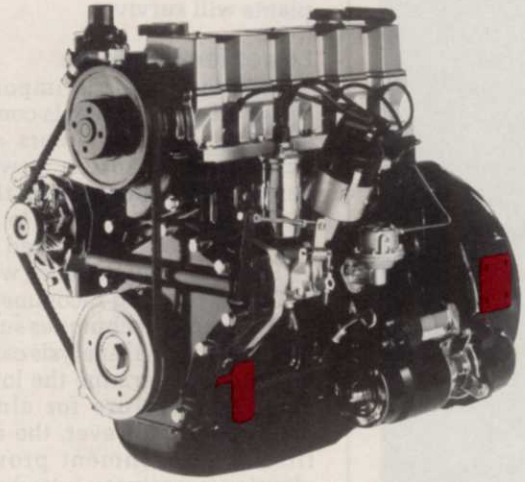
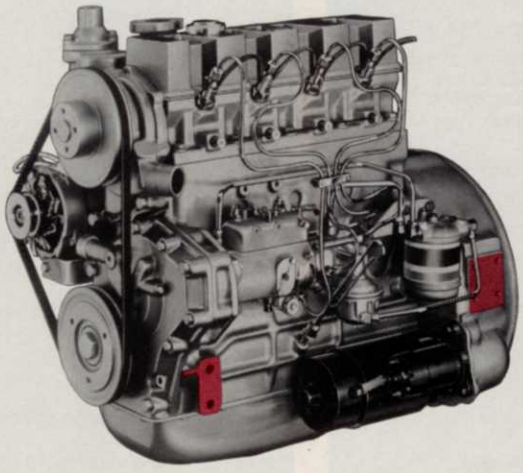
REDUCE THE MOUNTING COSTS OF ENGINES.



TM27—Gasoline, LPG, Natural Gas



TMD27—Diesel

Seems like different fuel options always add to the expense of mounting an engine on your equipment.

Not if you use Continental TM engines.

As you can see, all our engines—gasoline, diesel, LPG and natural gas—come with identical mounting points. Which cuts down on design hours and dollars spent coming up with multiple configurations for your new applications.

Plus you'll gain power when you install one of our 24-80 hp Continental TM engines. Instead of being a glorified car engine, it's specifically made for industrial use. With, for example, an extra main bearing to support crankshaft torque.

So it can stand up to heavy industrial torture.

Power. And flexibility. Get more of both (not to mention less expenses and design headaches) when you choose Continental TM engines for your equipment.

How's that for cutting your costs?

Continental RED SEAL

More power to you.

TEMPERATURE GUIDE

AVERAGE KILLING LOW TEMPERATURES:

Species	Killing Temperatures (°F)
Acer palmatum 'Atropurpureum'	+14 (roots)
Agrimonia pilosa	+14 (buds); +18 (rhizomes); +23 (roots)
Anaphalis margaritacea	+18 (buds); +18 (rhizomes); +18 (roots)
Artemisia japonica	+10 (buds); +10 (rhizomes); +10 (roots)
A. montana	+14 (buds); +18 (rhizomes); +18 (roots)
Buxus sempervirens	+15 (roots); +27 (immature roots)
Chamaele decumbens	+23 (buds); +23 (rhizomes); +23 (roots)
Cornus florida*	−6 to −22 (twigs); +21 (immature roots); +11 (mature roots); +20 (roots)
Cotoneaster adpressa var. praecox	+10 (roots)
C. dammeri	+23 (immature roots)
C. horizontalis	+15 (roots)
C. microphyllus	+25 (immature roots); +9 (mature roots)
Cryptomeria japonica	+16 (roots)
Cytisus praecox	+15 (roots)
Daphne cneorum	+20 (roots)
D. pseudo-mezerum var. jezoensis	−4 (buds); −18 (leaves); +23 (roots)
Euonymous alata 'Compacta'	+19 (immature roots); +7 (mature roots)
E. fortunei var. radicans	−4 (buds); −4 (leaves); +14 (roots)
E. fortunei 'Argenteo-marginata'	+15 (roots)
E. fortunei 'Carrierei'	+15 (roots)
E. fortunei 'Colorata'	+5 (roots)
E. fortunei var. vegeta	+23 (immature roots); +12 (mature roots)
E. kiautschovica	+21 (immature roots); +16 (mature roots)
Hedera helix 'Baltica'	+15 (roots)
Hypericum spp.	+23 (immature roots); +18 (mature roots)
Ilex cornuta 'Dazzler'	+25 (immature roots); +18 (mature roots)
I. crenata 'Convexa'	−22 +20 (roots)
I. crenata 'Helleri'	+23 (immature roots)
Illex crenata 'Hetzii'	+20 (roots)
I. crenata 'Stokesii'	+20 (roots)
I. glabra	+15 (roots)
I. X meserveae 'Blue Boy'	+23 (immature roots); +9 (mature roots)
I. 'Nellie Stevens'	+23 (immature roots); +14 (mature roots)
I. opaca	+23 (immature roots); +9 (mature roots); +20 (roots)
I. 'San Jose'	+21 (immature roots); +18 (mature roots)
Juniperus conferta	+12 (immature roots); −10 (mature roots)
J. horizontalis	0 (roots)
J. horizontalis 'Douglasii'	0 (roots)
J. horizontalis 'Plumosa'	+12 (immature roots); −4 (mature roots)
J. squamata 'Meyeri'	+12 (immature roots)
Kalmia latifolia	+16 (immature roots)
Koelreuteria paniculata	−17 (twigs); +16 (immature roots); −4 (mature roots)

* differences in temperatures for the same species indicates more than one reference or test or differences in experimental procedures.

chart continued on page 34

Aside from all the other stress-creating situations that challenge the survival of plants in a city or urban environment is the failure of the plants to re-grow in the spring. Even with the best care during the prior growing season and attention during the winter, the entire plant will either appear to be dead come spring or buds will swell and perhaps open a bit. Then the entire plant appears to suddenly die.

This phenomenon is common in container nurseries. The plant which classically exhibits these symptoms is the tough juniper. All through winter, it appears a healthy green until spring when warm temperatures arrive. Just when the nurseryman thinks his winter headaches are over, almost overnight all the junipers take on a sickly shade of yellow-green, ultimately turning dead-brown.

The problem is often found to be dead roots, apparently killed during some period of unanticipated low temperatures—temperatures which did not affect the plant's stem and leaves.

Where landscape architects in the past have relied on available literature that lists the lowest winter temperatures at which a plant will survive, little if any information has been available on the low temperatures at which the roots of these plants will survive.

Lower temperatures

This information is important because the roots of plants contained in above-ground containers are often subjected to much lower temperatures during winter than they would ever be exposed to in either their native or transplanted home.

History and experience would lead to future planting recommendations. And scientific techniques such as differential thermal analysis can quickly be used to determine the lowest survival temperature for almost any plant tissue. However, the added artificial environment provided by planting containers introduces variables which may have to be determined on an individual basis.

First it must be realized that any soil volume elevated above ground will both cool and heat faster than on bare ground. More importantly, it will also heat to higher temperatures and cool to lower temperatures than that same surrounding soil. The dynamics of this heating and cooling occurs daily, weekly, seasonally and annually.

Larger soil volumes heat and cool slower than smaller volumes. However beneficial the use of a large soil

Fine Fescue Defined

What are Fine Fescues and why are they so important to turf managers?

Our Fescue turfgrasses are part of most every park, golf course, industrial campus, athletic field, condominium commons and home lawn from the transition zone, Northward.

But, many people are not aware of that. Perhaps we are the most overlooked turfgrass in existence.

We feel that Fine Fescues are the best turf investment a grounds manager can make. And, we'd like to point out *why.*

Fine Fescues are *real* grass. And, as with all living things, there is give and take. Sure, our Fescues take water and some maintenance, but they are better *givers.* Our natural grass turns noxious gases into oxygen and is a natural air conditioner for turf users.

We feel that while artificial turf has its place on locker room floors, it has no business where *real* people work, play and relax. Our grass is just *naturally* more refreshing.

Our Chewings (Festuca rubra commutata) and creeping red (Festuca rubra rubra) Fescues are rather unique when compared with other turfgrass species. Although they have most of the features of other cool season grasses, Fescues have several distinct benefits worth noting.

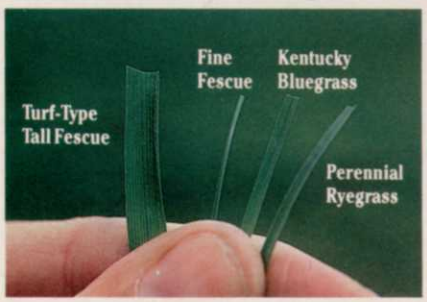
Fine Fescues are low maintenance. Our varieties require less fertilizer and water than other species. That's a big *plus* at today's water, fertilizer and manpower prices.

Fine Fescues fare well around trees. It seems our grass doesn't need as much sunlight, water and nutrients as other turfgrass species. Because Fescues don't compete with trees for these important elements, they're called *shade grass.* Our Fescues don't creep into flower beds, nor crowd out other species in a mixture.

And, because they're Oregon grown, our Fescues germinate, adapt and perform better than imported types.

You'd expect to pay a fortune for such a turfgrass, but Fescues are quite reasonable

Why don't Fescues cost a great deal? Fine Fescues have been around a long time and have been changed very little. Why mess with a good thing? While other former "pasture" species are coming closer to looking like our old standard; receiving notoriety for their "improvements" and enjoy the price increases associated with the word "new," our Fescues have continued what they do best . . . support the up-and-comers. But then, Fine Fescues were meant to be stepped on.



Fine Fescues are Ideal for Recreation, Sports and Leisure

Not only do Fine Fescues excel alone or in perennial ryegrass/Kentucky bluegrass mixtures on horizontal playing surfaces; Fescues are excellent for low maintenance areas like berms, roadside banks, ski slopes and hilly spots that don't retain moisture. So, you see, Fescues are ideal all-around grasses for *all around* your recreation and sports facility. Their low maintenance requirements offer *turf managers* a chance for a little more leisure . . . and there's nothing wrong with that.

For a series of nine tech sheets on Oregon grown Chewings and creeping red Fescues, call or write:

Oregon Fine Fescue Commission
866 Lancaster Dr. SE
Salem, OR 97301
503/585-1157

TEMPERATURE GUIDE

AVERAGE KILLING LOW TEMPERATURES:

Species	Killing Temperatures (°F)
Leucothoe fontanesiana	+19 (immature roots); +5 (roots)
Lilium cordatum var. glehnii	+23 (buds); +23 (bulb); +23 (roots)
Lysimachia vulgaris var. davurica	+18 (buds); +18 (rhizomes); +18 (roots)
Magnolia soulangiana	+23 (roots)
M. X soulangiana	+23 (roots)
M. stellata	+23 (roots)
Mahonia bealei	+25 (immature roots); +12 (mature roots)
Maianthemum dilatatum	+14 (buds); +23 (rhizomes); +23 (roots)
Miscanthus sinensis	+18 (buds); +18 (rhizomes); +18 (roots)
Pachysandra terminalis	−4 (buds); −4 (leaves); +18 (rhizomes); +23 to +15 (roots)
Petasites japonicus var. giganteus	+23 (buds); +23 (rhizomes); +23 (roots)
Picea glauca	−10 (roots)
P. omorika	−10 (roots)
Pieris floribunda	+5 (roots)
Pieris japonica	+14 to −8 (twigs), −11; +16 (immature roots); +10 (roots)
P. japonica 'Compacta'	+15 (roots)

chart continued on page 35

volume may appear then, the volume does not heat and cool uniformly. Outside edges, and especially southern and western edges, will be affected most dramatically—possibly to the extent that roots will be killed only there from high or low temperatures while interior roots remain undamaged.

Containers with shapes that expose a greater surface area per unit volume will both cool and heat faster than containers that expose less. Containers that present a large surface area to the ground beneath also benefit from the heat transferred from that ground.

As might be expected, the color of the container can also make a dramatic difference in the temperature dynamics as well. Darker colors absorb more light and heat than do lighter-colored ones. Where light-colored containers may prove beneficial during summer months, a darker-colored one may prove as beneficial during the winter season. However, a dark container in winter may also result in container temperatures too high during the day, leaving the roots in a condition unable to quickly adjust to lower nighttime temperatures. The material from which the container is

TEMPERATURE GUIDE

Species	Killing Temperatures (°F)
Plantago asiatica	+14 (buds); +14 (rhizomes); +14 (roots)
Potentilla fruticosa	−10 (roots)
Pyracantha coccinea	+18 (roots)
P. coccinea 'Lalandei'	+25 (immature roots); +18 (mature roots)
Pyrola alpina	+18 (buds); +9 (leaves); +23 (rhizomes)
P. incarnata	+1 (buds); +5 (leaves); +18 (rhizomes)
P. renifolia	+9 (buds); +23 (leaves); +23 (rhizomes)
P. secunda	+1 (buds); +5 (leaves); +23 (rhizomes)
Sanguisorba tenuifolia var. alba	+18 (buds); +18 (rhizomes); +23 (roots)
Sanicula chinensis	+23 (buds); +23 (rhizomes); +23 (roots)
Solidago virga-aurea	+9 (buds); +14 (rhizomes); +14 (roots)
Stephanandra incisa 'Crispa'	+18 (immature roots); 0 (mature roots)
Taxus X media 'Hicksii'	+18 (immature roots); −4 (mature roots)
T. media 'Nigra'	+10 (roots)
Tiarella polyphylla	+14 (buds); +18 (leaves); +14 (rhizomes); +23 (roots)
Trifolium pratense	+23 (buds); +23 (rhizomes); +23 (roots)
Viburnum carlesii	+15 (roots)
V. plicatum f. tomentosum	+19 (immature roots); +7 (mature roots)
Vinca minor	+15 (roots)

made can also affect soil temperatures. Just as in heat gain and loss in homes, thin dense materials transfer heat more rapidly.

Other factors

Sunshine and air temperature do not always act alone in determining the fate of the roots in containers.

The nature of the surroundings will also affect the resultant container temperature. Large expanses of nearby asphalt or concrete, as well as other large heat-absorbing masses and light-reflecting surfaces, will combine to dramatically alter the container temperature. Containers unprotected by any surrounding shelters or large material masses will cool faster and deeper than otherwise-protected containers. Containers which wick water to an outside surface can cool the interior soils to temperatures lower than air temperatures. This may be a benefit in the summer, but a few degrees lower in the winter may damage roots.

The type of soil can also affect container temperatures. The movement of heat through soil is generally affected by porosity, moisture and organic content.

continued on page 36

Generally, organic soils do not transfer heat as fast as mineral soils. Where soil volume and type, container color and material may afford overnight protection from low temperatures, none of these may provide any protection from a period of sustained low temperatures.

The freeze factor

When roots were killed by low temperatures, it is often said that the reason for their death was due to freezing. As evidenced by the depth to which frost penetrates in many parts of the country, the roots of most temperate zone plants will survive freezing temperatures quite well.

The damaging low temperature zone for the roots of many plants is generally between 15 and 25° (see chart). It must be realized, however, that the killing low temperatures listed for these plants was determined for plants that had become completely acclimated to the winter season. Not indicated is the increased susceptibility of damage to roots at even higher temperatures during other times of the year.

Roots in the normal position in the ground naturally acclimate more slowly in the fall to low temperatures than do the plant parts above-ground. Where a temperature of 25° may not injure a root in December or January, the same temperature experienced during October or November may prove fatal.

Where freak occurrences of low temperatures of short duration normally do not affect roots in the ground, soils in containers can be affected much more dramatically.

FACTORS AFFECTING HEALTH OF PLANTS IN ABOVE-GROUND CONTAINERS

1. LOW TEMPERATURES!
2. VOLUME OF SOIL
3. CONTAINER SHAPE
4. CONTAINER COLOR
5. CONTAINER MATERIAL
6. NATURE OF SURROUNDINGS
7. TYPE OF SOIL

Jim Borland owns Flora West in Denver. He is a horticultural consultant specializing in native and dryland plants and former plant propagator for the Denver Botanic Gardens.

Additional variables

Some of the same variables involved with potential low temperature damage to roots in containers is applicable to plantings at the top of walls. At least one side of the root system is exposed to the weather at all times. Until roots can establish themselves some distance from the wall, they are susceptible to the same problems.

There is no easy way to determine what is the best size, shape or color of container to use for any particular project since too many other variables are involved. The best piece of advice aside from not using containers is to use the largest container possible. The closer we can approximate the natural condition, the better will be the plants in the container. **LM**

THE PROVEN PROFIT-MAKER.

Get ready to profit from fall lawn renovation with the LESCO Renovator 20. It's the easy-to-operate slicer/seeder with built-in maneuverability and proven performance.

Powered by an 8-HP Honda engine, the LESCO Renovator 20 features exclusive hydraulic drive with 0 to 2 mph forward speed control. Spring-loaded reverse gives the unit greater maneuverability in tight areas and simplifies trailer loading and unloading. A compact low-profile design provides excellent hillside stability.

Last year, the renovator supply did not meet demand. It could happen again. Prepare now to profit this fall. Order the proven profit-maker today.

We're ready to deliver. Contact your LESCO sales representative, visit the nearest LESCO Service Center or call toll free (800) 825-3726.

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Rocky River, Ohio 44116
(216) 333-9250

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Reroute roots and
the ugly side of yo

Introducing Typar® Biobarrier™ root control system.

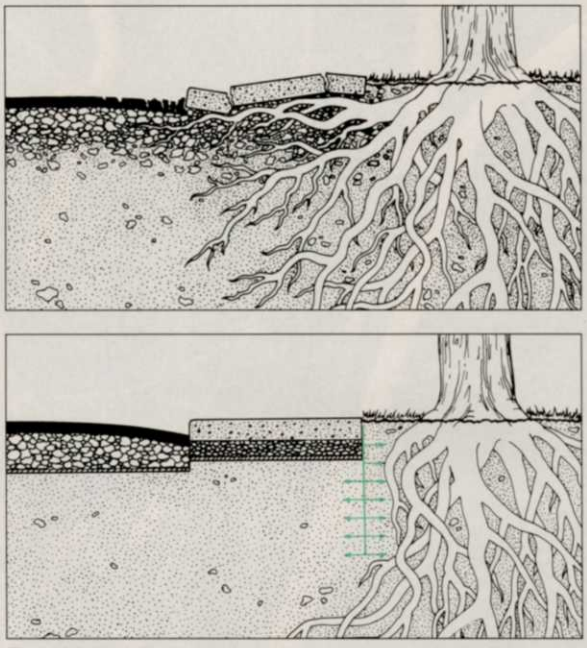
Give unsightly roots a new direction in life. Down. With new Biobarrier, the advanced root control system that sends your maintenance costs in the same direction.

Biobarrier combines two of the most effective, longest-lasting elements in root control. One is Treflan®, one of the most proven herbicides in the country, featuring new controlled-release pellet technology. The other is Typar® fabric, made with rugged polypropylene geotextile that's porous enough to let air and water through but holds the Treflan pellets in place.

Together, they reroute roots without harming your trees and plants. And preserve the beauty of your landscaped areas — golf greens, cart paths, sidewalks, curbs, walkways, parking lots, swimming pools, gardens and others — for years to come.

Forget roots for 15 years.

Underground, Biobarrier sets up a solid rootproof zone that spans one to two inches on each side of the fabric. That's the Treflan controlled-release vapor zone. A zone so powerful, it repels roots at a controlled rate for 15 years or more.



Top Without Biobarrier, tree roots penetrate paved surface and aggregate base, causing unsightly cracking and heaving.

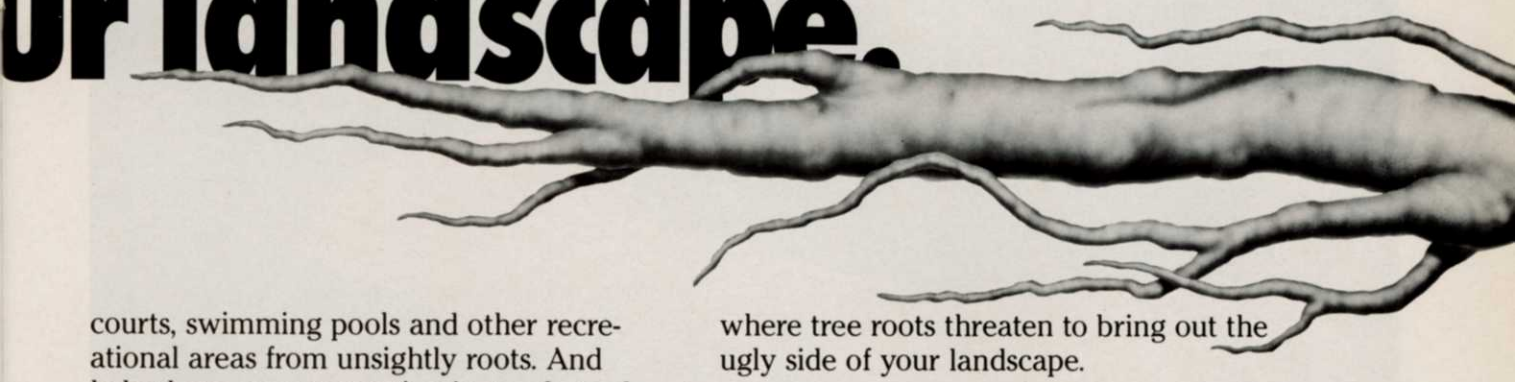
Bottom With Biobarrier, a protective zone of Treflan vapor reroutes roots downward without harming roots or tree.

Forget extra labor.

Without Biobarrier, you're spending plenty of time and labor to trench, trim roots and replace damaged landscaping. But with Biobarrier, you'll only do the job once every 15 years—trim roots, replace damaged cart paths and install Biobarrier.

By rerouting roots downward, Biobarrier protects your golf greens, cart paths, tennis

tame
ur landscape.



courts, swimming pools and other recreational areas from unsightly roots. And helps keep your reputation in good standing among your customers.

Easy on plants and landscaping.

Unlike other control methods, Biobarrier won't harm trees or nearby landscaping. It doesn't kill roots, it just reroutes them away from your golf, recreational or landscaped areas.

Treflan's active ingredient is biodegradable. It cannot be taken up by plant systems. And it stays put without leaching out to keep rerouting roots for 15 years or longer.

Easy to install.

The Typar fabric in Biobarrier is flexible to make installation simple. Just install vertically along your golf, recreational or landscaped areas where tree roots threaten to bring out the ugly side of your landscape.

Call toll-free.

For the complete story on Biobarrier, see your Elanco representative. Or send for a free technical brochure from Elanco Products Company, Lilly Corporate Center, Dept. EM-455, Indianapolis, IN 46285, U.S.A. Or call toll-free: **1-800-352-6776.**

TYPAR® Biobarrier™
Root Control System

Typar Biobarrier is jointly marketed by Reemay, Inc., a member of The InterTech Group, Inc., and Elanco Products Company, a division of Eli Lilly and Company.

Treflan® — (trifluralin, Elanco)

REEMAY
a member of The InterTech Group, Inc.

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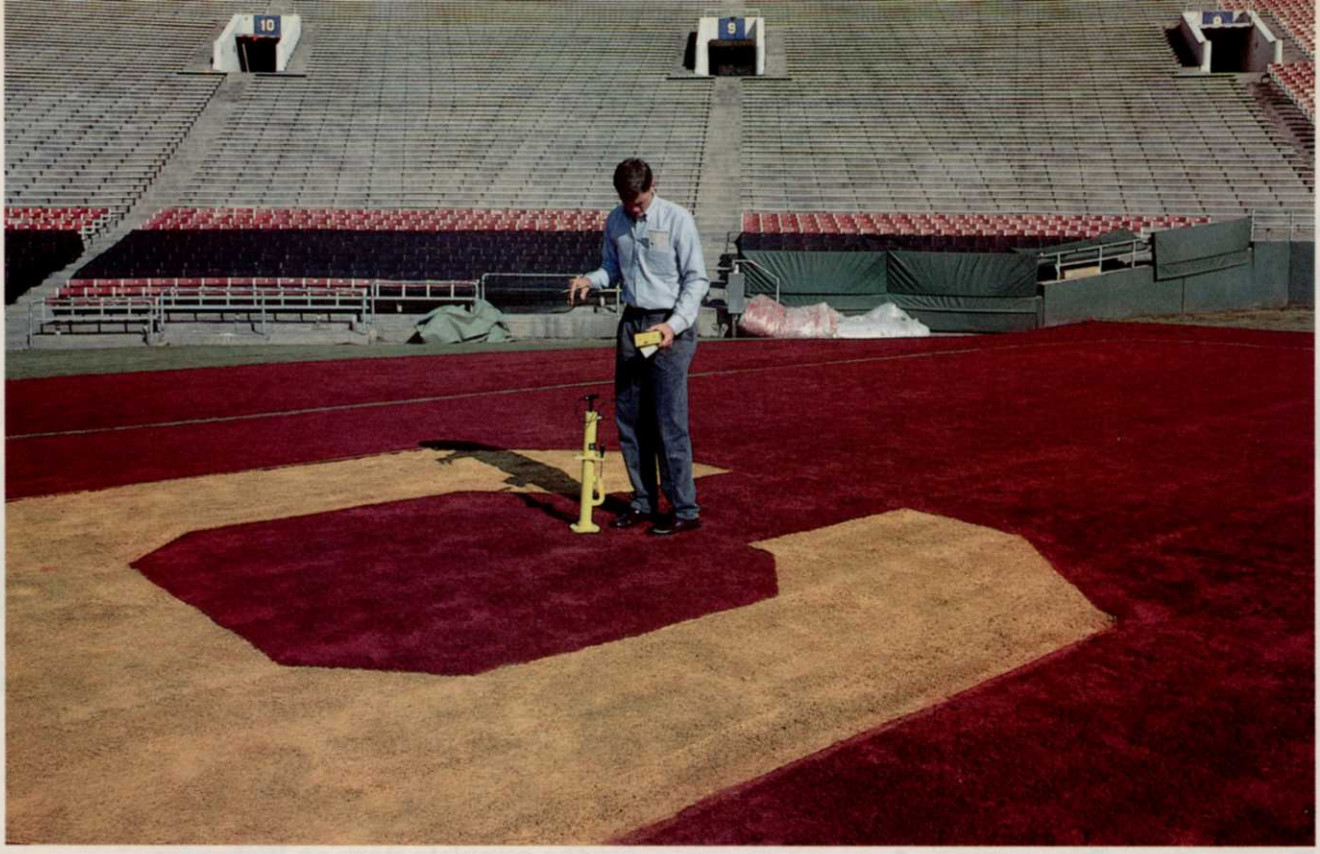

The interaction between an athlete and the playing surface is based on traction and field hardness. Measuring these characteristics, researchers are paving the way for improved field conditions across the country.

SAFE AT ANY SPEED

The primary objective of experiments conducted at Penn State University was to advise high school athletic field managers of ways to improve playing field conditions. The conclusions were not surprising.

by John N. Rogers III, Ph.D. and D.V. Waddington, Ph.D.

An athletic field's quality is assessed differently by players, coaches and fans. Viewers judge it by appearance. However, a dark green field with 100 percent turf cover doesn't guarantee player performance or safety. For players and coaches, quality is a function of performance and safety.

Interactions between player and surface are based on traction and field hardness. To measure these characteristics, researchers use equipment designed to evaluate turf surfaces.

● *Traction*, the relationship between a player's foot and the playing surface, can be quantitatively assessed with a device known as a shear vane, which simulates the action of cleats pressed into the ground. The measurement is made by rotating the shear vane until the turf or ground breaks loose. Similar devices pressed onto but not into the surface have also been used.

● *Hardness* is a measure of the surface shock-absorbing properties. It can be determined using accelerometers attached to weighted objects that simulate a player's falling or running on the surface. By dropping the objects from a constant height and using a constant mass, different surface hardnesses can be compared.

Study results

Good maintenance practices and good field conditions were generally associated with lower impact values, which indicates more softness. Higher impact values were found for fields with lower moisture contents, greater bulk densities and less turf cover. It became apparent that, in football field maintenance and renovation programs, the center of a field requires the most attention.

And in general, higher shear resistance values were found for game fields and outside hashmarks, where greater vegetation had a more apparent effect than bulk density and moisture values, which would have favored low shear resistance.

The volunteers

Twelve volunteer Pennsylvania high schools with 24 athletic fields were evaluated five times each between November 1986 and November 1987. Evaluations were done to include as many different environmental conditions as possible, both inside and outside the hashmarks at the 35-yard lines.

School representatives provided