction of chlorophyll, which inhibits photosynthesis and restricts growth. Injury is usually more severe at high light intensities, temperatures above 40°F, and high atmospheric relative humidities.

Fluorides

Toxic fluoride containing gases, such as hydrogen fluoride and silicon tetrafluoride, can be serious problems in the vicinity of certain types of industry. Extremely low concentrations of fluorine can cause serious plant injury. Typical symptoms are a gray-green, water soaked appearance at the leaf tips. Lesions form which turn light tan to reddish brown and gradually extend downward to the leaf base. Succulent, young leaves are most sensitive to fluoride injury. Annual bluegrass, perennial ryegrass, and red fescue are quite sensitive to hydrogen fluoride whereas Kentucky bluegrass is intermediate in sensitivity.

Smog

Smog is a more complex type of air pollutant involving a unique blending of solid and liquid aerosols in fine particles with numerous inorganic and organic gases. The more significant toxic constituents of smog are not the direct products of industrial-urban activities but are formed by slow photochemical reactions which occur in the atmosphere between certain non-toxic substances, such as the unsaturated hydrocarbons admitted from the internal combustion engine, and small concentrations of certain nitrogen oxides. The resulting toxic oxidants include ozone, ozonides, peroxyxinitrates and peroxyacids.

The prerequisites for a serious smog problem are (a) sources of nitrogen oxide and unsaturated hydrocarbons, (b) atmospheric conditions involving a low wind velocity and a large scale semipermanent, non-diurnal temperature inversion which prevents transport of atmospheric pollutants from the area and (c) solar radiation for driving the photochemical reactions which produce ozone and peroxyacetyl nitrate (PAN). Ozone is the primary phytotoxic atmospheric pollutant along the Eastern, industrial-urban coast line of the United States, whereas PAN is most serious along the industrial-urban complex of the United States Pacific coastline.

The turfgrass ozone phytotoxicity comparisons given in this study vary somewhat from the California studies. Evidently the smog studies of California involve a greater response to PAN phytotoxicity and associated symptoms whereas this study has concentrated on the direct effects of ozone alone.

Symptoms of smog (PAN) injury involve tan spotting and/or transverse banding of the grass leaf blades. Elongating leaf tissues are the most sensitive to smog injury, particularly if the stomata are open. Smog injury results in a reduced chlorophyll content, an impairment of photosynthesis and an increased respiration rate. The relative rankings of turfgrass species in terms of smog (PAN) sensitivity are fairly comparable to the ozone sensitivity comparisons given here.

It is quite evident from this discussion that one should specify the particular phytotoxic agent involved to avoid confusion when discussing turfgrass injury from atmospheric pollutants. The specific injury symptoms and relative phytotoxicity among turfgrass species and cultivars vary substantially depending on the particular atmospheric pollutant which occurs in a given area.
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Par for
"My championship flight for all golf course maintenance," says Vance R. Price, superintendent of Tanglewood Park, Clemmons, North Carolina, "are these Dolge winners. Any course is easier to keep up to par at less cost with Dolge products. They have my heartiest recommendation for every golf course maintenance need."

**Dolge Stroke-Savers**

1. **TOTE Weed Eradicator.** Total kill, plus maximum safety. Acts positively on annuals, biennials, perennials; sterilizes soil. Exceptionally high LD rating. One gallon of TOTE in 15 gallons water treats 1000 sq. ft. at 83.3% saving.

2. **E.W.T. 2,4-D Selective weed killer** kills all broadleaf weeds—dandelions, plantain, poison ivy.


4. **DOLGE LAKE DYE.** Turns muddy water hazards and ponds bright, lasting blue. No danger to pets or wildlife.

5. **BOOST J-70.** Miracle solvent cleaner for all machinery from mowers to golf carts. Improves wearing qualities, keeps them at top performance level years longer. Non-flammable.

6. **NEW ALL PURPOSE, BROAD SPECTRUM TURF FUNGICIDE.** One fungicide to control all turf diseases. Another Dolge first!

**PLUS—** Dolge makes all the extras to make your maintenance job easier. Such as: **CRABGRAX (AMA/DSMA),** for positive crab grass control, even hard to kill silver crab grass. Full line of **Turf Insecticides** to control animal and insect pests. **DOLCO Pine Ball Wash,** pleasantly piney, quick thorough cleaning of golf balls in paddle or rotary machines.

For Better Grounds Maintenance—Dolge, the Complete Caretaker.
Dolge Indoor Threesome

1. CINDET, the one multi-purpose cleaner and wax stripper does all routine cleaning jobs better, faster, easier. Cleans all surfaces, floors, walls.

2. KING-COTE® the all-purpose zinc-interlocked floor finish that obsoletes all others. Superb layup; slip resistant.

3. BRITE N' UP, the 20 minute rug shampoo. Get carpet sparkling clean, walk on it 20 minutes later!

Up-to-Par Club House Maintenance

Indoors & Out—Dolge, the Complete Caretaker.
What to use?

With the coming of spring and another season of planting, questions are being asked which indicate confusion and indecision concerning what to plant. This is especially true of the bluegrasses. Pennstar, an improved Kentucky bluegrass developed by Joseph Duich at Penn State, has joined Merion, Prato, Fylking, Newport, Windsor, Park, Cougar, Sodeo and all the rest of the named varieties available. In addition, there are the common types, including South Dakota Certified Common. Where does each one fit? What are its limitations regarding climate, use, fertilizer requirements, tolerance to close mowing, susceptibility to pests and diseases and other factors? Hopefully each new variety will be superior in every respect, but can we safely assume this?

The trend is toward blends. The idea is that the strong features of certain components will mask the weak points of another. For example, Merion’s superior leaf spot resistance covers for varieties that are weak in this regard; Fylking with its resistance to stripe smut covers for Merion which is susceptible. Common bluegrass is notoriously susceptible to leafspot. To plant it alone for lawns or fairways without a strong leafspot resistant companion would be inviting disaster. But what should the blend contain in Pennsylvania, New Jersey, Maryland, Ohio and all the way to Nebraska and Colorado?

It is of interest that when turf research begins to flower at the University of Nebraska, the number one goal apparently will be to solve the blend problem. In the meantime we shall hope to gather data from every bluegrass consuming state and experiment station to find more answers to the dilemma. Let us not forget that there are those bluegrasses reproduced by vegetative means only. Among them are Warren’s A-10, A-20 and A-34. While this is neither the time nor the place to elaborate on their merits, they are in use and they do have a place. It will take more time to sort them out into their special categories but, so far, they stand alone and do not seem to lend themselves to blends with seeded bluegrasses.

Another big question is, “Should I include red fescue or ryegrass?” It would seem that red fescue has no place in a blend of elite bluegrasses that are maintained at a fertility level suitable for bluegrass. The fact remains that many bluegrass mixtures contain red fescue and ryegrass.

The new elite fine-leaf perennial ryegrasses (Pelo, NK-100, Manhattan and Pennfine) have a place in bluegrass blends especially in spring seedings where summer protection is needed. We’ve had excellent results from a simple Pelo-Merion-Fylking mixture for fairways. In some cases we will work Pennstar into the blend. If seed supplies are short, Prato can be added as an “extender.”

The better turf varieties of bluegrasses tend to be poor seed producers which raises production costs and retail prices. Research has shown that with adequate nutrients in the seedbed, light rates of seeding can produce the desired turf density. So, when supplies of elite varieties are short, plant less seed and “beef up” the seeded nutrients.

No replacement foreseen

Q—Do you feel that, because of its tolerance to close, frequent mowing, Fylking bluegrass will replace Merion for fairways? (Minnesota)

A—We do not anticipate any “replacement” of Merion by Fylking, because both grasses are quite tolerant of close mowing and are compatible. In practice we find Merion and Fylking being used in about equal parts in blends with other varieties.

(Continued on page 42)
MOST UNWANTED

POA ANNUA
Aliases: Jekyll & Hyde grass, annual bluegrass

GOOSEGRASS
Aliases: crow foot, silver crabgrass

HAIRY CRABGRASS
Alias: large crabgrass

SMOOTH CRABGRASS
Alias: small crabgrass

BARNYARDGRASS
Alias: watergrass

GREEN FOXTAIL
Alias: green bristlegrass

YELLOW FOXTAIL
Alias: yellow bristlegrass