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WT&T

CONTENTS

JUNE 1980/VOL. 19, NO. 6

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Cover: Diver adjusts a sheet of Aquascreen, a vinyl coated fiberglass netting designed to shade out and compress weeds on lake floors.

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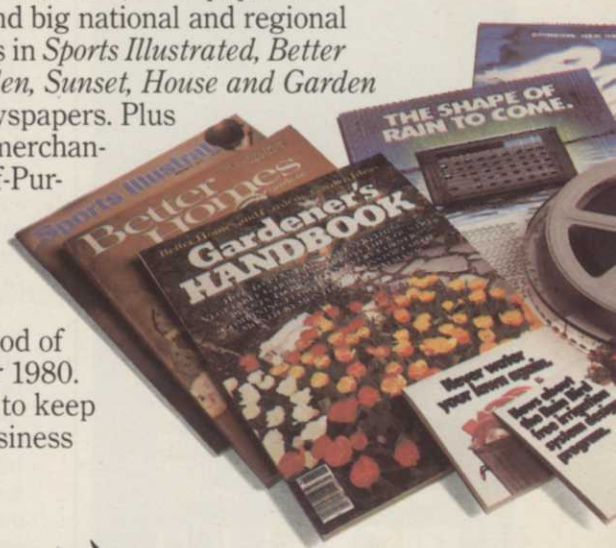

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OUTLOOK

By Bruce F. Shank, Editor

Employment shift could boost competition

Be prepared . . . your car mechanic of today may be your competitor tomorrow.

Hard times in industries which employ vast numbers of people can cause a deluge of new small businesses in fields which appear simple on the surface. Horticulture is one of those fields that on the surface appears simple and one that will no doubt attract many auto and steel workers in the next two years.

From our position we can gauge this movement from requests we receive on how to start a landscape business, lawn care business, etc. We call them "Tell Me All There Is To Know" letters. So far we detect no increase in this type of request, but feel it is about to happen as layoffs lengthen and subpay funds dry up.

Before it happens, some thought should be given to dealing with this influx of competitors. We must impress upon them that the market is not a simple one and that years of experience and training are needed to be successful. The situation supports the contention of industry associations that togetherness is beneficial for the protection and progress of our various Green Industries.

However, it would be careless to assume that these persons will jump untrained into our markets. Some determined and proud workers will train prior to market entrance; obtain experience under a good contractor, superintendent, or arborist; and be partly trained by 1981. In fact, some of these people may make an important contribution to the Green Industries in the next five years due to their drive, pride, and desire.

This only further reinforces the need to stay on top of technological advances, discuss problems with fellow professionals, and constantly impress your customer with your concern for their property or business. Show them you are a member of a professional organization, certified where applicable, and involved in constant training to provide them with the latest and best technology.

People don't remain unemployed. They change occupations and force people in other fields to prove their worth or take their place in the unemployment line. Harsh but true, no job is guaranteed just on the basis of time. We must keep up-to-date, alert, and valuable to our customers.

Turf management series begins with seed market

The staff of Weeds Trees & Turf has been interviewing many of the industry founders over the last two months in preparation for a six-part series on the history and development of the turf industry beginning in July.

The first section will concern the history, development and future of the seed market. We will cover the steps taken by early agronomists to establish turf types just for fine turf areas. We trace occurrences from 1985 to 1980, and then tell you what is coming in the next ten years. After reading this special feature you'll have a good idea of the background of the turf seed market.

For example, how the turf seed market, originally based in the Midwest, moved to the Northwest. While early Kentucky bluegrass seed companies used machinery to strip the seedheads of the mature grasses in the fields, modern growers in Oregon, Washington, and Idaho mow the carefully weeded fields first, let the swathed crop dry in the field, and then use a combine to pick up and separate the seed from the stems. The difference means tremendously increased yields, purer seed, and improved germination of seed.

We'll trace today's improved varieties back to various parks and country clubs where natural stands of hardy grasses were discovered, collected for seed, and bred for hardiness and resistance.

In August we cover the history and development of the sod industry in similar fashion. September will cover seed and sod installation. October begins a look into current turf management practices and the history behind them. November and December issues will probe turf disease and insect control. **WTT**

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The more you listen to what he has to say, the more you'll know we've been listening.

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GREEN INDUSTRY NEWS

IRRIGATION

Buckner is purchased by Royal Coach

Following months of speculation about the fate of Buckner Irrigation System Division of Johns-Manville, Denver, Colorado, Royal Coach Sprinklers of Fresno, California, completed purchase arrangements for the Buckner line.

James Coson, founder of Royal Coach, owned the Buckner firm from 1961 to 1972 when he sold it to Johns-Manville. Coson said the two product lines will be consolidated into one brand, Royal Coach-Buckner. The Buckner distributors will be added to the Royal Coach distributor network.

The Buckner inventory and manufacturing equipment will be moved to Fresno as soon as possible.

Speculation about the fate of the large irrigation firm began when Buckner did not occupy its booth at the Golf Course Superintendent Show in St. Louis. Superintendents with Buckner systems expressed concern over repair and parts. The purchase procedure took months to complete and many thought it was the end of the line for this large company. The announcement of purchase comes as a relief to many turf managers with Buckner systems.

Pennsylvania Turfgrass Council 1980 officers: (left to right) President James MacLauren, Lebanon, PA; Executive Secretary-Treasurer Christine King, Bellefonte, PA; Second Vice-President J. Craig Reinhardt, Clementon, NJ; and Vice-President George Morgan, Allison Park, PA.

LAWSUIT

Dow accuses EPA of surveillance tactics

Dow Chemical Co. has charged in a federal suit that the Environmental Protection Agency has been using "spy-like military surveillance tactics" on it to discover company secrets.

The company says the EPA with the assistance of the Air Force and Navy is using several types of highly sophisticated and covert surveillance techniques to gather information about U.S. companies.

"Any photographs they took on their fly-over were public information under the Freedom of Information Act," says Tim Scott, Dow's communication specialist for environmental quality. The company started its original suit in 1978 because of fear that the photos would be released to its competitors and the public.

An amended suit expanded the charges against the EPA to more deeply pursue the government's action. Scott says Dow discovered that the EPA has employed the Air Force on 50 to 60 occasions over the last nine years for fly-over missions. "We don't feel the use of reconnaissance planes is within their charter," says Scott. "That's not what the EPA is all about."

Larry O'Neill, information specialist for the EPA, says the government acted entirely within the bounds of law. "We use the material to meet air and water standards," O'Neill says. "We consider it a perfectly legitimate enforcement tool."

LAWN CARE

PLCAA inaugural show is centrally located

The first Annual Meeting and Trade Show of the Professional Lawn Care Association of America has been scheduled for November 12-14 at the Commonwealth Convention Center in Louisville, KY. The location is roughly in the center of major lawn care market areas, easily accessible for both lawn care businessmen and suppliers.

But the hope is to get lawn care businessmen throughout the country to participate and to exchange ideas. Convention Chairman John Latting of Lawn Groomer, Normal, IL, says, "In this unpredictable economy, lawn care operators need to plan carefully to make effective decisions and maximize employe efficiency and productivity."

The convention program includes topics such as leasing versus buying equipment, employe motivation and training, advertising and public relations, budgeting and accounting procedures, computers, and many agronomic turf management topics.

Registration fees are not prohibitively expensive at only $35 for members and $50 for nonmembers. A $5 early bird discount is given prior to August 1. The registration fee difference may be applied to those who apply for membership within 30 days after the meeting.

The General Session begins at 1 p.m. on November 12 and ends at noon on November 14. Exhibits will be open from 8 a.m. on the 12th to noon on the 14th.

Persons interested in the first lawn care show and membership in PLCAA may contact Sharon Duling, 435 N. Michigan Ave., Suite 1717, Chicago, IL 60611 (312/644-0828).

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Pennwalt aquatic herbicides kill water weeds and algae on contact*. And because these herbicides are based on a non-persistent compound—endothall—there is no bioaccumulation in the aquatic environment. Endothall breaks down in two weeks or less into carbohydrates—common constituents of plant life.

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LANDSCAPE CONTRACTOR NEWS

Plantscape Assn. names executive director

Carol Felix has become executive director of the Interior Plantscape Association for the 1980-81 year.

Ms. Felix has served as IPA's executive director since its foundation in March 1979. Daily managing of association business and deep involvement in the annual meeting and regional seminars has provided her a strong background.

In IPA's second year of existence, which it has designated a year of technology, Ms. Felix plans to make certain that all important scientific and business information is readily available to the membership. She says that she is looking forward to a year of growth for IPA as other interior plantscape professionals join the ranks of the association.

Landscape business outlook good for 1980

Members of the National Landscape Association are predicting a year in which 85 percent expect increased sales.

Nationally, NLA firms are projecting a 10 percent increase in business. They indicate their best prospects are in residential renovation work, with new commercial landscape next, followed by commercial renovation landscaping.

New residential landscaping was the only category in which less than half the respondents indicated increases. This portion is to remain about the same with only small gains.

Two regional groups affiliate with ALCA; Oregon, metro Detroit bring total to 13

The Associated Landscape Contractors of Oregon and the Metropolitan Detroit Landscape Association became the 12th and 13th state/regional landscape contracting associations to formally affiliate with ALCA.

The two groups are titled "Sponsoring Members," which is the mechanism through which state and regional groups affiliate with ALCA. Under this arrangement, member firms of the Oregon and Detroit associations gain direct access to all ALCA publications and meetings.

ASLA to consider insurance programs

An investigation of various group insurance programs by ASLA national headquarters has yielded two potential programs for the ASLA membership.

The first program involves group health insurance with the added possibility of a health insurance trust owned by ASLA. This arrangement could produce "excellent group insurance benefits and moderate premiums for ASLA members and their staffs in private practice," said Ed Able, executive director, and Lane Marshall, chairman of Professional Practice Institute.

While a trust would not insure immediate lower premiums, "it would result in the return of any excess 'profits' from the program to the benefit of those members insured by the trust," said Able, "and not into the pockets of insurance companies as profits."

The second possilbity for ASLA insurance involves professional liability (errors and omission) insurance, which is traditionally a difficult and costly item for private practice firms.

INSECTS

IPM, latest research topics of turf symposium

Turf managers can avail themselves of the latest information on turf insect control, October 14-15, in Columbus, OH, at the "Symposium on Turfgrass Insects-1980" sponsored by ChemLawn Corp.

This is the second in-depth symposium sponsored by ChemLawn on major turf topics. The first was last fall on turf diseases.

Major topics to be covered include: host plant resistance, IPM programs for turf, pesticide research, new insect pests, and entomology and the turfgrass industry. The meeting is cochaired by Dr. B.G. Joyner, Plant Diagnostic Labs, and Dr. Harry Niemczyk of the Ohio Agricultural Research and Development Center, Wooster.

The subject matter is technically based. Registration is $25. Contact Dr. B.G. Joyner, Plant Diagnostic Labs, ChemLawn Corp., 6969 Worthington-Galena Rd., Worthington, OH 43085 (614/885-9588.)

UNIVERSITY

Nebraska's campus opens new plant center

The University of Nebraska-Lincoln dedicated a new plant science hall to house the agronomy, horticulture, and plant pathology departments. The 170,000 square ft. structure contains classrooms, greenhouses, and research laboratories. It is connected to the older plant science building.

The structure costs $10 million and has easily interchanged utilities for energy alternatives.

LAKE QUALITY

Symposium planned on lake water policy

An international exchange of scientific information and policy considerations on lake water quality problems will be presented September 8-12 in Portland, Maine.

The symposium is sponsored jointly by the U.S. Environmental Protection Agency and the Organization for Economic Cooperation and Development. The OECD established its Eutrophication Program in 1972 to monitor inland waters and to access the relationship between nutrient load and trophic response.

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Road maintenance engineers deal with heavy salt applications from the Rockies to the Eastern seaboard. And if you're a golf course superintendent or a park supervisor, you know the difficulties of turf maintenance in saline soil.

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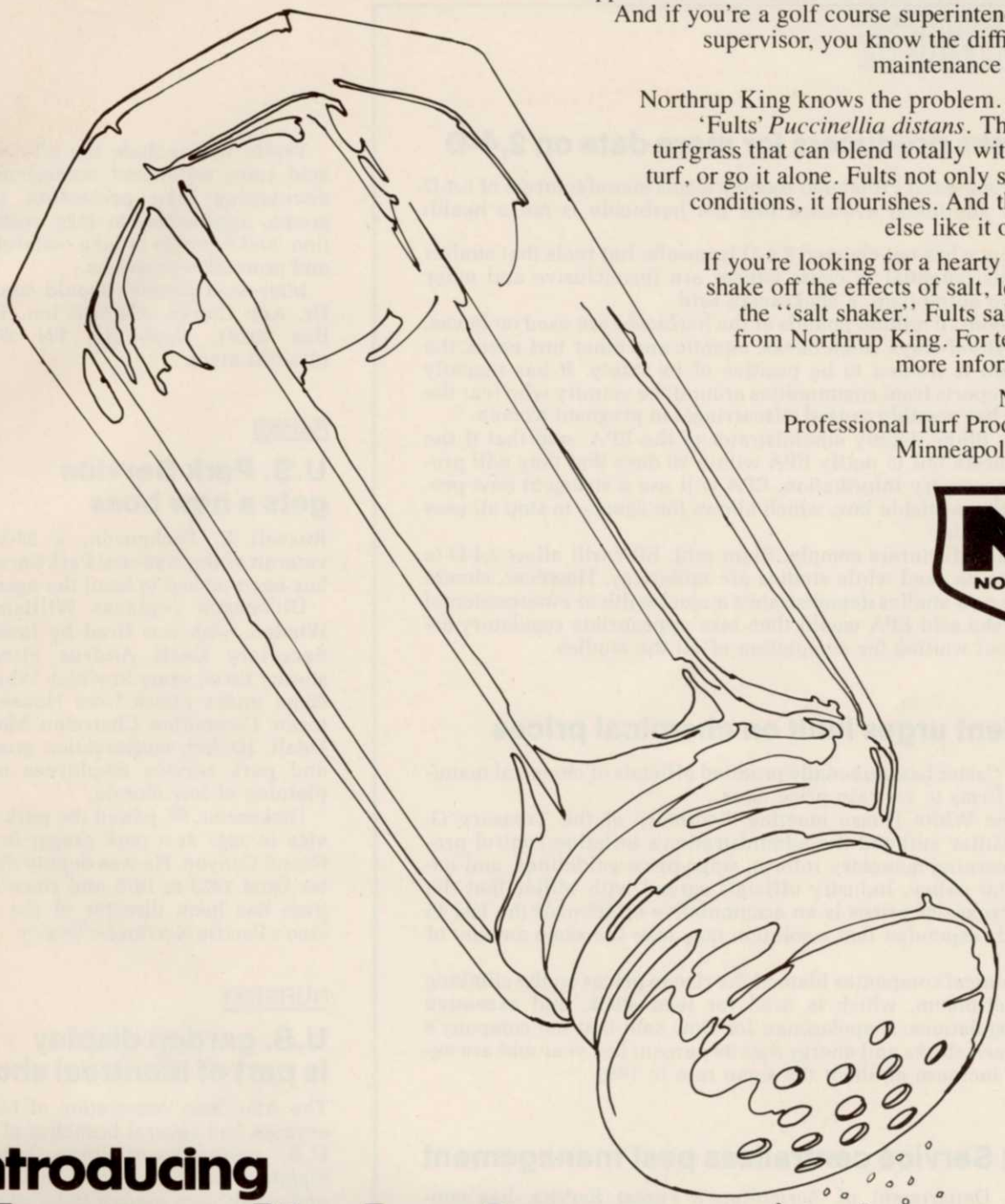

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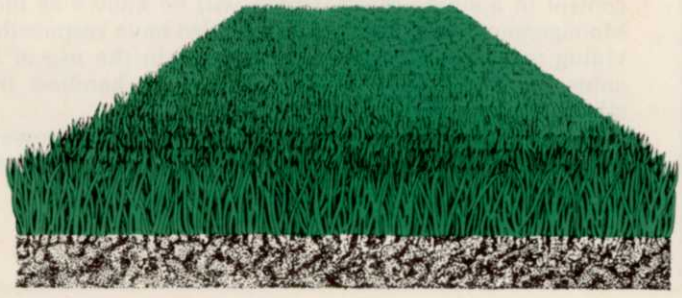

GOVERNMENT UPDATE

EPA asks producers for more data on 2,4-D

The Environmental Protection Agency wants manufacturers of 2,4-D to submit additional evidence that the herbicide is not a health hazard.

The agency has not claimed 2,4-D is unsafe, but feels that studies done on its potential to cause cancer are inconclusive and other studies are out-of-date, a spokesman said.

Since about 70 million pounds of the herbicide are used on lawns, forests, right-of-ways, ditch banks, aquatic and other turf areas, the agency said it wanted to be positive of its safety. It has recently received reports from communities around the country who fear the herbicide has possibly caused miscarriages in pregnant women.

Barbara Blum, deputy administrator of the EPA, said that if the manufacturers fail to notify EPA within 90 days that they will provide the necessary information, EPA will use a stringent new provision of the pesticide law, which allows the agency to stop all uses of the pesticide.

If the manufacturers comply, Blum said, EPA will allow 2,4-D to continue to be used while studies are underway. However, should any of the new studies demonstrate a major health or environmental problem, she said EPA would then take appropriate regulatory action without waiting for completion of all the studies.

President urges limit on chemical prices

President Carter has personally prodded officials of chemical manufacturing firms to restrain price rises.

After the White House meeting, Secretary of the Treasury G. William Miller outlined the administration's inflation control program concerning monetary reform, wage-price guidelines, and environmental policy. Industry officials agreed with Miller that the steady increase of prices is an accumulative effect over the last 15 years, and responded that a solution may take the same amount of time.

The chemical companies blamed the rise in prices on the climbing cost of petroleum, which is used for feed stock, and excessive federal regulations. A spokesman for Dow said that the company's costs for feed stocks and energy rose 39 percent last year and are expected to increase at about the same rate in 1980.

Forest Service centralizes pest management

The U.S. Department of Agriculture's Forest Service has consolidated its pest management activities to improve its use of integrated pest management against pest insects, animals, diseases, and plants.

M. Rupert Cutler, assistant secretary of agriculture for natural resources and environment, said the centralization places technical assistance responsibilities for pest management and animal damage control in a single group, which will be known as the Forest Pest Management Staff. The group will also have responsibility for providing technical advice and assistance in the use of forest herbicides. In the past, several staff groups handled these responsibilities.

The new staff group, to be directed by James L. Stewart, will maintain all of the Forest Service's current insect and disease control functions.

Topics will include the effects of acid rain, watershed management, developing lake protection programs, approaches to lake restoration, and benefits of lake restoration and protection programs.

Interested persons should contact Dr. Ann Clarke, AWARE Inc., P.O. Box 40284, Nashville, TN 37204 (615/794-0110).

PARKS

U.S. Park Service gets a new boss

Russell E. Dickenson, a 33-year veteran of the National Park Service, has been picked to head the agency.

Dickenson replaces William J. Whalen, who was fired by Interior Secretary Cecil Andrus after a stormy three years in which Whalen came under attack from House Interior Committee Chairman Morris Udall, (D-AZ), conservation groups, and park service employees complaining of low morale.

Dickenson, 57, joined the park service in 1947 as a park ranger in the Grand Canyon. He was deputy director from 1973 to 1975 and since that time has been director of the service's Pacific Northwest Region.

NURSERY

U.S. garden display is part of Montreal show

The American Association of Nurserymen and several branches of the U.S. government have joined together for the creation of a two-and-a-half acre garden to be part of the Les Floralies internationales de Montreal which begins in May. The display will contain more than 200 trees of 36 types, 2,600 shrubs of 30 types, and 21,500 perennials, wildflowers, ferns and grasses of 24 types.

The U.S. is among 30 nations participating in the event. Displays will be maintained as a permanent park after the show ends in September.

The Floralies internationales begins May 17 at the site of the 1967 Exposition and Olympics in Montreal, and ends September 1.

The display has been named the

Continues on page 65

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There's a good reason why Cushman has been around for such a long time: We build equipment that lasts a long time.

And that's never been more obvious than with our new Front Line rotary mower.

Built for keeps.

The Front Line's 72" mower deck is made of 12-gauge carbon steel, reinforced and arc welded. It has a multi-disc PTO clutch, direct drive to the deck gear box with a sealed and lubricated shaft drive. The hydrostatic transmission is driven by two continuously engaged "A" section belts with self-adjusting tension.

There's no need to worry about overloading the Front Line's engine. The combination of our high torque engine and specially designed mower deck allows you to mow tall weeds and fine grass.

Superior performance.

The Front Line's cut in fine grass is so smooth, you won't believe it was made with three separate blades. That's because the blades overlap 1½" to reach every inch of grass in the full 72" swath. Also, the cutting height is adjustable to eight positions, from 1" to 4½" in half-inch increments.

Operating the Front Line couldn't be easier. With individual front wheel brakes, and wheel-type steering controlling a single rear wheel, you get tight maneuverability and better control on varying terrain.

The Front Line's mower deck makes your job easier, too. It extends more than a foot to one side, so you can trim right up to fences or trees. And it lifts hydraulically for transport over curbs. What's more, a large capacity fuel tank lets you work up to 6 hours between refills.

100% Cushman.

Most rotary mowers use engines built by outside suppliers. Not the Front Line. Its 18-hp, air-cooled engine is all-Cushman. So is the differential. And the PTO drive. Which means all parts and service are provided by your Cushman dealer.

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EFFECTIVE AQUATIC WEED CONTROL ENTAILS MIXING MANAGEMENT TOOLS

By John Kerr, Assistant Editor

Even though the U.S. Department of Agriculture does not define the aquatic weed manager's work as integrated pest management (IPM), the term well describes the approach of the aquatic weed manager. Integrating diverse methods of control as opposed to a rifle approach with only one method has been the weed manager's tact long before the government coined it this way. He has gathered information about plants and their life cycles; identified natural predators and their characteristics; and discovered their vulnerability to various chemicals and breeding sites. Pursuing chemical, biological, mechanical, and cultural fronts against aquatic weeds has been not just the most effective way but the only way of control.

"When the notion of integrated control came out several years ago, there was talk of putting one method together with another to double control, smothering the weeds," says Louis Decell, manager of the aquatic plant control research program for the U.S. Army Corps of Engineers. "Now we are doing a better job of management. If you use an integrative program with different means, you get a synergistic approach to control."

Leon Bates, a biologist for the Tennessee Valley Authority, says, "The new trend, the necessary trend is integrating methods of control. These weeds are so efficient in reproducing, one means is not enough. Also, environmental compatibility is important and will require an integrated approach."

Chemicals still provide the most popular control for aquatic weeds. Herbicides are usually inexpensive, easy to use, and regularly successful. Although there is a constant influx of new materials on the market, most are variations of four major active ingredients or several minor ingredients. According to Dr. Alva Burkhalter, bureau chief of aquatic plant research and control for the Florida Dept. of Natural Resources, the four basic kinds of aquatic compounds include 2,4-D, copper compounds, endothall, and diquat. He lists minor ingredients as Amitrol, dalapon, dicholobenil, Fenac, simazine, Roundup, Diuron, Banvel, Ammate, and aeromatic oils.

Many variables exist for comparing the major ingredients. Labels should be closely read for uses and restrictions. Burkhalter cautions the applicator to look particularly at the active ingredients, because manufacturers of different formulations may attempt to sell a weak product at a cheap price. The charts (p. 17, 18) explain Burkhalter's compilation of major and minor herbicide ingredients, their uses, and limitations. However, use and restriction in one state may totally differ from that of another because of regulatory agencies.

Since 1963, biologists have been studying the white amur, a species of grass carp imported from China, and its ability to control weed spread. Only five states — Florida, Missouri, Arizona, Iowa, and Kansas — have laws that allow its use and those on a limited basis. States have made it illegal to import because of fear it will overpopulate waters of fish indigenous to the area.

Last year, study began on a hybrid carp, called the "triploid." This fish is a hybrid between the female grass carp from China and the male big head carp from Siberia. It contains 72 chromosomes compared to a normal 48 in the white amur. But more importantly, data from Hungary, where the fish was originally produced, shows that it is sterile. This could make it very attractive to states worrying about infestation of the white amur.

Jim Malone, owner of Jim M. Malone & Son Enterprises in Lonoke, Arkansas, developed the first triploid in the United States. He expects to sell the fish in Florida this year and has recently sent some to California for experiments. The triploid should be sterile 99 times out of 100 and be an excellent weed eater, Malone says. "If the triploid proves a success comparable to the white amur, it's predictable the Florida Game and Fish Commission will use it against native plants as well as exotics without a barrier restriction."

Tom Jackson of the Fish and Game Commission in Denver has also been studying the triploid and is enthusiastic about its potential in the west, where there are more than 20,000 square miles of water surface in 17 states. Much of this water lies in irrigation canals, which often have restrictions on herbicide use. "I'd like to substitute the carp for herbicides," Jackson says. His office has researched fluridone (Sonar), which shows promise for controlling hydrilla and other plants without harming fish. Yet it is his opinion that "The long term prospect for chemical control is that the cost is skyrocketing at a rate which will put it out of reach of small organizations. The same goes for mechanical controls with gas engines."

"I don't see the fish replacing chemicals and mechanical controls," Malone says. "I stress the point of fine tuning the water. We've always had two tunes available; we need three." He says that where potability is not a factor, one can use chemicals. And for immediate relief, mechanical controls do a good job. "The triploid is just another tool that needs to be incorporated into water management."

Other types of natural predators of aquatic weeds include insects, pathogens, and other animals. In the past 12-15 years, the Army Corps of Engineers has been researching two types of moths for the control of water hyacinth. The Sameodes moth has already proven successful. The Arzama moth, another good predator of the water hyacinth, does not yet reproduce itself for solid establishment in the environment. The Corps thinks it will happen in a year or two.

In other biological work, the Environmental Protection Agency has granted the Army Corps permission to go ahead with work on the Cercospora fungus, which also attacks the hyacinth. Crews

Major Ingredients of Aquatic Herbicides

Product	Uses	Restrictions
1. 2,4-D		Very selective, potential drift hazard. Limited in irrigation and swimming. Has potable drinking tolerance.
A. dimethyline salt	Broadleaves; floating and ditchbank plants	
B. butoxy ethanol	Submerged plants, mainly milfoil	
C. emulsamine	Broadleaves; floating and ditchbank plants	
Manufacturer: Many companies Comment: Only a few of the many formulations have aquatic registrations.		
2. Diquat	Submerged plants primarily, but fairly broad spectrum. Also for floating aquatics, such as duckweed and water hyacinth.	For irrigation, 2-3 weeks. Won't work in muddy water.
Manufacturer: Chevron and others Comment: Consumers beware! There are many trade names with varying rates and percentage of active ingredients. More active in warm climate and sunlight.		
3. Endothall	Most forms non-selective. Gives fairly broad control, but primarily for submerged weeds and algae trouble.	Toxic to fish at high rates.
Manufacturer: Pennwalt Comment: Some products are best used as partial treatments to prevent fish kill.		
4. Copper compounds	Primarily for algae control and in combination with endothall or diquat for submerged weed treatment.	Fish and plants are sensitive at low rates in soft water and high rates in hard water.
Manufacturer: Many companies Comment: Beware of the existence of many different types of coppers, especially copper sulfates. Most active in sunlight and higher water temperatures.		

have recently applied a commercial formula produced by Abbott Laboratories in a dry powder in a large-scale experimental test and are studying results.

Other micro-organisms which host upon aquatic weeds are being examined as potential control agents. Competitive plant species have been introduced in some areas to overtake existing noxious species. And although not done with any prescribed formulas, putting ducks and swans in an infested water body can help the situation.

Different types of mechanical equipment, which mainly cut and harvest aquatic weeds, are available to the weed manager. The boxed article delves into specific details of some of the equipment. Units range in size from sickle blades which attach to a rowboat up to large harvesters equipped with retrieval and unloading conveyors.

Harvesters often combine with chemical treatment for effective treatment along hard-to-reach shoreline areas. Another approach involves harvesting a week or so prior to chemical treatment. Drawbacks to harvesting include limited mobility around shorelines and uneven bottoms, short-term control requiring several cuttings, and the ability for regrowth to branch out and become denser.

Cultural controls, or ways of manipulating plant habitats, can also help stop the spread of weeds. A form of algae like the *Chlorela sp.* with a light green tinge keeps the sunlight from going below 2½ ft. of the surface. Applicators have also tried other means, such as black plastic sheeting, soluble dyes, and artificial structures.

Jim Carsner who runs Aquatic Control Co. in Tacoma, Washington, says that the State of Washington has purchased five acres of Aquascreen to control watermilfoil in parks and lakes. This fiberglass screen with a fine mesh sinks to the bottom and prevents light from getting to the plants. Because of its expense, the screen suits high-use areas.

Other plant managers have used drawdown or periodic lowering of water levels to expose bottom sediments for drying out underwater weeds. Freezing of the ground during drawdown will also kill the roots and underground stems of certain aquatic plants.

Using a combination of means seems to give the aquatic weed manager encouragement to experiment and share discoveries with his colleagues. Bill Rushing, president of the Aquatic Plant Management Society, thinks that environmental restraints and controls have also fostered this situation. Yet depending upon what part of the country and what type of water body you work, certain methods will be more successful. "All aquatic problems are site specific," Rushing says.

In the Tennessee Valley Authority area, which encompasses 625,000 acres of impounded water and 11,000 miles of shoreline, managers are spending more than a half million dollars a year to keep Eurasian waterfmilfoil at a level that allows use of the lakes. Research has shown that stranding or dewatering the weeds by water level drawdowns and then applying 2,4-D to colonies that remain in the water are effective and environmentally acceptable control methods. "The most effective and economical way to control waterfmilfoil is to lower the lake level to expose plants for several weeks to drying or freezing," says Leon Bates, but the Tennessee Valley Authority cannot lower all its lakes far enough without interfering with other uses.

"We know Eurasian watermilfoil can't be eliminated from the Tennessee Valley area," says Bates. "It's biologically so productive, it's not feasible to remove each fragment. All the plant needs is a single sprig to proliferate in a short period of time." He has investigated mechanical and biological means but they are not feasible at the present. Spinyleaf naiad, often mistaken for Eurasian watermilfoil, is another serious problem for

the Tennessee Valley Authority, which only recently got clearance to use diquat against it in some states.

Fears are arising that hydrilla, the bane of aquatic bodies in Florida, threatens to invade the Tennessee Valley. It is already an $8 million problem just trying to control its spread and keep some boat channels open in Florida. Researchers hope that the grass carp helps with both hydrilla and water hyacinth, Florida's two major infestations. Two weevils, the *Neochitina eichhorniae* and *Neochitina bruchi*, along with the Sameodes moth, also slow these rapidly growing weeds.

Mechanical harvesters work well for quick control in the artificial canals of Florida, but cannot sustain the check of weeds in natural systems. Weed managers use endothall and combinations of diquat and copper compounds on hydrilla and 2,4-D, and diquat on water hyacinth. Eurasian watermilfoil, alligatorweed, reeds, and other plants must be dealt with in artificial systems. Dr. Burkhalter says that the mixture of natural and artificial bodies of water as well as the various aquatic weeds in Florida lend good reason for integrative controls.

Donald Lee, coordinator of aquatic plant research and control in the Louisiana Dept. of Wildlife and Fisheries, says that Louisiana uses all of the four main ingredients on its aquatic weeds. He suggests 2,4-D for water hyacinth, alligatorweed, and Eurasian watermilfoil. Endothall, copper compounds, and diquat in varying rates help control submersed weeds.

Minor Ingredients of Aquatic Herbicides

Product	Uses	Restrictions
1. Amitrole (amino triazole)	Primarily ditchbank material. Fairly non-selective.	
Manufacturer: Union Carbide		
2. Dalapon (Dowpon)	Primarily for ditchbank and shallow water. Irrigation-type canals west of the Mississippi.	
Manufacturer: Dow		
3. Dichlobenil (Casoron)	Control in water levees. Works best in early part of growing season.	Irrigation, swimming, and fish.
Manufacturer: Thompson-Hayward		
4. Fenac	Primarily in drawdown areas.	
Manufacturer: Union Carbide		
5. Simazine (Aquazine)	Enclosed ponds or lakes. Broad spectrum.	For irrigation, 12 months.
Manufacturer: Ciba-Geigy		
6. Roundup	Primarily monocot ditchbank grasses and also broadleaves.	Limited in water.
Manufacturer: Monsanto		
7. Diuron (Karmex)	Primarily ditchbank and irrigation canals.	Apply after flushing.
Manufacturer: duPont		
8. Banvel (dicamba)	Primarily ditchbank.	Only has state registration for water use.
Manufacturer: Velsicol		
9. Ammate (ammonium sulfamate)	A chemical trimmer for ditchbanks and other areas.	
Manufacturer: duPont, Chipman		
10. Aeromatic oils (acrolein)	Irrigation canals in western states. Broad spectrum.	Highly toxic to fish and wildlife.

Although the white amur remains on the prohibited list in Louisiana, biological agents, such as the alligatorweed flea beetle, two species of hyacinth weevil, and two species of moths, are widely used. Very little mechanical control is involved, one reason being the deep ditches which prevent access.

The western part of the country is often overlooked in the subject of aquatic weeds. Of the 17 states, there are 240,000 miles of canal constructed by the Bureau of Reclamation. Dependence on this water for irrigation and holding reservoirs makes weed control very important from an economic standpoint.

In the Southwest, particularly southern Arizona, lakes and golf course ponds are loaded with spinyleaf naiad. Tom Camp, who runs the Aquatic Management Co. in Phoenix, employs chemical, biological, and cultural practices to counter the weed's spread. Aquathol K works well at low rates and won't hurt fish. The *Tilapia zillii* is a very aggressive, weed-eating fish, which reproduces between 1,000 and 5,000 within 28 days. Camp also will use *Chlorella* algae to his advantage. The phytoplankton give a light green tinge to the water and prevent sunlight from reaching beneath 2½ ft. of the surface.

In northern Arizona, Camp has a different problem — Eurasian watermilfoil in 90 percent of the lakes. He uses gypsum to bring the pH down in areas of extremely heavy growth and then a granular 2,4-D to clean up.

Scientists discovered a new infestation of hydrilla in 1977 in the Imperial Valley, whose water irrigates much of the cropland of Southern California. One quarter of the Imperial Valley's irrigation system, about 370 miles of canals and laterals, is filled with hydrilla. Experiments are presently testing the hybrid grass carp on a trial basis in an area from which the fish can't escape. Eurasian watermilfoil abounds in canals, reservoirs, lakes, and ponds; pondweeds of various types, spinyleaf naiad, cattails, and bullrushes also thrive.

One popular herbicide is the copper compound Komeen, says Leslie Sonder from the California Dept. of Food and Agriculture. It is especially effective in combination with Nalquatic, a thickening agent which holds the Komeen in close contact with a plant.

Dr. Richard Yeo of the botany department at the University of California-Davis suggests endothall and diquat for hydrilla, 2,4-D for watermilfoil, and acrolein for submersed water weeds. He is studying spikerushes, which grow only 1 to 2 inches tall, and can displace water weeds.

In the Northwest, serious action against aquatic weeds began in 1977 when the Army Corps began investigating Eurasian watermilfoil in the state of Washington. The Grand Coulee, which supplies water for thousands of acres of irrigation, had become a home for milfoil. The Seattle area is spotted with recreational lakes and residents noticed the encroachment of weeds. While the Seattle District Corps of Engineers was doing its study, Metro, Seattle's metropolitan area government, was also

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conducting a two-year study.

The Corps presented a choice of methods to the local government, who manages the program. "We're letting them tell us what they want to use," says Bob Rawson from the Seattle District Corps. "We realize not one method is applicable to all situations. One method won't usually work." The program studied Aquascreen, harvesting, and herbicides.

Suzanne Schweitzer, program manager for the aquatic plant control program for Metro, says, "Aquatic plant control is a relatively new topic so we looked at what other parts of the country are doing." Metro has recommended that non-chemical control techniques should receive priority for 1980 with respect to the Corps of Engineers cost-sharing for the program. Metro is working this year with citizens and governmental agencies to halt use of the herbicides dichlobenil, diquat, and 2,4-D and by next year develop a uniform herbicide policy. It is encouraging harvesting on a much larger scale and use of Aquascreen on city beaches.

In the Midwest, managers of inland waters — ponds mainly for recreation, fishing, and watering livestock, golf course ponds used for ornamentals and irrigation, natural lakes, and drainage ditches — contend with filamentous algae, cattails, and underwater weeds like Eurasian watermilfoil. None of the states in this region have legalized biological controls. "People have worked with the grass carp but there is skepticism about its benefits," says Dr. Carole Lembi, from the department of botany and plant pathology at Purdue University.

Lembi says that the larger communities have invested money in mechanical harvesters, but chemicals are the main way of dealing with the problems. Copper compounds, especially copper sulfate and Cutrine-Plus, work on algae; Aquathol-diquat combinations against watermilfoil; and Dowpon against cattails. Lembi says that a combination tank mix of Cutrine-Plus, Aquathol, and diquat provides a broad spectrum control of algae, watermilfoil, coontail, and pond weeds.

Continues on page 25

MECHANICAL OPTIONS FOR THE AQUATIC CONTROL MIX

Benefits of a successful aquatic weed control program clearly reveal themselves when one has seen the destruction and waste weeds can produce. When dead fish, foul odors, and excessive algae leave for clean, healthful, and enjoyable water, the transformation stuns the eye. That it happens does not startle the experienced applicator, but what can do the job may surprise him.

Chemicals, because of their popularity and long-time use for land applications, have been discussed more thoroughly than other means of aquatic management. Other industries have also begun to contribute to the relatively new field of aquatics. Manufacturers of harvesting equipment, aerators, and other products have devised their own solutions to weed problems. What follows captures a few of these now available.

Harvesters

In states where regulatory agencies have restricted certain substances in the water, use of mechanical haresting has become more widespread. Although documented reports are usually kept for chemical applications in an aquatic project, accounts of a mechanical harvesting operation rarely show specific cost and effectiveness information. A study done by Gerald Smith of Aquatic Control Technology, Inc., Wayland, MA, revealed that harvesting can be an effective control over aquatic weeds in terms of both cost and yield.

Aquamarine Corp., Waukesha, WI, makes a "CHUB"—Cutter Harvester Utility Boat—to control weeds. With two levers, an operator maneuvers the zero-turn radius transmission, which drives the two aluminum paddle wheels in six inches of water. Visibility is unrestricted and all controls operate easily.

High aluminum handrails and a non-skid deck make the CHUB safe. The cutter bars and conveyor stop automatically and instantly when the operator's foot leaves the clutch pedal. Simple V-belt and chain drives keep the harvester easy to maintain.

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Aerators

Through oxygenation and mixing, aerators can produce many beneficial effects on water quality. With an adequate supply of dissolved oxygen, fish will stay healthy and the natural processes that biodegrade organic wastes will have a chance to work. This reduces unpleasant odors and gives the water a cleaner, fresher appearance. Aerators can also create sparkling spray displays in ponds in parks, golf courses, and municipal bodies.

Barebo Inc., Emmaus, PA, makes an Otterbine line of industrial aerators, which it calls a "floating mechancial surface aeration/mixing system." They have two components — a high-density, foam-filled polyethylene plastic float and a sealed electric power unit that contains an electric motor which runs in a bath of oil. The motor operates at 1,750 rpm, a low speed that helps prolong motor and bearing life.

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Continues on page 25

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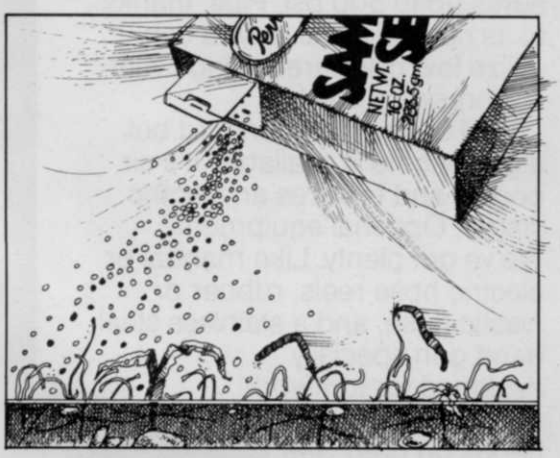

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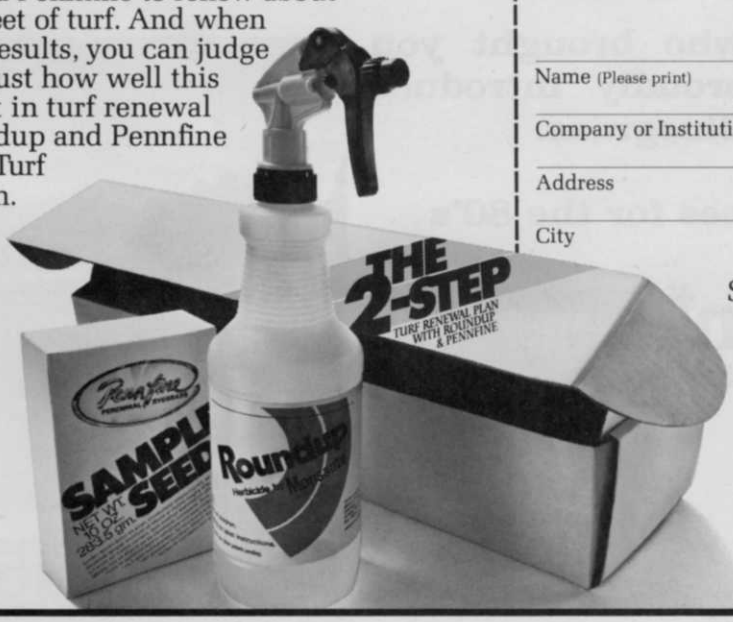

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33 ☐ $5,000 to $15,000
36 ☐ $15,000 to $30,000
37 ☐ $30,000 to $50,000
38 Other_____

3B/ Fertilizers (All Formulations)
51 ☐ Up to $5,000
52 ☐ $5,000 to $15,000
53 ☐ $15,000 to $30,000
56 ☐ $30,000 to $50,000
57 ☐ $50,000 to $70,000
58 Other_____

3C/ Equipment (for turf, tree and grounds care)
61 ☐ Up to $10,000
62 ☐ $10,000 to $30,000
63 ☐ $30,000 to $60,000
66 ☐ $60,000 to $100,000
67 ☐ $100,000 to $150,000
68 Other_____

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72 ☐ $5,000 to $15,000
73 ☐ $15,000 to $30,000
76 ☐ $30,000 to $60,000
77 ☐ $60,000 to $100,000
78 Other_____

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Homeowners around Midwest lakes often form an association and then contract an applicator to do the work. A group of researchers recently started its own Midwest Aquatic Plant Management Society and is trying to get affiliation with the national organization. Its main objective, says Lembi, is to exchange technical information on aquatic plant management and involve the commercial applicator.

The Northeast, where aquatic weeds are fortunately not a severe problem, does not have a formal approach to the few weeds that find their way into lakes and rivers.

The North Atlantic division of the Army Corps has recently studied the water chestnut, Eurasian watermilfoil, and yellow floating heart in Lake Champlain and started a 10-year program with mechanical harvesters, says Dr. Robert Pierce of the division. New York has completely cut chemical control and is studying biological controls.

Managers, both researchers and applicators around the country, have begun to share expertise about the unique aquatic environment and the plants they want to control. Although problems vary throughout the states, this exchange crosses borders as freely as rivers. Florida's study on watermilfoil will help Washington, and Arkansas's experiments with the triploid should benefit California. Today's weed problems necessitate a broad-based diversified attack.

Aquatic plant management in many regions is just emerging from its embryonic form. For others who have been dealing with severe problems, the science, profession, and solutions are still in the early stages of development. Says Dr. Burkhalter, "Aquatic plant problems and control technology are rapidly changing. The future of aquatic plant management belongs to individuals who will do likewise." **WTT**

Mechanical Options *from page 20*

additional oxygen to the water through splashmaking and wavemaking. The company makes various models for different applications. (Write **202** on reader service card).

Clean-Flo Laboratories, Inc., Hopkins, MN, manufactures an aeration system called the "Fish-Air." Based on the principle of multiple inversion, it floats the bottom water up to the surface to be oxygenated by the energy in the wind. Through this multiple inversion, Fish-Air rolls a pond or lake over and over so every drop of water repeatedly comes to the top.

The system consists of an oilless 1/3-horsepower, 115-volt, single-phase compressor, necessary fittings, a spare set of air filters, a location float, a microporous diffuser, and easy instructions. It can purify an acre of water 6 feet deep three to four times a week while using the electricity equivalent to a 250-watt light bulb. Fish-Air works in all types of water bodies. (Write **203** on reader service card).

Dredgers

Dredging can remove existing rooted plants and nutrient rich sediments and also increase water depths. If the bottom is properly contoured, underwater weed growth can be reduced or eliminated. Large hydraulic dredges may be used on large bodies of water.

The Water Vac Dredge, made by Aztec Development Co., Orlando, FL, removes both rooted weeds, such as hydrilla, by the roots and tubers, and floating weeds, such as water hyacinth. It can also deepen canals, remove shoals, and do work normally involved in dredging. Because of its nonturbidity and ability to ingest and mulch weeds, this machine can also take out deposited runoff, sediment, hazardous materials, and muck down to the original bottom and safely enclose these materials in pipes for transportation to remote areas.

The machine cuts an 8 foot wide by 18 inch deep row of weeds, and can operate to a depth of 10 feet, 6 inches. It is 30 feet, 2 inches long, 8 feet wide, and weighs 16,000 pounds. It can hold 360 gallons. (Write **204** on reader service card).

Dredgeast, Inc., New Canaan, CT, makes the Mud Cat dredger to remove mud, muck, silt, sand, chemical sludges, and industrial wastes from water bodies without severely disturbing the water. A well-muffled diesel engine, capable of pumping 2,000 gallons per minute of liquid with solid concentrations of up to 20 percent, powers it. The cutter head houses a spiral auger with twin horizontal screws which enables it to make a precise cut of up to 15 feet deep and 8 feet wide.

Mud Cat can remove 120 cubic yards of solids per hour. It maneuvers around stumps and other obstructions. It is 30 feet long by 8 feet wide and draws only 21 inches of water. (Write **205**).

Miscellaneous

Every piece of equipment used to control weeds is not mechanical yet the unique nature of this material defies classification into a large listing. One of these is Aquascreen, a closely woven, vinyl-coated screening material that is inert, very strong, and durable. Menardi-Southern Corp., Augusta, GA, manufactures it.

When pinned to the bottom of a pond, this material controls weeds by compression and by reducing 50 to 60 percent of the light necessary for growth. The weeds covered will decompose over a four to six week period, while life continues back and forth through the screen. It transfers to another site by just pulling the pins, moving it, and replacing it. (Write **206**).

Aquashade, Inc., Eldred, NY, also has a solution to the problem of aquatic weeds—Aquashade. This liquid concentrate turns water a beautiful blue to cut off the sunlight that weeds and algae need for growth. Water remains non-toxic to fish, wildlife, and people, making it immediately safe for swimming. It is a continuing control after application, stopping excessive algae and weed growth for a period as long as the color stays.

Aquashade is best applied at a rate of 1 gallon per acre of water four feet deep. Application remains in the water dependent on length of growing season, water flow rate, fertility, and clarity. (Write **207**).

MANAGING TREES TO REDUCE DAMAGE FROM LOW-LEVEL SALINE IRRIGATION

By E. P. Van Arsdel, Associate Professor,, Forest Pathology, Texas A&M University, College Station, Texas

Accumulation of salts in shade trees from low-level saline irrigation water (which is absorbed by the roots and left behind in the leaves from evaporation and transpiration) is common in areas where irrigation is used to supplement the natural rainfall. It is more common where most of the water taken up by the trees is from irrigation. Chloride builds up in the leaves where the water contains 40 ppm chloride. This is common in Bryan-College Station, Texas, and in areas to the west and north. Calcium and sulfate in the water tend to reduce the amount of damage from the sodium and chloride.

The damage to vegetation from low levels of salt is occurring with water usually considered safe for irrigation. The water in Bryan and College Station is classed as fresh or slightly saline (Texas Dept. Health 1977, Winslow and Kister 1956), but evaporation from the leaves causes chloride to build up in them to well above toxic levels. The sodium also builds up to high levels in the soils. The soils themselves contribute to the problem because their impermeability prevents the salts from being leached away, and the abundant montmorillonite clay has a great capacity to absorb sodium.

The salinity standards for waters have been set by their content of total dissolved solids (Winslow and Kister 1956), but the water in Bryan, College Station, and Texas A&M University has an uncommonly high proportion of its dissolved solids in sodium and chloride (Tex. Dept. Health 1977). Carbonate is the only other abundant ion.

Another factor contributing to the commonness of saline injury to shade trees is the use of unnecessarily large quantities of irrigation water by the homeowners in irrigating their lawns. They often use many times the amount of water a farmer would use to irrigate his crop to bring it to maturity.

Some owners whose trees have declined or died from salt accumulation from the irrigation water are reluctant to modify their management practices; but unless the practices are changed, after the trees have died the conversion of St. Augustine grass to more salt tolerant Bermuda grass might occur. This grass might then give away to more salt tolerant weeds, and then bare spots might appear in the lawn. Such shifts may portend a local desertification of the lawn through sodium accumulation and the advanced development of black alkali. Not responding to the declining and dying trees and the shifts in vegetation by changing management practices can lead to greater problems in the future. A picture on page 626 of the November 1979 National Geographic shows advanced cases (Gore 1979).

Diagnosis

Salt in trees may come from many sources, and it has been said that the sources of salt, whether from the ocean, highway deicing, or saline soils are not important (Dirr 1976). However, there are differences in the amount of salt taken up by the leaves

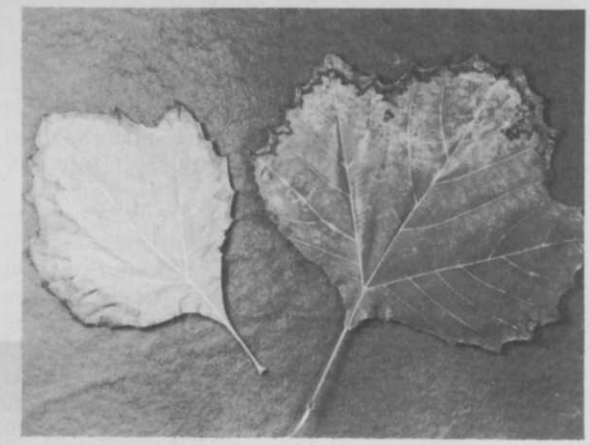
or the roots. For example, southern Magnolia, which has a thick glossy cutin on its leaves and does not readily absorb airborne ocean salt sprays, does readily absorb salt in the irrigation water through its roots. It is relatively more resistant to salt in the air than it is to salt in the soil solution. The gross symptoms of dieback on a post picture (p. 27) shows oak absorbing salt from low-level saline irrigation applied to a golf green.

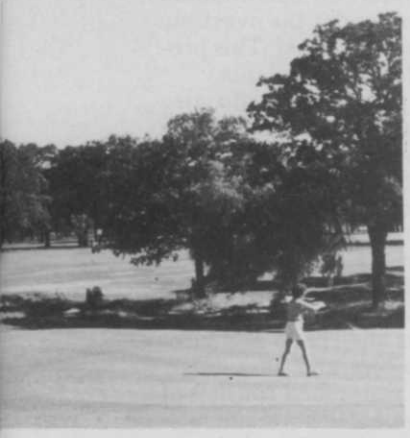
The symptoms of salt injury are difficult to distinguish from symptoms of infection with the oak decline fungus *(Cephalosporium diospyri)*. Both maladies produce thin crowns through which skylight is readily seen, both cause dieback. At times the salt produces a brown or gray peripheral injury of the leaves. In cases where the spring rains were adequate and irrigation was delayed until summer, a serial reduction in leaf size has occurred. Full sized leaves were produced in the spring, but each new set of leaves produced was smaller than the last one, and in the fall the last leaves formed were truly tiny dwarfs.

Comparative leaf symptoms of some maladies on oaks, including salt, are illustrated in another paper (Van Arsdel 1978). Salt injured trees seem to be more subject to wind breakage, and insects seem to prefer to feed on them.

Usually the separation of the fungus decline from the salt injury requires culture isolation tests for the fungus, salt (chloride) tests for the leaves, and soil tests for alkalinity and sodium content. Both maladies produce similar physiological drouths and they often occur in the same tree at the same time. Where they occur together the two kinds of physiological drouth supplement each other.

Killing the vascular wilt fungus with a systemic





Post oak by golf green exhibiting saline irrigation decline.
Sycamore leaves with perimeter scorch and shape distortion caused by saline low-level saline irrigation.

fungicide makes the trees seem to recover, with larger leaves and crown thickening, but if the saline irrigation continues, the trees continue to die back and decline. The dwarfed leaves have been found with salt injury in the absence of the decline fungus, and the trees have had dieback and eventually death from the salt, but we have not had cases in which the saline irrigation was terminated to see what effect this would have on the *Cephalosporium* infected trees. We now have a case where we can terminate the saline irrigation by using unsoftened water where salt-softened-water was the source of the sodium and chloride, and this should disclose the symptom change where the salt water intake is reduced and the *Cephalosporium* remains undisturbed.

An important part of the diagnosis for salt injury is the testing of the irrigation water for its salt content. This can be done with chloride testers (titration) or spectrophotometrically for the sodium, but in Texas all of the public water supplies are regularly tested by the State Board of Health. The results are available upon request and are also published in a book. Often the slightly saline water supply is the only water available for irrigation, and the problem is to manage the irrigation when the only supplies are saline. Some representative Texas water supplies were listed with their salt contents in my recent paper (Van Arsdel 1979).

Another aid to diagnosis of saline irrigation is the order in which the trees and shrubs show injury or die. A table of relative susceptibility is appended. This list should aid in diagnosis and in suggesting substitute plants where saline irrigation can not be avoided. This rating list carries the salt tolerance level beyond the least tolerant plants listed in the USDA Ag. Hndbk. 60, and some of our most "resistant" plants are among their "least tolerant" species. Our listing is in closer agreement with another list of salt tolerance which summarizes observations of many authors of the salt tolerance of shade trees to blown and splashed deicing salt along roads in the northeast (Uirr 1976). Together the three lists indicate that shade trees are generally less salt tolerant than field crops.

Mode of action

Salt is sodium chloride, and its solutions contain these ions independently. They act in different ways as they cause the decline of trees absorbing the salts. The chloride does not reach a high level in the soil — 50 ppm is the highest I have measured — and usually there has been less than 20 ppm. The chloride builds up to high levels in the leaves of the trees. There is usually dwarfing at levels of 1,000-3,000 ppm chloride in the leaves, and there are usually scorch symptoms at more than 3,000 ppm. I have found as much as 35,000 ppm in living leaves, although more than 6,000 ppm is exceptional. The chloride concentrations above 3,000 ppm kill tissues, and cause the perimeter scorch, but chloride is mobile in the plant, and the level often decreases during rainy weather.

Sodium builds up to high levels in soils. Levels of 2,000 ppm sodium in the soil are fairly common. This is usually indicated by extreme alkalinity (pH 8.5-9.0). The sodium builds up to the highest levels where montmorillonite clay in the subsoils prevents percolation. This clay is the fraction of the soil that absorbs the sodium and holds it. The sodium disperses the clay causing the soil to lose structure and to become hard, alkaline, and impermeable in a condition known as black alkali. Trees can not grow in a soil in this condition.

Management program to minimize damage

Management of low-level salinity irrigation problems presented here involves changing the source of water, watering less, and making physical and chemical modifications to the soil. Often alternative sources of water are not available, but most homeowners can water less. Locally, the Lufkin soil on Yegua formation parent material, permits no internal drainage through the claypan or the deep layers of clay and shale under it and thus prevents leaching, but some leaching can occur over the surface, especially in winter when there is abundant rain and low evaporation. Each of these management alternatives is considered below .

Normal procedures to manage crops with saline irrigation are (1) to grow salt tolerant crops, (2) to avoid clay in the soils, and (3) to provide excellent drainage to permit leaching (Boyko 1968). None of these alternatives are available to us. We are working with plant species more susceptible to salt than those generally considered in the saline soil and irrigation literature (Richards 1954), and with plants which are already growing on the site with no chance of moving them. The soils we are concerned with must be utilized in place, and have high montmorillonite clay contents in both the soil and subsoil. These clay soils originally had no in-

ternal drainage, but the addition of salt through saline irrigation makes them even less permeable to water. Often they are held to certain levels by streets, curbs, and gutters that were laid out with no plan for drainage.

Change the water source:

If water of very low salinity is available, then using it is a good solution. Some examples follow.

Rain barrel: Potted house plants, greenhouse plants, or any other plants under roofs and not receiving rainfall usually have salt injury. Using rainwater is a very good solution to the problem. If you have many plants or a long dry season, many barrels may be required (I use 4). A major problem is the mosquitoes who lay eggs and reproduce in the water in the barrels. Goldfish eat the mosquitoes and wigglers readily, but the water must be aerated for them to survive, and as you use up the water supply, then what do you do with the fish? The goldfish are cheap enough that you can let them die and keep replacing them, but since I am soft hearted, I find myself putting a good deal of effort into maintaining the fish. A fishpond with a relatively larger surface area makes a better reservoir than rain barrels if you want to use fish. However, you can never use chemicals to kill the algae (green scum) in the pond because these weed killers will kill the plants that are irrigated with the water.

A screen over the barrels is a good way to keep the mosquitoes out, but it must be a fine mesh, and it must be maintained to prevent holes and clogging. Other covers can be used with downspouts and overflow outlets if they are tight enough to keep the insects from entering. Inlets and outlets would require screening.

Insecticides can be used to keep the mosquitoes from living or reproducing in the water. An ounce of almost any insecticide added to 55 gallons of water will kill the larvae. Malathion was one that was effective, and that amount of insecticide had no effect on the plants. No insecticide can be used with goldfish, even a little spray drift into the barrel has killed fish of mine.

Distilled water: Most desalinization projects use distilled water. Chemical processes for removing salt seem to be expensive and difficult. The largest and cheapest source of distilled water that most of us have is the condensation water from the cooling coils of the air conditioner. Systems can be worked out to use the condensation water for lawn watering as well as for house plants, but if provisions were not made at the time the house was built, then it is usually expensive to convert the system so it can be used for watering. Window air conditioners can be used by placing a barrel under the overflow and drain to collect the condensing water. This provides good irrigation water for potted plants.

De-ionized water: A Bryan plant store who also manages plants in and around businesses uses all deionized water. For most people, deionized water is probably impractical or too expensive at this time, but improved methods should be developing.

Surface water: Many of the salts found in well water are not found in surface drainage water, especially near the source. At times this can provide a water source with a lower salt content. However, most permanent streams and rivers exchange water with underground aquifers and have fairly high salt contents. Where the watershed consists of lawns watered with saline water, the streams will have a higher salt content than the original source because of evaporation to the air and dissolving salts from the soil.

Shallower well water: Since the salts in the well water are leached from the rocks it flows through, generally, the deeper the well, the more salt in the water. Sometimes a shallower well, or a well from a different aquifer, can be found with a lower salt content.

Continues on page 61

Susceptibility to Saline Water Irrigation

This is a subjective list of susceptibility to salt in irrigation water. It has been made from observations of plants in my own yard (Bryan water containing 48 ppm chloride & 188 ppm sodium), the TAMU campus (56 ppm chloride, 205 ppm sodium), and in other parts of the state where comparative observations could be made. It includes Wichita Falls water with 137 ppm chloride & 72 ppm sodium, and Wixon WSC water with 140 ppm chloride and 445 ppm sodium.

SUSCEPTIBLE	MODERATE	RESISTANT
American holly	Windmill palm	Austrian pine
Sycamore (American)	*Washingtonia filifera* (Calif. fan Palm)	Yaupon *(Ilex vomitoria)*
Elm (winged, cedar, and American)	Hickory (shagbark)	*Citrus*
Linden	Norfolk Island pine *(Araucaria excelsa)*	*Pyracantha*
Ginko	Pin oak	*Green ash*
Monkey puzzle *(Araucaria imbricata)*	Black jack oak	*Ligustrum*
Rose	Bois d' arc (osage orange)	*Japanese yew (Podocarpus macrophyllus)*
Sweetgum	Slash pine	*Chinese holly*
Silver maple	Post oak	*Avocado*
River birch	Loblolly pine	*Arizona ash*
Pecan (hickory)	Cottonwood	*Live oak*
White ash	*Magnolia grandiflora*	*Chinese tallow*
Buttonbush	Scotts pine	*Pindo palm*
		Russian olive
		Siberian elm
		Agave
		Yucca

Order within classes is from most susceptible to most resistant. Relative values are tentative. Most plants in this list are more susceptible than those listed in USDA Handbook 60, 1954. Plants in both lists are resistant in this list and of "low salt tolerance" in the Handbook. Listings agree with those in Dirr(1976).

NITROGEN SOURCES FOR TURF FERTILIZATION

A seminar presented during the 20th Annual Illinois Turfgrass Conference December 18-20, 1979, Champaign, Illinois

NITROGEN: THE 'TNT' OF TURF FERTILIZATION PROGRAMS

By John R. Street, Associate Professor, Department of Agronomy, Ohio State University, Columbus, Ohio

Turfgrass growth is dependent on maintaining an adequate supply of all essential plant nutrients as well as properly managing a multiplicity of other cultural and edaphic factors. There are at least sixteen elements considered necessary for plant growth and development. Nitrogen is the essential element that receives the most attention in turfgrass fertilization programs. Nitrogen is the element to which turfgrass is most responsive. The nitrogen content of the turfgrass plant is usually higher than any other essential element (i.e. 3-6 percent on a dry weight basis). Nitrogen is a very dynamic element in the soil system. The concentration of soil nitrogen is in a constant state of change. Nitrogen depletion in soils may result from leaching, clipping removal, volatilization, denitrification, immobilization, or nitrogen fixation in the lattice structure of certain clays. Thus, nitrogen must be added to turfgrass sites on a routine basis in order to maintain a sufficient soil level for turfgrass growth.

Generally, nitrogen additions to the turfgrass system from clipping return, decomposition of organic matter, topdressing, nitrogen fixation, and rainfall are not sufficient to supply the needs of high quality turf. The main source of nitrogen is added by the application of nitrogenous fertilizers. Nitrogen fertilizer is initially added to the turfgrass system as ammonium (NH_4+) and/or nitrate (NO_3-) or some nitrogen carrier that eventually breaks down to ammonium. The turfgrass plant absorbs nitrogen from the soil as either ammonium or nitrate. Nitrate is the predominant form absorbed by the plant since ammonium is rapidly converted to nitrate by soil bacteria. This biological oxidation of ammonium to nitrate is called nitrification. Nitrification is a two-step process in which the ammonium is converted to nitrate (NO_2-) by Nitrosomonas bacteria and then to nitrate by Nitrobacter bacteria. The process is temperature dependent and increases with soil temperatures from 32°F. to an optimum range of 85-95°F.

Once absorbed into the plant, nitrate can be stored in the cell, or reduced back to the ammonium form. The storage of free nitrate within the plant cells results in a luxary consumption of nitrate (absorption of more than is used). This is likely an inefficient use of nitrogen, especially if clippings are removed. Nitrate must be converted to the ammonium form before it can be further utilized by the plant. The reduction process (NO_3- to NH_4+) within the plant requires at least two enzymes (compounds that assist in the reaction). Nitrate reductase is the enzyme involved in the conversion of nitrate to nitrite. Nitrite reductase is the enzyme involved in the conversion of nitrite to ammonium. In grasses, the reduction process predominantly occurs in the shoot or foliar portion of the plant, although some reduction may occur in the roots. The ammonium ion is then readily combined into various complex organic (carbon) compounds within the plant. Chlorophyll, amino acids, proteins, enzymes and vitamins are among some of the organic compounds containing nitrogen. Photosynthesis provides the source of carbohydrates or organic skeletons for the nitrogen assimilation processes.

Carbohydrates produced by photosynthesis are the necessary precursors for the formation of nitrogen-containing amino acids and proteins which are utilized in growth processes. The more turfgrass growth, the greater is the demand for carbohydrate. Carbohydrate is also the key source of energy for maintaining all the various growth and physiological processes within the plant. Carbodydrates are broken down into carbon dioxide and water through a process called respiration, and energy is released. Respiration therefore is a "carbohydrate-utilizing" process. When the rate of photosynthesis exceeds the rate of respiration and the requirement for growth, carbohydrates accumulate as reserves. Carbohydrate reserves are usually stored in the crowns, rhizomes and stolons of cool-season grasses. Carbohydrate reserves are desirable since they serve as an immediate source of energy and carbon skeletons for regrowth and recovery from defoliation or stresses that may injure or thin the turf. A "carbohydrate deficit" may develop when respiration rates are high and/or growth is rapid. Usually any factor that stimulates rapid topgrowth will deplete or drain carbohydrate reserves. The turfgrass manager should manipulate cultural practices so as to maintain an adequate level of carbohydrates within the plant for normal as well as unusual energy and growth demands. In essence, the carbohydrate status of the plant reflects the energy status of the plant.

Nitrogen fertilization has a definite effect on the carbohydrate status of turfgrasses. Nitrogen applications favor turfgrass growth. As nitrogen rates are increased, usually more topgrowth is produced. More topgrowth results in the use of more carbohydrate. Physiologically, under rapid growth conditions shoots take priority over roots and rhizomes for available carbohydrate. Shoot growth will usually continue to respond to higher nitrogen levels causing a distinct suppression in root growth and other growth processes.

These effects are well illustrated from a fertilization study evaluating the response of a Merion Kentucky bluegrass sod to incremental rates of nitrogen (Table 1) (3). Higher nitrogen rates resulted

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in an increase in clipping yield (topgrowth) and nitrogen content of clippings. In contrast, sod strength (a reflection of root and rhizome growth) and rhizome weight decreased at the higher nitrogen levels. Thus, when most of the plant's carbohydrate was directed toward producing shoot growth, root growth and other plant growth processes suffered accordingly. Agronomists well recognize that a plant is no better than the root system that supports it.

Research has shown that a considerable amount of root initiation and root growth of cool-season grasses occurs in the spring (2). Liberal nitrogen fertilization in the spring will have a tendency to restrict root growth. The turfgrass plant will go into the summer with a shorter root system than where moderate rates of nitrogen fertilizer are used. Furthermore, high amounts of nitrogen will increase topgrowth and increase the need for more frequent mowing in the spring. The rapid topgrowth may result in the removal of large amounts of clippings at each mowing. The removal of excess foliage (i.e. more than a third of the foliage at any one mowing) is known to retard both tiller and root development. Thus, mismanagement of nitrogen during the spring can have a dramatic effect on the root system under the turfgrass going into the summer.

Liberal nitrogen fertilization also causes a lush, succulent plant growth that is characterized by decreased cell wall and cuticle thickness, increased cell size, and an increased level of plant tissue hydration. The thinner plant cell walls are most like the result of more rapid plant growth and the production of condition increases the severity of plant disease and lowers the hardiness of the plant to heat, cold, and drought. Lush, succulent tissue also contains high concentrations of nitrogen-rich storage compounds. The nitrogen-rich compounds accumulate in guttation fluid (leaf exudates). The guttation fluid serves as an ideal medium for the enhancement of many turfgrass diseases. Thus, mismanagement of nitrogen in the spring can take the plant into the summer in a soft growth condition in which it is more vulnerable to disease, heat, and drought.

Liberal nitrogen fertilization is known to increase the severity of Pythium, brown patch, Fusarium blight, stripe smut, snow mold, and Helminthosporium (leafspot) diseases (5). Leafspot, a serious disease of both Kentucky bluegrass and bentgrass in the midwest, is much more serious at high nitrogen levels, especially in the spring. Kentucky bluegrass varieties like Park, Kenblue, and Delta are very susceptible to leafspot. Many lawns and older turfgrass areas have been established to these common-type Kentucky bluegrass varieties. Research at the University of Illinois (4) has shown the incidence of Fusarium blight in the summer to be greater with increasing nitrogen application rates in the spring. Nugget, Merion, Fylking, and Pennstar were highly susceptible to the disease when more than a total of two pounds of soluble nitrogen per 1,000 ft. was applied in the spring. Kenblue was affected by the disease at all the fertility levels. This information lends support to moderate levels of nitrogen fertilizer in the spring. It more specifically suggests a critical limit of no more than two pounds of total soluble nitrogen in the spring.

Liberal nitrogen fertilization is also critical during the summer (1). As seasonal temperatures increase, photosynthesis of cool-season grasses decreases and respiration increases. As mentioned earlier, carbohydrates are consumed during respiration. Respiration is known to increase with increasing nitrogen fertility levels. Thus, during periods of high temperature, liberal nitrogen fertilization may reduce carbohydrate reserves due to rapid growth and high respiration. Additional stress may result from lower photosynthetic rates. Because carbohydrates are produced at a slow rate and respiration is high during the summer, nitrogen should be applied at low rates for cool-season grasses.

Nitrogen is a necessary component of turfgrass fertilization programs. High quality turf exhibiting acceptable green color and density requires periodic application of nitrogen. Nitrogen however, is frequently referred to as the "TNT" of turfgrass fertilization programs. It can be just as detrimental as beneficial, if mismanaged. Proper timing and rate of application are important in successful long-term programs. Always remember! Greener is not always better. A happy medium must be met between agronomics and aesthetics.

WTT

Table 1. Nitrogen treatment effects on a Merion Kentucky bluegrass sod (3).

Nitrogen Rate	Annual Clipping Yield (dry wt.)	Nitrogen Content in Clippings	Sod Strength	Rhizomes
lb/A/month	lb/A	%	lb to tear	grams
0	463	3.0	146	99
15	1807	3.3	188	89
30	2555	3.6	130	120
60	5676	4.5	97	43
120	8447	5.4	67	14

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CHARACTERISTICS OF WATER SOLUBLE NITROGEN FERTILIZERS

By Roger Funk, Vice President of Research and Development, Davey Tree, Kent, Ohio

Nitrogen is the keystone of a lawn fertilization program, and both soluble and slowly soluble sources are available to the turfgrass industry. Soluble nitrogen fertilizers are less expensive than the slowly soluble sources but, in general, have a higher burn potential and are more likely to be lost through leaching and volatilization. These risks can be minimized, however, if the contributing factors are understood.

Fertilizer burn

Fertilizers contain salts that are similar to table salt (sodium chloride) except that fertilizer salts contain the elements essential for plant growth. When salts dissolve in water, they dissociate into positively and negatively charged ions, **and it is in this form that nutrients are absorbed by plant roots.** Soluble fertilizers are in the salt form when applied to turfgrass, which accounts for their immediate availability for absorption. Slowly soluble fertilizers may contain some soluble salts, but most of the nutrient salts are released over a period of time as the slowly soluble fertilizer is hydrolyzed or decomposed in the soil. Thus, a major difference between soluble and slowly soluble fertilizer is the release rate of the nutrient salts.

Salts dissolved in soil solution increase the osmotic pressure that governs the flow of water across a root cell membrane. Water always moves through a cell membrane from the side that has the lowest osmotic pressure to the side that has the highest pressure. Since root cells actively absorb nutrient salts, the osmotic pressure of the cell sap is normally higher than that of the surrounding soil solution — and water is absorbed into the root tissue. This process, in fact, is how plants absorb water. However, if excess fertilizer salts in the soil solution increase the osmotic pressure above that of the cell sap, water is drawn out of the roots, and the resultant injury is termed "fertilizer burn." Symptoms of fertilizer burn resemble those of drought injury since, in both cases, the immediate problem is lack of water in the plant.

The relative tendency of a fertilizer to release salts and increase the osmotic pressure of the soil solution is measured by the salt index. The higher the salt index value, the greater the tendency of a fertilizer to increase the osmotic pressure and the greater the burn potential. The salt indexes of common soluble nitrogen fertilizers are listed in Table 1, which also compares the adjusted salt indexes, based upon the total nutrient content.

Environmental factors such as temperature, humidity, and soil moisture also affect the burn potential of a fertilizer. As the air temperature increases and as the humidity decreases, the water requirement of plants increases. Because of the increased water requirements for plants, the level of soluble salts in soil solution that is "safe" during

Table 1. Solubility and Salt Indexes of Soluble Nitrogen Fertilizers

Fertilizer	Formula	Primary analysis (percent) N	P_2O_5	K_2O	Total plant food[a]	Salt index[b]	Adjusted salt index[c]	Solubility[d]
ammonia	NH_3	82.0	—	—	82.0	47.1	57.4	90
urea	H_2NCONH_2	46.0	—	—	46.0	75.4	163.9	67
ammonium nitrate	NH_4NO_3	33.5	—	—	33.5	104.7	312.5	118
ammonium sulfate	$(NH_4)_2SO_4$	21.0	—	—	21.0	69.0	328.6	71
sodium nitrate	$NaNO_3$	16.0	—	—	16.0	100.0	625.0	73
calcium nitrate	$Ca(NO_3)_2$	15.0	—	—	15.0	65.0	433.3	134
potassium nitrate	KNO_3	13.0	—	46.0	59.0	73.6	124.7	13
monoammonium phosphate	$NH_4H_2PO_4$	11.0	48.0	—	59.0	29.9	50.7	43
diammonium phosphate	$(NH_4)_2HPO_4$	18.0	46.0	—	64.0	34.2	53.4	25
ammonium polyphosphate (liquid form)	NH_4PO_3	10.0	34.0	—	44.0	29.9[e]	67.9	—

[a]Percent N + percent P_2O_5 + percent K_2O (primary analysis).
[b]Rader, L. F., Jr., et al. 1943. *Soil Science* 55(3):201-18.
[c]Salt index per unit of plant food = (2) x 100/(1).
[d]Parts in 100 parts pure water at 32° F.
[e]TVA.

cool, humid weather may cause burn injury during periods of warm weather or low humidity or both.

Soil moisture is a major factor in determining the fertilizer's potential to burn. If the soil is relatively dry, a fertilizer will have a greater effect on increasing the osmotic pressure of the soil solution. Conversely, if the soil is saturated, the fertilizer salts will disperse and the osmotic pressure will not increase greatly. In addition, the evapotranspiration of water will help cool the plant and raise the humidity near the soil surface, effectively reducing the plant's water requirement.

Leaching

Nutrient leaching is the removal of soluble fertilizers from the root zone by the downward percolation of water. Most of the soluble fertilizer nitrogen will be present in one or more of three forms: ammonium (NH_4+), nitrates ($NO_3—$), and urea ($CO(NH_2)_2$).

Ammonium is water soluble, but the strong attraction between the positively charged ammonium ion and the negative sites on clay minerals and soil organic matter prevents leaching. Ammonium, however, is rapidly oxidized to nitrates when the soil temperature is above 50°F.

Nitrate is a negatively charged ion and, as such, is readily leached because it does not bind to soil particles. Leaching of nitrate from the rooting zone is a much greater problem in coarse-textured soils. Research has shown that nitrate may be leached about 1 inch of rainfall for each inch of rainfall in clay loam soils to 2.5 inches for each inch of rainfall in sandy loam soils.

Urea fertilizer is readily soluble when it is first applied to the soil, but when it changes to ammonium it is held by clay and humus is a form that is readily available to plants. Under favorable temperature and moisture conditions, urea hydrolyzes to ammonium carbonate and then to nitrate within less than a week.

Volatilization

Volatilization involves the conversion of nitrogen to ammonia gas, which is lost to the atmosphere. This process is favored by alkaline soils, dry soils, soils with a low exchange capacity, and warm temperatures. When conditions favor volatilization, 25 percent or more of the applied nitrogen may be lost to the atmosphere.

When ammonic fertilizers and urea are placed in the soil, the ammonia gas that they release is held by the soil particles. However, when urea or ammonic fertilizers are placed on top of the soil, the released ammonia does not have the clay or moisture to hold it from being partly volatilized.

All of the characteristics of nitrogen fertilizers should be considered when a turf fertilization program is planned. If the materials are applied properly for the existing soil and environmental conditions, soluble nitrogen fertilizer can be just as effective as slowly soluble sources in providing the turfgrass plant with the nitrogen it requires. **WTT**

LONG TERM FIELD PERFORMANCE OF NITROGEN FERTILIZERS

By Don Waddington, Department of Agronomy, Pennsylvania State University, University Park, PA

More complete information can be obtained to characterize nitrogen (N) sources or N fertilization programs if long-term studies are used. The residual effects of slow-release N sources are of particular importance in such studies. "Long-term" is not defined in this presentation because assigning an exact time or minimum time would be difficult. Certainly, making observations or collecting results from a single application or during a single season could be considered short-term. Depending on the type of information desired, various lengths of time would be needed to obtain meaningful data from long-term studies.

Field Observations

Continued use of an N source or N fertilizer program has produced satisfactory turf for many turf managers. Although individuals may not agree on a "best" N source or N program, many have stuck with practices that work for them. It should be common knowledge that long-term use of activated sewage sludge (in particular, Milorganite) has proven successful. Also, continued use of ureaform or IBDU has given good results. Sulfur-coated urea, a relative newcomer to the family of slow-release N sources, has not been available long enough to have had years of use on turfgrass like these other sources, but I am confident that long-term use of this product will also be favorable. Use of soluble N sources and various combinations of soluble and slow-release sources in mixed fertilizers have also given good long-term results. This is not to say that all materials will work in all situations, but instead that many people have selected a program that works under their conditions. We also have turf managers who are continually changing their fertilizer program for one reason or another. Their reasons are varied: N sources may not do what they expected, salesmen may sell them on the merits of another fertilizer, cost may be a deciding factor, or they may be searching for that panacea that will cure all their turf's ills.

Now, back to those who have stuck with one program, perhaps making minor adjustments as needed. How do they know that a different program or N-source would not have worked better? Usually they do not know for sure. However, if a person has a program that works, he is best advised to stick with it. Most turf managers are not in a position to evaluate several N sources or programs at one time. Comparisons among N treatments are usually left to the turf researcher.

Long-Term Research

In research studies several N sources or fertilizer programs can be observed at one time. The longer a study is conducted, the more can be learned concerning the effects of a treatment. Long-term studies are also valuable for providing mine the residual effects of slow-release N sources, which are often inefficient in the first years of use. Even if residual effects are not of major importance, it is a good idea to obtain data from several growing seasons, which can provide different weather patterns or disease pressure. Longterm studies are also valuable for providing information on responses such as turfgrass species competition, weed encroachment, disease incidence, and thatch development when these responses are desired. However, in studies designed with N-source evaluation as the prime objective, it is best to minimize the effects of things such as species changes, weeds, and diseases. The researcher likes to know for sure that responses such as slow growth, poor color, and thin turf are related directly to the availability of N from an N

Nitrogen Source Test on Merion After Seven Years

Material	Treatment (lb. N/1,000 ft²)	Appl.*	Average clipping yields 1966	1967	1968	1969	1970	1971	1972
						(grams)			
IBDU	5	2	72	121	116	108	122	94	98
Ureaform	5	2	46	68	82	90	120	75	103
Urex	5	2	102	109	103	106	124	85	100
ADM	5	2	103	129	116	125	135	105	118
Milorganite	5	3	69	87	89	88	106	67	96
Urea	3	9	76	96	80	74	91	67	82

*Number of equal applications to obtain annual rate of N shown.

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source rather than being due to a turf disease or a shift in species composition.

Turf stands developed in long-term N research studies provide sites with known histories. These areas can then be used for other research subjects such as physiological responses to various stresses, soil test calibration, diseases, and weeds.

Perhaps the greatest deterrents to and disadvantage of long-term studies are time and cost. One may wonder about the value of studies involving experimental materials that never reach the market. However, it is better that these materials are dropped after research rather than being dropped after they have been passed onto the public without adequate testing.

Representatives of a few companies want to make decisions after one season's results. At the university level we feel that long-term research gives us a much better basis for our opinions and extension recommendations. Representatives of other companies agree with this philosophy, and they often provide grants to help support these studies.

Results from Long-Term Research

Perhaps the best argument for long-term research can be provided by comparing initial results with those obtained later in an experiment. The results given here were obtained in studies at Penn State.

Lawn Fertilizer Test. Milorganite and ureaform were included in a test with various lawn fertilizers having lower amounts of water-insoluble nitrogen. In treatments in which 2 pounds of N per 1,000 square feet were applied in spring and fall for two years, Milorganite and ureaform gave relatively low yields and color response in the first year. The greatest response was obtained in the first year by fertilizers having lower amounts of water-insoluble N. By August of the second year, prior to fall fertilization, the best color was found on plots fertilized with these two N sources. Fertilizer was not applied in the third year, but clipping weights were taken for 13 weeks beginning in late April and ending in mid-July. The good residual effects of Milorganite and ureaform, and also of Scott's 23-7-7, were quite apparent in the third year.

N Source Test on Merion Kentucky Bluegrass. Eight N sources were used to fertilize Merion bluegrass for 7 years. Nitrogen recovery in the clippings was calculated for the first 2 years. The inefficiency of Milorganite and Uramite (ureaform) was striking. Urex (a urea-paraffin matrix), ADM (plastic coated urea), and urea had higher recoveries.

The study was continued for 5 more years. To cut expenses, nitrogen analyses of clippings were discontinued. However, clipping yields, which give almost as good an indication of N use by the grass, were continued. Average fresh-weight yields showed that 3 pounds of N from urea produced greater yields than 5 pounds of N from IBDU in the first year and more than 5 pounds of N from ureaform and Milorganite in the first two years. The residual effects of IBDU were noted in the second year, but with ureaform and Milorganite it took longer for the response to reach that obtained from other sources.

In the summer of 1973, tests for soil N, turf color, and clipping yield showed that the greatest residual effect was obtained from ureaform. Milorganite and IBDU ranked second and third.

At least two findings in this research tie in with the actions of turf managers. First, the slow start from ureaform has been the reason for their dropping it from consideration after short-term use. Second, long-term users of ureaform and Milorganite have been able to reduce application rates as residual N has built up. Occasionally we hear of superintendents drastically reducing N rates and still maintaining adequate turf. If a man who has been using 6 or 8 pounds of N per 1,000 square feet can successfully drop to 3 pounds of N, it may be because of the N reserves that have accumulated in the soil.

Evaluation of Sulfur-Coated Urea Formulations. Not all sulfur-coated ureas are the same. Different coating methods and thicknesses are used during their manufacture. A study was started in 1974 to evaluate five TVA formulations and Gold N, a product of ICI in England. Spring applications of 4 pounds of N per 1,000 square feet were made. Initial response decreased as the coating weight of the material increased. Response was also slower when a sulfur-only coating rather than a sulfur-plus-wax coating was used. We thought that the slower releasing materials would come on during the fall. They did not. Then we thought that perhaps the residual effects would show the next spring. They did not. We applied 4 pounds of N again in 1975, expecting that we would observe some residual response if we continued for another year. It did not happen. In May of 1976, we sampled the plots for residual sulfur-coated urea and found as much as 37 percent of the applied material still there. We applied another 4 pounds of N that spring. Still no striking residual effect occurrred. We sampled for residual pellets that fall, again in 1977, and twice in 1978. No more fertilizer was applied after 1976.

The difference in residual N release over a two-year period (11/76 to 11/78) was as high as 2.5 pounds of N per 1,000 square feet. However, no visual effects from residual N were noted during this time. The first visual effect noted was in August of 1979, when SCU-17 treated plots had significantly less dollar spot and better color than Gold N plots. The slight differences observed at this time were not significant. Additional studies are now being conducted to characterize the release of N from different N sources. **WTT**

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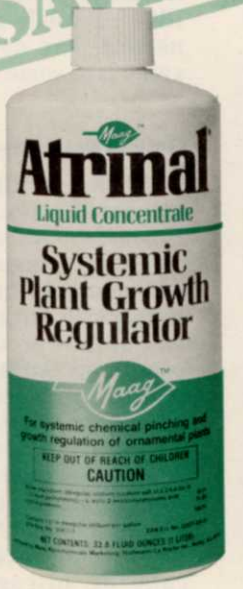
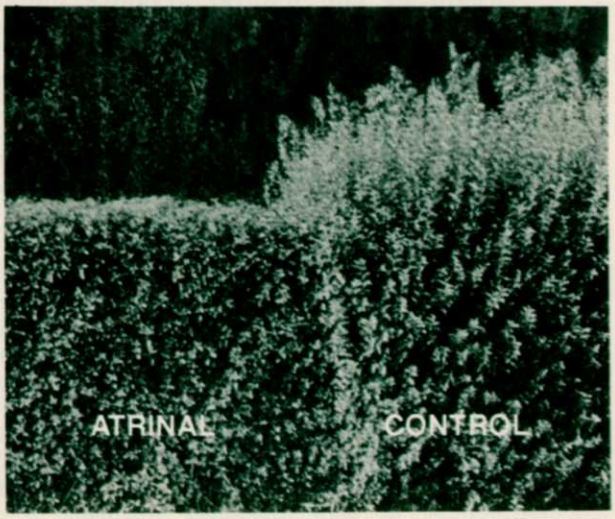




RCD 5791/380

UREAFORM: FIRST SYNTHETIC SLOW RELEASE FERTILIZER

By John T. Hays, Research and Product Development Specialist, Boots Hercules Agrochemicals Co., Wilmington, Delaware

Fertilizers based on the reaction of urea with formaldehyde have been known for a long time. Solutions containing urea and formaldehyde were marketed by the du Pont Company in 1939. The pioneering work on the solid condensate was done by Dr. K.G. Clark of the U.S. Department of Agriculture (USDA), as reported in publications beginning in 1946. He coined "ureaform" for this product, and this name seems to us to be far preferable to "urea-formaldehyde" to distinguish the odorless, stable fertilizer from the noxious urea-formaldehyde resins made with a large excess of formaldehyde. There is no free formaldehyde in ureaform (as exemplified by Nitroform slow release fertilizer), and it cannot liberate formaldehyde under use conditions.

Manufacture of solid ureaform was begun by the du Pont Co. and the Nitroform Corporation in the mid-1950's. Hercules purchased the Nitroform Corp. in 1960 and marketed Nitroform slow release fertilizer until early this year, when Boots Hercules Agrochemicals Company (formed jointly by Hercules Incorporated and the English firm Boots) took over marketing this product. Du Pont has discontinued manufacture, so Nitroform slow release fertilizer is the only solid ureaform manufactured in this country at present. O.M. Scott utilizes urea-formaldehyde solutions in the manufacture of mixed fertilizer, but these products are technically not ureaforms.

In addition to designating ureaform as the "oldest" synthetic source of slowly available nitrogen, we might add that it is also the longest lasting (in the agronomic sense).

Ureaforms and natural organics undergo decomposition by soil microorganisms to form ammonia (ammonification), which may be converted to nitrate (nitrification). Variables, such as temperature, soil pH, and aeration have a great effect on these reactions. The microbiological reactions are less sensitive to particle size and soil moisture. Generally, conditions that favor plant growth also favor microbiological reactions.

Quality factors

According to the "Specialty Fertilizer Labeling Format" proposed by the American Association of Fertilizer Control officals and widely adopted: "When a fertilizer infers or connotes that the nitrogen is slowly available through use of *organic, organic nitrogen, ureaform, longlasting,* or similar terms, the guaranteed analysis must indicate the percentage of water-insoluble nitrogen in the material."

Unfortunately, specification of minimum WIN and its source, which is all that is required by the labeling format, gives no indication of agronomic availability; a fertilizer can appear to be of high quality on the basis of its WIN but be of little value because of low availability. In the case of ureaforms, solubility determinations can be used to calculate the Activity Index (AI), which gives an indication of agronomic availability.

Ureaform Specifications

The specifications for commercial Nitroform ureaform fertilzer are:

Total nitrogen—38.0 percent (minimum)

WIN—27.0 percent (71 percent of 38 percent total nitrogen)

AI—40 (minimum) (percent WIN soluble in hot water)

The AI thus supplements the WIN determination by indicating the percentage of the WIN that is readily available (soluble in hot water). The AI does not give the complete picture: it gives no measure of the cold water-soluble fraction, and it does not indicate the availability of the fraction insoluble in hot water. Nevertheless, an AI of 40 in the normal WIN range will assure availability of a major portion of the ureaform.

The solubility approach is not directly useful for other types of slowly available fertilizers. For sulfur-coated urea, dissolution rate or coating thickness is needed to indicate availability. For IBDU, particle size and soil moisture content are needed. For natural organics, the permanganate value is of some use.

Rate of Release—Nitrification Studies

When a fertilizer containing organic nitrogen is incubated with soil, micro-organisms in the soil convert the nitrogen to ammonia. Under favorable conditions (near neutral pH, adequate aeration), the ammonia formed is quickly oxidized by soil bacteria to nitrate (nitrification). Measurement of the nitrate produced under carefully controlled conditions is thus a good laboratory indication of the rate of release of nitrogen from ureaforms and other organic nitrogen fertilizers.

We have found the nitrification method to offer a good qualitative basis for comparison of slowly available nitrogen fertilizers. Generalizing from a large number of laboratory experiments at 86° F (30° C), we arrive at the following projection of rate of nitrogen release from commercial Nitroform ureaform.

This pattern allows application of a relatively large amount of nitrogen in a single application, provides gradual release for up to 24 weeks, and leaves a portion for carry-over and utilization in the next growing season. To get an early response comparable to that from a soluble source, it is necessary to apply more ureaform nitrogen initially, or as is frequently done, to add a soluble source along with the ureaform.

Product Grades Available

Nitroform ureaform is available in both granular and powder forms. The granular form, Blue Chip nitrogen fertilizer, is designed for direct application in mechanical spreaders. It is also used in balanced fertilizer (N,P,K).

Powder Blue nitrogen fertilizer is the powder form. It is well suited for use in liquid-application equipment. One gallon of water will carry 1 pound of Powder Blue in a power sprayer. Screens should be removed from the spray system to avoid clogging, and a nozzle with a large orifice (9/64 inch or larger) should be used. Other fertilizer materials (P,K) normally applied in liquid form can be used along with Powder Blue as desired.

Another advantage of applying the powder form, in addition to its ready application in water suspension, is that it is somewhat more readily available than the granular form. Our nitrification data have indicated that the powder releases 1.3 to 1.65 times as fast as the granular.

Recommended amounts

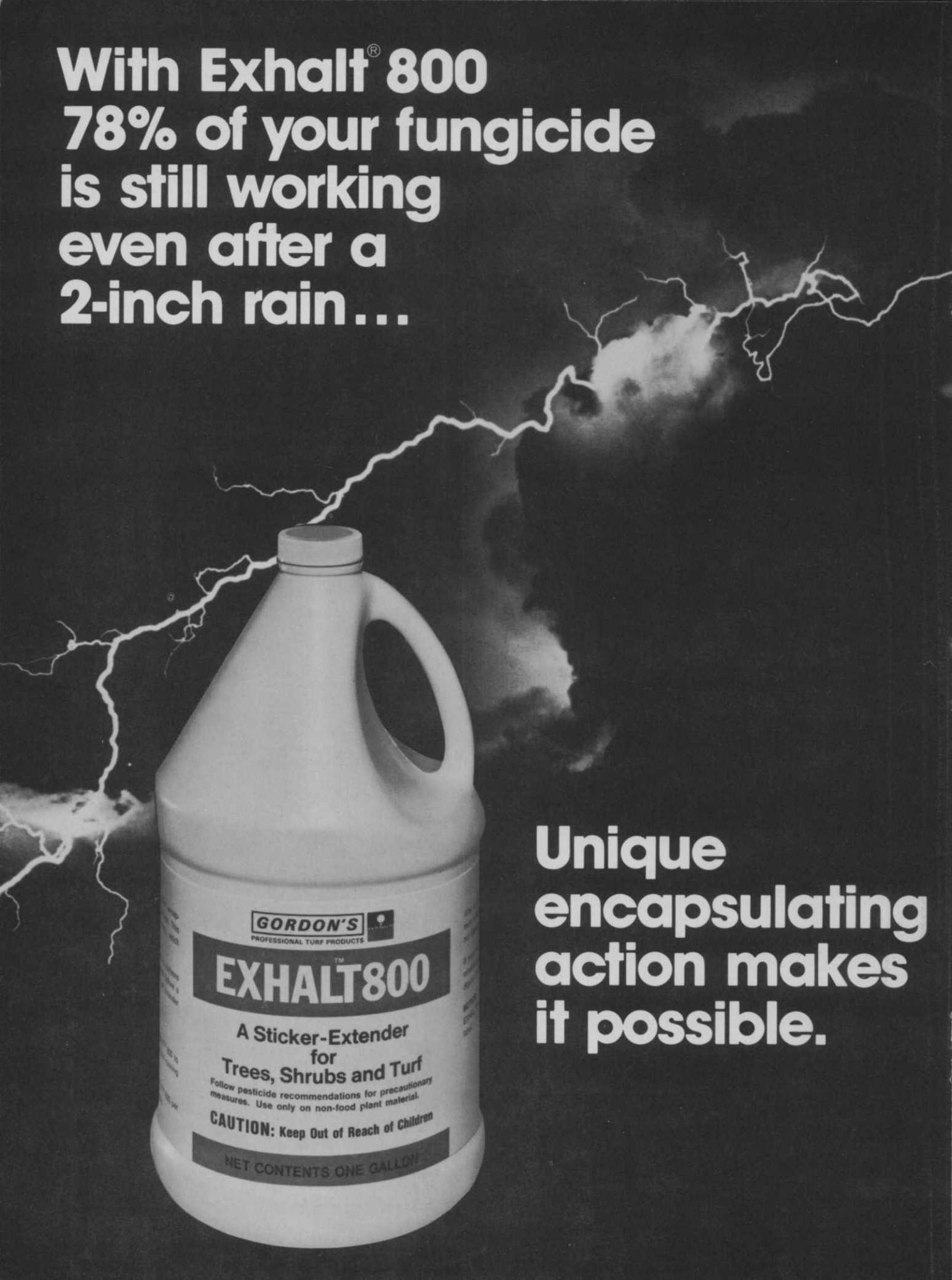
On fairways, lawns and other similar turf areas, application of 10 to 15 pounds of Nitroform fertilizer per 1,000 square feet or 400 to 600 pounds per acre is recommended. Split applications are preferred with the heaviest application at the most important phase of the growth cycle. For cool-season grasses (bluegrass, fescue and bent) apply ⅔ in the fall and ⅓ in the spring. For warm-season grasses (bermuda, zoysia, centipede, and St. Augustine) apply ⅔ in the spring and ⅓ in the fall. For seedbed application, the year's supply is worked into the top 2 to 4 inches of soil.

On bentgrass greens, three applications of 7 to 10 pounds of Nitroform fertilizer per 1,000 square feet are recommended: the first in early spring, the second in early summer, and the third in early fall. A fourth application at half this rate may be needed in mid-summer until the residual nitrogen has built up. For seedbed application on average-size greens, use 25 pounds of Nitroform fertilizer worked into the top 3 inches of soil.

A striking feature of these recommendations is the relatively large amounts of nitrogen used in a single application. Thus 10 to 15 pounds of Nitroform fertilizer (3.8 to 5.7 pounds of actual nitrogen) is routinely put on turfgrass and other plants in a single application. Contrast these amounts with those of soluble fertilizer, where the rule of thumb is to use no more than 1 pound of nitrogen per 1,000 square feet in a single application and then to take the precaution of watering it in.

WTT

With Exhalt® 800 78% of your fungicide is still working even after a 2-inch rain...



Unique encapsulating action makes it possible.

Percentage of fungicide retained after rains, Exhalt 800 versus Brand X:

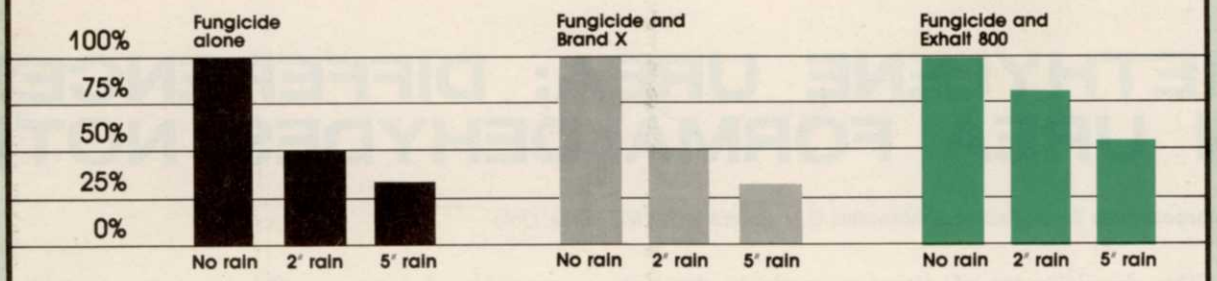


Chart shows how Exhalt 800 resisted wash-off in a laboratory test. Spray coatings were applied to glass panels and dried 10 minutes at approximately 70° F. Retention after erosion by rain was measured by solvent stripping the panels and determining the residual fungicide by quantitative ultraviolet spectroscopy.

See how Exhalt 800's encapsulating action guards against costly fungicide wash-off:

This test with Exhalt 800 shows 78% of fungicide was still intact after a 2-inch rain. Even after 5 inches of moisture, 60% was still in place.

We're painfully aware that you may be disenchanted with spreader-stickers, so we want to emphasize that Exhalt 800 is *not* a spreader-sticker. Rather it is a *Sticker-Extender*, and there's a world of difference!

The *spreader* part of a spreader-sticker is a detergent that actually assists in wash-off. Exhalt 800, on the other hand, has a unique encapsulating action that causes fungicide to *resist* wash-off.

Simply stated: Spreader-Stickers *assist* wash-off; Exhalt 800, a unique Sticker-Extender, *resists* wash-off.

Defies Rain

To illustrate its clinging power, let's suppose you have added Exhalt 800 to your fungicide and treated 18 greens. An hour later a dark, menacing cloud rolls in; in the next 45 minutes it dumps two inches of rain on your treated greens. What now?

Obviously, some of your treatment is washed away. But the silver lining is . . . *some 78% of it is still in place and working*. Thanks to Exhalt 800's unique encapsulating power, you won't have to repeat the whole costly process again tomorrow.

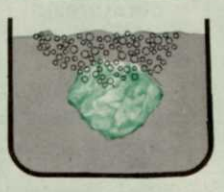
Even in arid regions plagued with occasional fungus flare-up, Exhalt 800 pays. It lets you spray and, after an hour, irrigate. With no more worry about losing your greens to either fungus or drought.

The Exhalt 800 difference

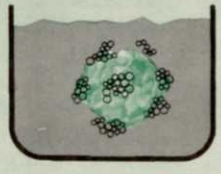
Unlike spreader-stickers that wash off with the first rain, Exhalt 800 (a sticker-extender) clings with encapsulating power. It's an extremely sticky, flexible, fabric-like protector that encases every fungicide particle, keeping it in place and working despite rainfall.

A closer look at Exhalt 800's unique encapsulating action:

One miniscule fungicide particle, greatly magnified. Countless millions of such particles in water become the spray solution.



Exhalt 800 enters spray tank. Hydrophobic (repelled by water), it breaks into myriad of tiny droplets and attaches to fungicide.



Tiny Exhalt 800 droplets form a porous "fabric" that encapsulates every fungicide particle, causing it to cling to turf or foliage.

To get a clear picture of Exhalt 800's superiority, study the chart above. This test, important though it is, is just one of many. Our files hold much other massive evidence of Exhalt 800's unique encapsulating power: the field-test data from many leading universities (test results available on request).

While Exhalt 800 is used extensively on turf, it also is registered for use with insecticides for trees and ornamental shrubs. In every use, it lets plants "breathe," grow and develop normally. It's economical and easy to use.

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METHYLENE UREA: DIFFERENCES IN UREA FORMALDEHYDES NOTED

By George McVey Senior Technical Associate, O.M. Scott & Sons, Marysville, Ohio

The development of nitrogen products derived from condensing urea with formaldehyde represented a significant advance in nitrogen fertilizer technology. It provided the basis for developing nitrogen-containing fertilizer products with some properties similar to natural organic nitrogen sources. These similarities include: (1) a controlled release of nitrogen and (2) a low burn potential. Additional beneficial properties provided by urea-formaldehyde (also known as methylene urea, MU) condensation products that are more beneficial than those provided by natural organics nitrogen sources include: (1) high nitrogen analysis (38 percent versus less than 10 percent nitrogen), (2) excellent consistency, (3) improved flexibility in adjusting nitrogen release characteristics, (4) lack of odor, and (5) economy.

Chemical properties

The nitrogen release characteristics of MU can be controlled by the method of manufacturing that is selected. Analytically the release characteristics are classified by the solubility of this product in water varying in temperature. Two temperatures are selected: (1) room temperature (22°C.) and (2) boiling water (100°C.). Based on the solubility at these two temperatures, the biological activity can be predicted. As the percent of the cold water insoluble nitrogen (CWIN) that is soluble in hot water decreases (NAI), the nitrification rate (conversion of MU to nitrates) decreases. The nitrification rate is dramatically reduced as compared with ammonium sulfate and urea. This rate can be reduced to a point that is relatively inactive biologically.

One of the primary benefits of MU is attributed to its low salt index. The low salt index at equal rates of material is dramatically reduced as compared with conventional fast release nitrogen sources. These differences are even more dramatic when compared on an equal nitrogen basis. Since the salt index is a measure of burn potential, it is obvious that on an equal weight or equal nitrogen basis, MU would have a much lower burn potential as compared with soluble nitrogen sources.

MU's slow release characteristics are also reflected in the rate of conversion to ammoniacal and nitrate nitrogen in the soil. The ammoniacal nitrogen level in the soil solution is up to four times higher when treated with urea as compared with the MU treatment. After 6 weeks, the ammoniacal nitrogen level is essentially zero regardless of the nitrogen source. In contrast, the nitrate nitrogen level dramatically increases as the ammoniacal nitrogen level decreases. This increase was only evident if the nitrogen source was MU. The nitrate nitrogen level continued at a high level for 120 days (50 to 100 ppm) if the soil was treated with MU. In contrast, soil treated with urea never had a nitrate level greater than 30 ppm. Urea readily leached from the media before conversion of urea to nitrates was realized, resulting greater pollution potential than with MU.

Biological properties

Controlled release nitrogen sources are often characterized by improved safety, increased residual, a more uniform growth pattern, and less total clipping removal as compared with turf treated with soluble nitrogen sources.

As the percent of cold water insoluble nitrogen increases, the degree of injury decreases. These differences are more dramatic when the fertilizer is applied to wet turf; however, they are still apparent on dry turf. At a CWIN of 42 percent, injury was not objectionable at all rates (1 to 4 pounds of nitrogen per 1,000 square feet) or methods of application (wet versus dry foliage). In contrast, complete formulations containing only 2 percent CWIN caused extreme foliar injury when applied to wet foliage using only 1 pound of nitrogen per 1,000 square feet under the conditions of this study (applied in late August under high temperatures).

When we compared two MUs relative to turf response, a substantial difference in turf color was noted. The spring greening response from a late fall fertilization was very slow when turf was treated with ureaform (Category 1) but was dramatically increased when treated with MU (Category 2). In this same experiment, the nitrogen source IBDU was also included. The initial response was comparable to that with ureaform whereas the residual of MU and ureaform was longer than for IBDU.

Spring applications of IBDU and MU (Category 2) were compared. In this study, initial greening was very slow when the turf was treated with IBDU even though rates of 2 pounds of nitrogen per 1,000 square feet were applied. In contrast, turf treated with MU exhibited a rapid spring greening response. The residual characteristics of these products were similar.

The residual of the MU (Category 2) was compared with that for urea. The initial surge of growth was reduced from 1.9 grams for turf treated with urea down to 1.1 grams when the turf was treated with MU (a 42 percent reduction in fresh weight).

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NITROGEN SOURCES FOR TURF FERTILIZATION

The reduction in initial surge growth is reflected in the residual. The differences from only one application, however, are not dramatic. When repeat applications of MU from Category 2 were used, the residual characteristics became more apparent. In this study, the fertilizer program was discontinued in the fall of the second year. Clipping fresh weights in the spring of the third year dramatically reflected the residual characteristics when MU containing 42 percent CWIN was compared with a product containing 2 percent CWIN. The color of the turf treated with the controlled release nitrogen source (23-7-7 42 percent CWIN) was comparable to that of turf treated with the fast release nitrogen source (10-6-4 2 percent CWIN) in 27 out of 32 observations over a 2.5-year period.

Turf growth is another measure of the controlled release properties of MU. The total fresh weight of clippings can be substantially reduced when turf is treated with MU as compared with urea. The weight of clippings removed over a 6-week period was reduced by one-third when Kentucky bluegrass was treated with MU as compared with treatment with urea. The lower weight of clippings removed is reflected in the fact that there is less tendency for scalping because of delayed mowing, a reduction in mowing frequency, and less labor for collecting and removing clippings. **WTT**

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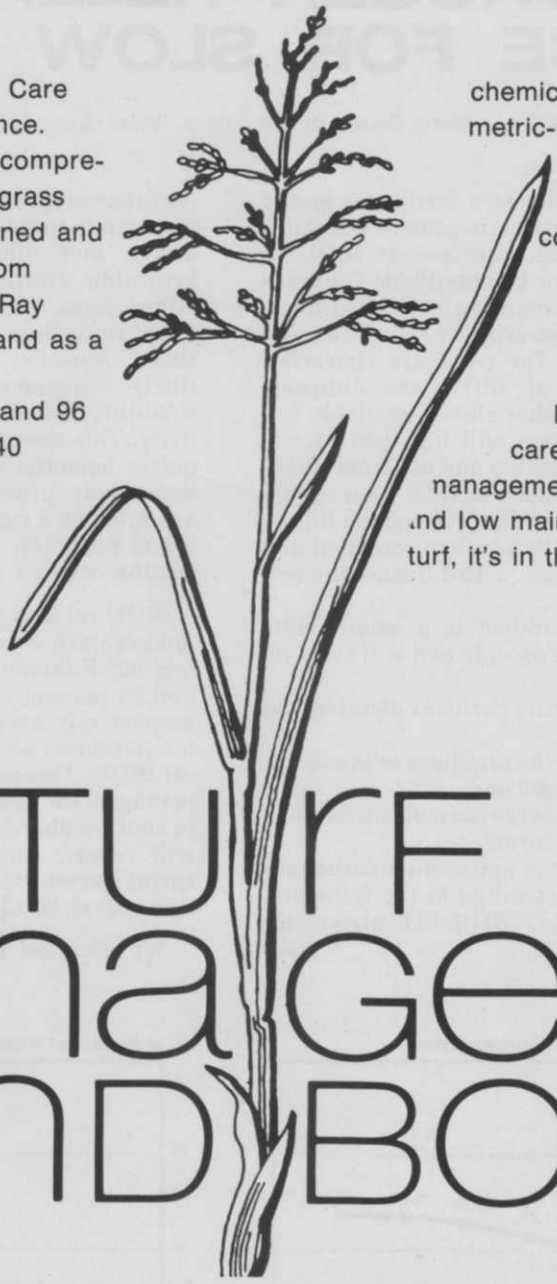

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HARVEST

IBDU: NITROGEN RELEASE IS UNIQUE FOR SLOW RELEASE

By Robert Rehberg, National Sales Manager, Estech General Chemical Corp., Winter Haven, FL

Proper management of nitrogen fertility is one of the keys to successful turf management due to its many effects on physiological processes. IBDU® is the trademarked name for Isobutylidene Diurea, a slow release fertilizer containing 31 percent nitrogen, marketed in North America by Estech General Chemicals Corporation. The n-release characteristics and properties of IBDU are uniquely different from those of other slowly available fertilizers and this discussion will highlight factors governing nitrogen availability and use from IBDU.

Preparation-The manufacture of IBDU is a simple mixing of isobutyraldehyde(IBA), which is a liquid, with solid urea. The product is then screened and bagged into two size ranges, a 0.5-1.0 mm. fine and a 0.7-2.5 mm. coarse.

The finished IBDU product is a small white granule which is not hydroscopic and will store indefinitely.

N Release Mechanism-IBDU particles dissolve and the molecule splits to give:

(a) isobutyraldehyde which volatilizes or is used as a food source by microorganisms.

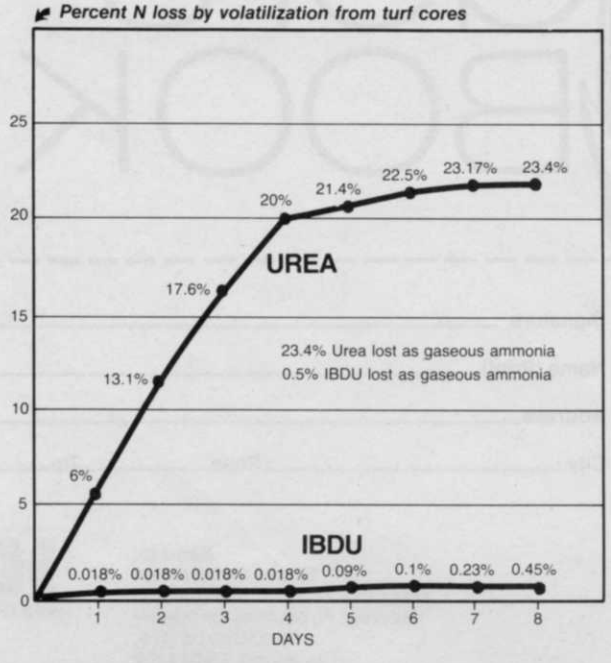
(b) urea, which would undergo normal conversions to ammonium and nitrate forms.

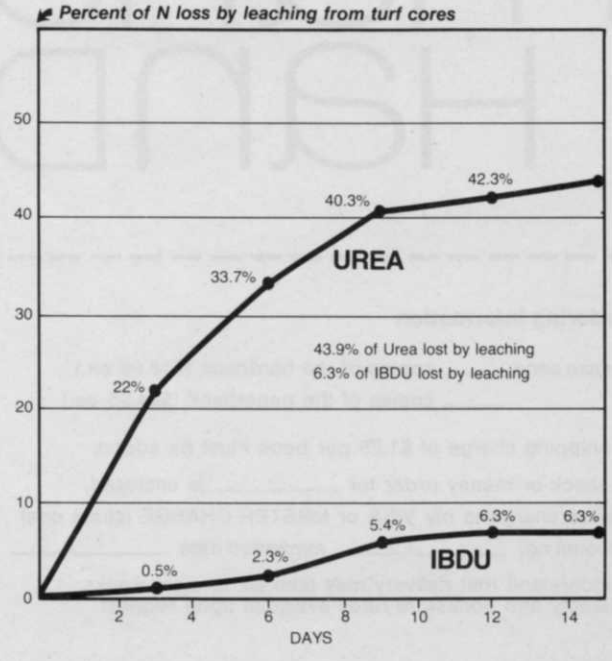
The hydrolysis of urea to ammonium carbonate occurs quickly in soils according to the following equation: $CO(NH_2)_2 + 2H_2O \rightarrow (NH_4)_2CO_3$ urea water ammonium carbonate.

Nitrobacteria could then convert the ammonium nitrogen to nitrate if temperatures are about 40° or above and other environmental factors are favorable. However, turf can utilize nitrogen in either form. The urea conversion would be the same regardless of parent material, UF, SCU or IBDU; however, the rate determining step for IBDU conversion to plant available forms is solubility, which is independent of bacterial activity. This distinguishes IBDU from UF which requires bacterial conversion, a highly temperature dependent process, and SCU which becomes available as a result of holes in the coating, cracking of particles, microbial oxidation of the sulfur coating, osmosis, or other factors.

IBDU release is temperature dependent only as temperature effects solubility, so at constant 40° F and 80° F temperatures approximately 50 percent and 75 percent of the nitrogen would be released respectively over a three month period. Freezing temperatures would stop water movement and shut off IBDU. This relationship works well for the turf manager; the grass plant does not grow as rapidly in cool weather so not as much N is required. IBDU will release longer into fall and sooner in the spring during the important carbohydrate assimilation period, resulting in greener, healthier turf.

We are often asked the question, "What happens





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if we get a heavy rain?" The answer is: some IBDU will dissolve. Continuous leaching tests in glass cylinders show that 36 in. of water is needed to dissolve powdered IBDU and about 80 in. water is required to dissolve a 1.4 - 1.6 mm. size. Therefore, a five in. deluge of rain would release about six percent of the N from coarse IBDU or about 0.1 lb. of N from a 1.5 lb. N/1000 ft.^{2} application.

Efficiency-A nitrogen source is efficient if most of applied N is absorbed by the plant and not lost in the environment by leaching past the root system, volitization, or other factors. The preceding two graphs are a result of the work of Falkenstrom and Turgeon at the University of Illinois comparing leaching and volitization of IBDU to Urea.

The first graph demonstrates the amount of nitrogen lost by volitization from turf cores over an eight-day period. Over this time 23.4 percent Urea - N was lost as gaseous ammonia versus only 0.5 percent N loss from IBDU.

The second graph shows leaching losses of 43.9 percent from soluble urea and only 6.3 percent from the slow release IBDU over 14 days.

These studies were conducted in a laboratory microecosystem apparatus that monitored all gases and liquids entering and leaving the system.

The results of field studies by Brown, Duble, and Thomas of Texas A&M were published in the January 1977 USGA Green Section Record. They found on sand greens, as much as 22 percent of the N from soluble sources was lost by leaching in the first three weeks giving high nitrate contamination of leachate water. Less than two percent of the nitrogen applied as IBDU was lost.

It is obvious from these studies that nitrogen from IBDU trickles slowly past the root system, increasing the total uptake over time resulting in better nutrient efficiency and less nitrogen pollution of water when compared to soluble N sources.

Another efficiency factor of IBDU is that it is a single compound and not composed of polymers as is the case with ureaformaldehyde materials. All the nitrogen from IBDU is available in a single growing season. Some UF polymers may require several years to break down and become available.

Lawn care applicators have especially been pleased with this property of IBDU since with UF they may be investing 15-25 percent of the fertilizer cost for a competitor's benefit if they lose the customer.

Dormant Fertilization- Our research results from seven different universities were unanimous in showing IBDU to be a superior nitrogen source for producing excellent turf in the spring after an application the previous fall on cool season grasses. The best program, varying somewhat by location, is three applications of 1-1½ lbs. N per 1,000 ft.^{2} per year; May-June, August-September, and November-December. The last application should be applied when vertical growth has stopped or approximately 30-40 days before expected ground freezing.

IBDU also works well on overseeded Bermudagrass in southern areas. **WTT**

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SULFUR-COATED UREA: COVER CONTROLS NITROGEN RELEASE

By S.E. Allen, Research Agronomist, Tennessee Valley Authority, Muscle Shoals, Alabama

Potential benefits from controlled-release nitrogen (N) fertilizers include: 1. More efficient crop use of N (control of luxury uptake) 2. Decreased leaching of nitrate 3. Lower toxicity (reduced ammonia or salt injury or both) 4. Longer lasting, more uniform nutrient supply (fewer applications needed) 5. Reduced volatilization losses to the atmosphere (ammonia or gaseous products of denitrification).

Most controlled-release fertilizers, both synthetic and natural, fall into one of three classes: 1. Biodegradable organic compounds yielding ammonia or nitrate or both through the action of soil microorganisms (ureaform and natural fertilizers) 2. Organic compounds of low water solubility that slowly hydrolyze to form urea, which is then converted to ammonia and nitrate (IBDU) 3. Coated soluble sources that release the nutrient through membrane rupture or diffusion of solutes through pores or imperfections in the coating (SCU).

This paper is primarily concerned with the mode of action of SCU and its relationship to crop response.

Sulfur-coated urea is now available from three suppliers in North America. All use the process developed by TVA at Muscle Shoals, Alabama. In its simplest form, the process involves heating urea (granules or prills) to approximately 140°F., followed by spray application of molten sulfur (S) at 300°F. in a rotating drum apparatus. A sealant coat of polyethylene oil or microcrystalline wax is applied, and the final product is conditioned with diatomaceous earth or some other suitable conditioner. Typical products contain about 36 percent N, 16 percent S, and 5 percent sealant plus conditioner. Since an S coating of finite thickness is required, large and small granules of SCU often contain less or more S, respectively, than the average value reported. By varying coating weight or sealant or both, products differing in initial solubility may be prepared. For quality control purposes, products are often characterized by determining the amount of N released in 7 days in water at 100°F. Thus, SCU-30 refers to a product in which 30 percent of the N is released under the prescribed conditions. The 7-day dissolution value is primarily a measure of the relative number of imperfectly coated granules. Release of N from the insoluble fraction involves other variables to be discussed later.

The dissolution pattern may be estimated by extending the 7-day test over a longer period with analysis of N released at appropriate intervals. The results obtained, however, may be difficult to interpret in terms of expected field performance. More useful data have been obtained from experiments involving placement of SCU in soil under varying conditions followed by recovery and analysis of undissolved granules at appropriate intervals. Many trials have been conducted, all of which support the premise that individual granules release N rapidly once all the coating fails and water gains access to the substrate. Thus, controlled release of N results from many granules that supply N at different times rather than from gradual release of N from all granules at the same time. Once this fact was established, it was possible to characterize the dissolution pattern by recovery and analysis of undissolved granules. That portion of applied N not recovered is assumed released to the soil as water-soluble urea.

It has been shown by this procedure that many factors regulate release of N from SCU; a brief summary of the more important variables follows: 1. Release of N from SCU is accelerated in warm soil, which suggests that soil microorganisms are at least partially involved in coating failure. It has not been determined whether biodegradation of sealant or S is the dominant process. However, soil microorganisms do oxidize the S coating, yielding crop-available sulfate. Following coating failure, the flow of urea solution into the soil is primarily an osmotic process, which is much less sensitive to changes in soil temperature. 2. Experiments conducted in controlled environment regimes show that soil moisture stress increases the rate of dissolution of SCU. Thus, the rate of release in a silt loam soil at 75°F. was in the order: dry (10 percent H_2O) > alternating moist/dry > continuously moist (20 percent H_2O). Lowering the temperature to 55°F. slowed dissolution but did not change the ranking of soil moisture regimes. 3. Experiments conducted in both field and laboratory suggest faster dissolution with surface placement than with mixed placement. This effect is believed to be related to much wider ranges in soil temperature and moisture stress at the soil surface. 4. Root action apparently accelerates dissolution of SCU. This conclusion is based on recovery of undissolved SCU from fallow soil, as compared with cultures cropped with bermudagrass. 5. Dissolution was not affected by soil pH in the range 5 to 8. 6. That portion of SCU not dissolved is protected from loss during leaching incidents.

Results from many experiments conducted under widely varying conditions suggest that 5 to 30 percent of applied SCU may not dissolve during the season of application. There is evidence that

most of the carryover becomes available to crops in later years.

Crop Response to N in SCU

The chief objective of SCU research has been to improve crop yields by more efficient utilization of applied N. A wide variety of field and greenhouse experiments has been conducted with may crops throughout the world. This discussion is limited to results from forage and turfgrasses. The following brief summary is concerned with principles, rather than data from individual experiments: 1. More uniform seasonal growth usually results from SCU than from a single annual application of soluble N sources. In numerous experiments, the growth pattern has been similar to that obtained from multiple applications of soluble N. 2. In some greenhouse experiments, total yield from SCU has exceeded that from soluble N sources. Calculation of N uptake suggests that control of luxury uptake in early clippings is the dominant factor. 3. In other experiments, total yield from SCU has been less than that from soluble N. Recovery of undissolved SCU shows that the difference may be explained by rate effects produced by incomplete dissolution of SCU in the season of application. 4. Since dissolution of SCU is temperature sensitive, products with higher initial dissolution have given better results in northern areas; less soluble formulations may be preferred in the South, where soil temperature is higher and the growing season is longer. 5. Less than one-third of the total N applied from SCU is readily soluble. Thus, turf damage from SCU has been less than that from comparable rates of soluble N sources. 6. Losses of ammonia from surface application of N fertilizers are difficult to measure under field conditions. However, N recovery studies suggest that such losses may be reduced by use of SCU.

Crop Response to S in SCU

The coating in SCU is elemental S, a form not available for crop use until it is oxidized to sulfate by soil microorganisms. Sulfur oxidation studies invariably show that finely divided S mixed with the soil is oxidized in a few weeks, while prills or granules oxidize very slowly. The difference in oxidation rate is related to the surface area of S particles in contact with soil. On this basis, one would predict delayed availability of S in SCU. The N:S ration in SCU is about 2:1; thus, normal N rates supply two to five times the S requirement for most crops. Greenhouse studies with low-S soils where crops respond to both N and S permit the following conclusions: 1. Oxidation of S in SCU commences rapidly in warm soil, and crop response to S in SCU has been measured in 2 months. Since the rate of S is higher than necessary, oxidation of a small portion of total S apparently supplies crop needs. 2. Yield response and uptake of N and S clearly show that SCU is an excellent controlled-release source of both nutrients. 3. On a long-term basis (6 months of cropping), yield of bermudagrass not limited by N supply was greater from SCU than from Na_2SO_4. The difference was attributed to control of luxury uptake of sulfate in early clippings. 4. Increase in soil acidity by the H_2SO_4 formed through oxidation of S in SCU should not be a problem in most soils.

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FORMOLENE: SHORT CHAIN UF PROVIDES STABLE SOLUTION

By John Dietrich and Robert Doberneck, Specialty Fertilizer Department, Ashland Chemical Co., Columbus, Ohio

Nitrogen fertilizers have been around for a long time. **Solution** fertilizers have been around for a long time. But until recently, these solution fertilizers were really suspensions, not true solutions. Formalene™ is a true solution, controlled-release nitrogen fertilizer manufactured by Ashland Chemical Company.

Formalene™ is contained in a water solution of "short-chain" urea formaldehyde compounds, principally methylol-urea along with urea.

During the manufacturing process for producing these and other urea-formaldehyde products a large quantity of urea containing a high percentage of nitrogen is reacted with a small quantity of formaldehyde at moderately high temperatures in the presence of catalysts for a precise time period. This reaction causes the formation of a number of urea formaldehyde compounds which, as "short chain" methylol ureas, methylene diureas, and dimethylol ureas, will remain in water solution when kept alkaline at around 9 to 10 pH.

Some manufacturers elect to continue the polymerization process converting these soluble "short chain" compounds into "longer chain" urea formaldehyde water insoluble polymers which are subsequently chipped or powdered and bagged for distribution to the marketplace.

Whereas, "short chain" water soluble UF materials, methylol ureas, are shipped as bulk or drummed liquid concentrates. This concentrate contains only 15 percent water, has a nitrogen concentration of 30 percent, and does not salt out until the temperature drops below minus 20 degrees F.

A straight urea solution contains 57 percent water, 43 percent urea, 20 percent nitrogen, and salts out below 30 degrees F. This relatively high saltout temperature requires storage tanks to be heated or insulated to prevent saltout. This generally not necessary for Formalene™.

Formolene™ Fertilizer
Comparative Performance Properties
(After Application)

Property	Formolene Solution	UF Powder Suspension	Urea Solution
Burn Potential	Low	None	Med-Hi
Initial Response	Moderate	None-Low	High
N-Release Period*	8-12 Weeks	2-3 Years	4-8 Weeks
N-Utilization* (by the plant)	85-95%	70-80%	50-85%

*Estimates pending verification in continuing university and field tests.

Also, urea solutions are a neutral pH while Formalene™ is kept usually around a pH of 9 or 10 for it to remain as a stable water solution.

Formalene™ is both a foliar and root feeding liquid nitrogen. While it is possible to burn grass with "short chain" methylol ureas, their nitrogen phytotoxicity potential is significantly lower than with urea solutions; and when they are applied at rates of one to two pounds of nitrogen per 1,000 square feet, burn has not been a factor when used with normal water dilutions.

The moderate initial response of Formalene™ reduces the tendency for disease problems associated with the excessive burst of growth frequently experienced with urea applications particularly in the spring. The nitrogen release period is around 8-12 weeks. Also, its appears that there is a higher

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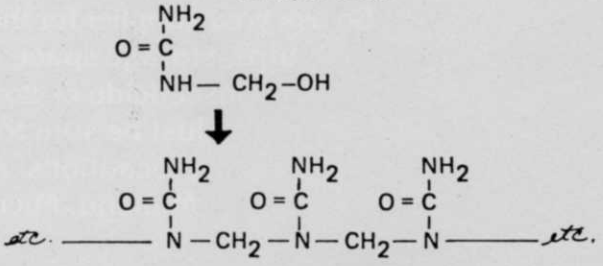

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degree of nitrogen utilization according to our first commercial year experience. If proven, this would permit a reduction in total applied nitrogen to still get the desired results. A reduction from 4 lb. per year per 1,000 square feet to 3 lb. may be possible.

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Your search for a high capacity mower encompassing a one man operation is now concluded. The Hydro-Power 180 with it's 15 foot hydraulically driven rotary mower has a mowing capacity of up to 11 acres an hour while incorporating rear wheel steering for maximum maneuverability. Cutting units are designed for maximum floatation and may be used individually or in any combination of the three. There is a 2-range hydrostatic transmission which affords mowing speed as well as transport speed to insure minimum travel time between the job sites. The Hydro-Power 180 offers year-round versatility with a 2-stage 66" snow blower and heated cab.

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Unsoftened water: This problem is rare because of the cost, but I have found softened water being used for irrigation (where the softening process adds salt). The solution is to quit using softened water for irrigation. Hard water is usually less damaging to plants and soils.

Water less

Practitioners of the art of diagnosing plant problems for the private home owner often feel that an automatic watering system installation is the beginning of major plant survival problems. Many systems can not be set with great enough intervals between irrigation times, nor for long enough flow periods at each of the waterings.

Increase the time between waterings: Established St. Augustine grass lawns can generally be maintained by watering once every week or ten days. In the hottest driest weather, weekly watering is needed. After long periods of shorter cycle watering, the change to the longer cycle may have to be gradual to develop a deeper root system. Sodium in the soil and high water tables from frequent watering also contribute to shallow root systems.

Increase the amount used each time you water: Always water long enough to thoroughly wet the soil (e.g. two hours) and have abundant run-off. There must be run-off to carry any accumulated salts away, and prevent surface build-up of salt where the water is removed only by evaporation.

Do not water trees where the grass is not "show place" grass in the front yard. The tree roots extend 30 to 50 feet from the trees, and will grow out into moist soil when there is less water next to them. In prolonged drouths, water once every four weeks. In narrow shady places between houses it is best to forget about growing grass and concentrate on growing trees. In such locations, the use of a rock mulch (e.g. 1½-in. gravel) will aid in preventing evaporation, absorbing rain, and preventing weeds. Line streams or drainageways that carry water from saline supplies to beyond the reach of roots with concrete. This lining must be root proof because the roots will actively grow toward a source of moisture. If this is not possible, **Cut the roots** to stop the transport of saline water from a stream to the trees. Ditch to a depth of four feet, or to shallower claypan or caliche layer that stops the deeper penetration of the roots. Ditching should be repeated every three years. Any stream whose major watershed area is watered lawns will have an augmented salt content.

Physical and chemical modification of the soil

Make physical and chemical modifications to remove the sodium from the soil and to build granular better-drained soil. Since leaching is an important part of chemical modification, good drainage must be established. Chemical changes that release sodium must be done slowly so the sudden release of large amounts of salt does not burn or kill the plants. It is best to use no more than 400 pounds of chemicals per acre per year. Slowly dissolving granular dolomite need not be included in the 400 pounds per year.

Physical modifications: Be sure the soil is as well drained as possible so the water can percolate through to leach the salts from the soil. In such cases drainage may be expensive and could require tiling or French drains into drainage pits with sump pumps or siphons. French drains leading into pits filled with course gravel and having siphons that start themselves at overflow times can be built at a relatively low cost, especially if you do your own labor.

Use a heavy spike toothed aerator to permit air, water, and chemicals to penetrate more deeply. Applying a top dressing of sand over the freshly spiked soil may make semi-permanent access channels.

Chemical modification:

While *sulfuric acid* treatments are used in agriculture and nurseries, there is danger of burning your perennial plants, and it should probably not be used in ornamental plantings and vegetation. *Sulfur* granules may be used up to 200 pounds per acre per year. Sulfur slowly changes to sulfuric acid. *Treatment with gypsum* (hydrous calcium sulfate) is the most frequently recommended treatment for alkali. The amount of gypsum required to neutralize the alkali is several tons per acre, but applying this much would cover the soil and burn the vegetation. Adding 400 pounds per acre per year should start reversing alkalization process. The addition of dolomite granules with the gypsum should help the structure, and the magnesium dislodges sodium, increases leaf retention, and improves leaf color and vigor. Potassium excesses present in most of our soils make magnesium unavailable to plants, and coastal plain soils are often deficient in magnesium. The dolomite should not be needed in the older limestone and hill country soils. *Fertilize with ammonium sulfate* to make the soil more acid, remove sodium, and to provide nitrogen. If 100 pounds of ammonium sulfate is used, then only 300 pounds of gypsum should be used per acre per year. Phosphate fertilizer is usually not needed for woody plants, and additional potassium is harmful in these alkali soils. However, if leaching is successful at removing much of the sodium, potassium can go with it. At the higher rates of sulfate use, it may be well to add some potassium to the soil in the fertilizer. At the rates recommended here, the potassium should not become in short supply in the Lufkin soils.

Physical-chemical modification with a top dressing of course sand and peat-moss will benefit the soil and roots. Add about one-half inch per year for 4-6 years. The roots will grow up into the sandy layer to get moisture, better structure, and less salt. Grass will grow much better in the sand, and the sand will increase rainfall absorption. Do not mix the sand and peat-moss into the soil, and do not add any soil with clay in it (top soil). The object of the top dressing is to provide a better soil on top of the old one so the roots can avoid the clay. Clay is the dangerous fraction of the soil where saline irrigation is used (Boyko 1968, Richards 1954).

Making these soil modifications will start to reverse the alkali trend of the saline water irrigated soils, and in a few years the conditions should be much better. Your trees should have larger healthier leaves (you will not see the difference unless you save pressed samples). If you can not do all of the ameliorating treatments, any part of these you can do will improve the health of your trees and soil. Reducing the amount of water applied by extending the time between waterings is most important. **WTT**

AESCULUS AND CARYA TREES DESERVE SECOND CONSIDERATION

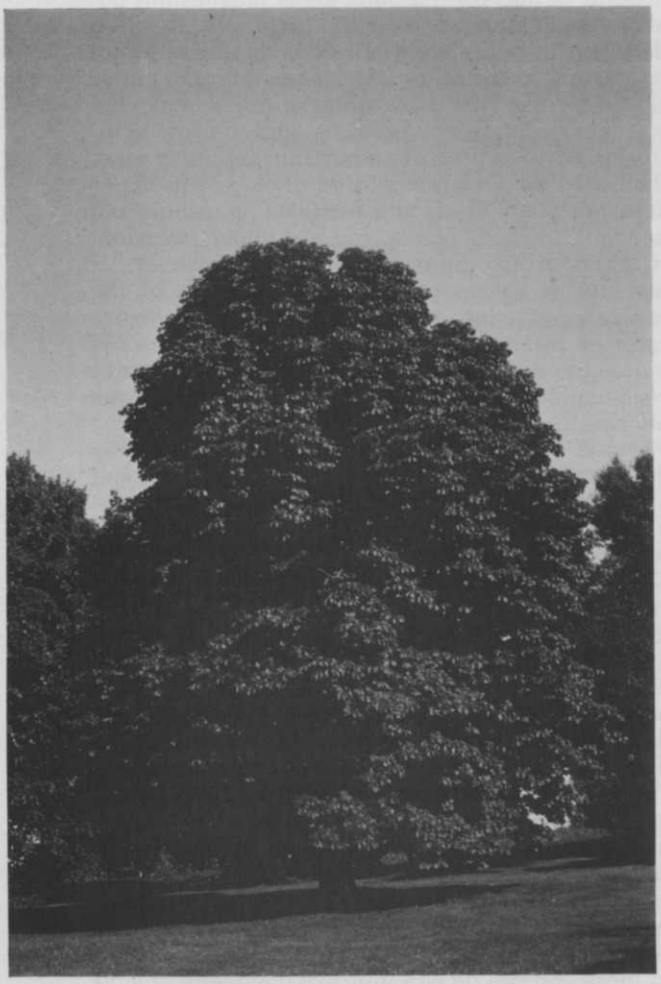
By Douglas Chapman, Horticulturist, Dow Gardens, Midland, MI

Horsechestnut, Ohio Buckeye, and hickory are trees that may have been overused in the past but deserve a second look; two for large area landscapes and the other for residential landscapes.

Common Horsechestnut *(Aesculus hippocastanum)* is a large upright, oval tree. Commonly, the landscape effective height is 50 to 75 feet, but it has been reported to reach 100 feet in height. This tree is striking when in full bloom during late May with showy yellow and red flowers borne on panicles, five to eight inches long and four to six inches wide. Normally, it is a biennial bloomer. The fruit can be a maintenance problem during the fall but children enjoy collecting and making pipes (fruit is not edible). The foliage is initially light green turning a rich dark green for the summer. The palmately compound leaves with the seven leaflets add a somewhat coarse texture to the plant. When the leaves first unfold, they are light green turning a good dark green for the summer. Fall color is not dependable, but when develops, it ranges from a poor brown to a light yellow. This fall color, which dependably develops on a few individual trees, may be a reason to select and introduce a new cultivar into the trade.

Although Common Horsechestnut is usually propagated by seed, we have been able to propagate it by cuttage. Cuttings should be taken as soon as elongation is six to eight inches (before flowering). These cuttings are treated with Hormodin No. 3 mixed with 5% Benlate and placed under intermittent mist. Within six weeks, one can expect 80 to 90% rooting. The young trees, with their well-developed, yet coarse root system, should be potted into half-gallon containers, grown for the rest of the summer. This young tree can then be planted out the following spring after being overwintered in controlled storage.

Horsechestnut is a large tree which can be used as a landscape specimen in institutional grounds, golf courses, or parks. It thrives in well-drained, fertile soil. The reported insects or diseases of Common Horsechestnut aren't catastrophic. In Southern Illinois, leaf blotch is a problem, but in Northern Illinois and throughout much of Michigan, leaf blotch need not be a concern. Many have reported Common Horsechestnut to be somewhat weak wooded, but during the most severe ice storm of the century to hit Central Michigan (1975), this tree was least damaged. Nino Mauro, Forester, City of Saginaw, reported that Common Horsechestnut showed little damage, while oak, elm, and Sugar Maple were broken apart due to the storm. *Aesculus hippocastanum* thrives in urban conditions and, because of its density, grass does not thrive under its canopy. Leaving these lower limbs on the tree decreases maintenance, while protecting the trunk from lawn mower damage. Further, leaving the lower branches on enhances the form of these trees.



Large Common Horsechestnut normally blooms every other year with showy yellow and red flowers.

Flowers of Ruby Red Horsechestnut are bright red contrasted against a dark green leaf.

Ruby Red Horsechestnut *(x Aesculus carnea* 'Briotti') has many of the desirable characteristics of Common Horsechestnut, but lacks fruit which

Shagbark Hickory Leaflets are bright yellow-green during late fall.

can be a maintenance problem. Ruby Red Horsechestnut has the same oval habit but is significantly smaller, reaching only 30 to 50 feet in height. The red flowers are outstanding, being contrasted by an extremely dark green leaf. This tree shows resistance to leaf blotch and isn't affected by leaf scorch (a physiological disease which often defoliates Common Horsechestnut). If a medium-sized tree, which adapts well to residential landscapes as well as parks, is desired, Ruby Red Horsechestnut is a good alternative.

Ohio Buckeye *(Aesculus glabra)* is an effective specimen tree in residential or park landscapes. Its habit is a dense, broad oval, reaching 30 to 40 feet in height. The palmately compound leaf, with five leaflets, is striking as it is one of the first to unfold in the spring. The yellow-green flowers are borne during mid-May on four to seven-inch long by two-inch wide terminal panicles. The flowers are exciting upon close inspection but add little to the

Fruitless Ruby Red Horsechestnut is smaller than the common horsechestnut, exhibits resistance to leaf blotch and scorch, and has bright red flowers.

overall landscape. The summer color is a shimmering bright green followed by a dependable yellow to orange fall color. This medium-sized tree can be effective when used in natural settings or specimens for residential or large area landscapes.

There are no catastrophic insects or diseases of Ohio Buckeye. Leaf scorch (a physiological disease often during late summer) causes defoliation of Common Horsechestnut, but rarely affects the Ohio Buckeye. Although leaf blotch, powdery mildew, and anthracnose can affect the foliage, they rarely cause severe defoliation or damage requiring control. Insects are numerous, but annual spraying isn't needed. A plantsman can watch insect populations, spraying only when necessary.

Shagbark Hickory *(Carya ovato)* is a large tree reaching 60 to 85 feet in height, with a narrow oval habit of growth. The flowers are ineffective. The fruit is edible but adds little to the landscape. It has pinnately compound leaves which are a bright yellow-green early in the spring with the five leaflets showing a brilliant yellow to brown color during late fall. The bark becomes characteristically shaggy in long platelets after the stems reach six to eight inches in diameter.

Hickory is a good companion plant for oak or horsechestnut. It thrives in fertile, yet well-drained soil, although it can adapt to many soil types. Although there are some insects and diseases that affect Shagbark Hickory, none are catastrophic. Hickory is difficult to transplant as it has a very deep taproot — this fact limits its availability in the trade. Landscape use is restricted to institutional grounds, parks, golf courses, or large natural plantings.

In general, Common Horsechestnut, Ohio Buckeye, and Shagbark Hickory are most effectively used in large area or golf course landscapes, while Ruby Red Horsechestnut and, in some instances, Ohio Buckeye fit into residential landscapes. All of these trees thrive in fertile, well-drained soil. In native situations, hickory and oak are climax forests. They require only corrective pruning when young; therefore, are relatively low maintenance. For urban conditions, Ruby Red Horsechestnut is most tolerant, followed by Common Horsechestnut, Ohio Buckeye, and lastly, Shagbark Hickory. These trees can be outstanding additions-variations to the landscape, while requiring relatively little maintenance. **WTT**

NEW EVIDENCE INDICATES GREENBUG OVERWINTERS IN NORTH

By Harry D. Niemczyk, Professor of Turfgrass Entomology, OARDC, Wooster, Ohio

The greenbug, *Schizaphis graminum* (Rondani), is not a new pest. It has been responsible for injury to a number of grassy plants, including barley, oats, wheat, and sorghum, since it was first discovered in the U.S. in 1882. Significant damage occurs annually in Texas and Oklahoma and occasionally as far north as Minnesota. Perennial bluegrass is known to be a host of this aphid, but prior to 1970 the aphid rarely caused damage to turfgrasses. The reports of damage to Kentucky bluegrass in Illinois (WTT, October 1978) and recent occurrences in Indiana (Indianapolis), Missouri (St. Louis), and Kansas (Kansas City), indicate a new association with turfgrasses. This association suggests that a new biotype has evolved which prefers perennial bluegrass over other host plants

Life History Unknown

Despite the fact that the life history of the greenbug as a pest of grain plants is well known, its association with turfgrass has never been studied. A key question is how infestations originate on home lawns? One theory is that the annual spring influx of aphids from Texas or Oklahoma on southerly winds is the source. While it is known that greenbugs are carried north on such winds and probably do establish on home lawns, it seems at least highly unlikely that such migrants could reinfest the same Ohio homelawns year after year while others nearby are not infested.

A more plausible explanation is that some of the aphid population overwinters, probably in the egg stage. This theory is supported by two facts: (1) up to 8 egg-laying females per square foot were collected from infested lawns in Columbus, Dayton, Cincinnati, and Toledo, during October-December 1979; (2) greenbug nymphs (young aphids) were collected from some of these lawns April 1, 1980. Our ability to deal with this pest now and in the future requires that its life cycle on turfgrass be known. It will be studied in 1980.

Damage

The greenbug damages grasses in several ways. With piercing-sucking mouth parts, it pierces the grass blade and sucks out the sap of the phloem. This feeding by large numbers of aphids (4,000 per square foot quite common) seriously weakens plants. In addition, the greenbug secretes a salivary substance which it injects into the plant as it feeds. This substance (phytotoxin) causes the tissues to die, giving damaged plants a burnt-orange color. There is a strong possibility that the phytotoxin is translocated within the plant and may weaken the root system.

Greenbug damage to Kentucky bluegrass in Ohio was first reported by lawn care firms on a few home lawns in Dayton, Ohio in 1973. Infestations were seen in shaded areas under trees but were also noted in open locations. Infested bluegrass turned a characteristic yellow to burnt orange color. If left uncontrolled, grass in infested areas was killed.

Since 1973, the incidence of infestation and damage from this aphid has increased steadily until it is presently considered a major pest of homelawns in Dayton, Cincinnati, and Columbus and certain areas of Toledo. Infestations now commonly occur in boulevards and turf islands in parking lots, with and without shaded areas. These areas and many homelawns become reinfested annually. Some have been infested as many as four years in succession.

Insecticide Resistance

Initially, a single liquid application of chlorpyrifos (Dursban®) or diazinon apparently gave acceptable control. However, in 1978, lawn care firms reported a resurgence of greenbug populations 2 to 3 weeks after applying chlorpyrifos or malathion at 1 lb AI/acre. Three and sometimes four applications were made to suppress the population and minimize damage. Despite these efforts, many home lawns were damaged so severely that replacement by resodding or reseeding was necessary.

The resurgence of populations after repeated applications of chlorpyrifos, diazinon or malathion strongly indicated resistance to these organophosphate (OP) insecticides had developed. Therefore, with this assumption, a "crash" program was initiated from July to November 1979 to test alternative insecticides. Funds provided by a few lawn care firms to help cover wages and travel expenses got the program started.

Tests on Home Lawns

Home lawns in Columbus and Dayton which had received liquid applications of either chlorpyrifos or diazinon during June or July, but were still heavily infested with greenbug, were used as test sites for two carefully selected test insecticides; acephate (Orthene®), a different OP; and pirimicarb (Pirimor®), a carbamate. Orthene is a systemic insecticide of known effectiveness against other species of aphids. Pirimor, a translaminar material (moves across the leaf but does not move through the plant) is known to kill aphids only, leaving other insects unaffected.

Working in a cooperative research effort, applications in Columbus and Worthington were made from a ChemLawn Corporation service truck at a volume of 4 gal. per 1,000 sq. ft. In Dayton, similar applications were made with Leisure Lawn Corporation equipment at one gal. per 1,000 sq. ft. All treatments were made by an experienced operator.

The greenbug population at each test site was sampled the day of treatment before application and at intervals thereafter. Four to eight circular samples of turf 3.75 inches in diameter by 3 inches

Continues on page 80

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31 ☐ Up to $1,000
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33 ☐ $5,000 to $15,000
36 ☐ $15,000 to $30,000
37 ☐ $30,000 to $50,000
38 Other_____

3B/ Fertilizers (All Formulations)
51 ☐ Up to $5,000
52 ☐ $5,000 to $15,000
53 ☐ $15,000 to $30,000
56 ☐ $30,000 to $50,000
57 ☐ $50,000 to $70,000
58 Other_____

3C/ Equipment (for turf, tree and grounds care)
61 ☐ Up to $10,000
62 ☐ $10,000 to $30,000
63 ☐ $30,000 to $60,000
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67 ☐ $100,000 to $150,000
68 Other_____

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71 ☐ Up to $5,000
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73 ☐ $15,000 to $30,000
76 ☐ $30,000 to $60,000
77 ☐ $60,000 to $100,000
78 Other_____

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82 ☐ $5,000 to $15,000
83 ☐ $15,000 to $30,000
86 ☐ $30,000 to $60,000
87 ☐ $60,000 to $100,000
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Green Survival Garden. It is a cooperative effort of AAN, the American Seed Trade Association, the US Department of the Interior, the US Department of Agriculture, and the US Department of State. For more information contact AAN, 230 Southern Building, Washington, DC 20005.

PESTS

Management program fights gypsy moth

The U.S. Department of Agriculture has formulated a plan it hopes can contain the gypsy moth, which last year stripped 643,000 acres of forests in 12 states at a cost of millions of dollars.

To coordinate the plan, the USDA formed an interagency steering committee. It consists of representatives of the USDA's Animal and Plant Health Inspection Service (APHIS), Forest Service, and Science and Education Administration and affected states. Subcommittees on research, operations, and information provide backup for planning control, regulatory, detection, and other aspects of the effort.

When outlying infestations are discovered, they are wiped out in carefully planned operations by APHIS in cooperation with the affected state. State, federal, and local officials carefully consider alternatives and present their plans to residents at public meetings.

Trying to eradicate the moth from the entire United States would involve unacceptable dollar, manpower, and environmental costs and might well be impossible in any case. But the present program is buying time for the uninfested area while better pest management systems are developed to deal with the gypsy moth.

EXTENSION

Shoulders of VPI retires from turf

John Shoulders, well-known professor of agronomy and extension turf specialist at Virginia Polytechnic Institute, has retired after 28 years of service in turf and forage work.

Shoulders helped create and occupied the new position of extension turf specialist in 1966. His many accomplishments include fall and winter nitrogen fertilization, doubling the state's alfalfa production between 1952 and 1961, and tripling corn silage production between 1952 and 1966. In 1977 he was honored as a fellow in the American Society of Agronomy, the highest honor the organization bestows upon its members.

Shoulders plans to remain in Blacksburg and maintain an interest in turf programs.

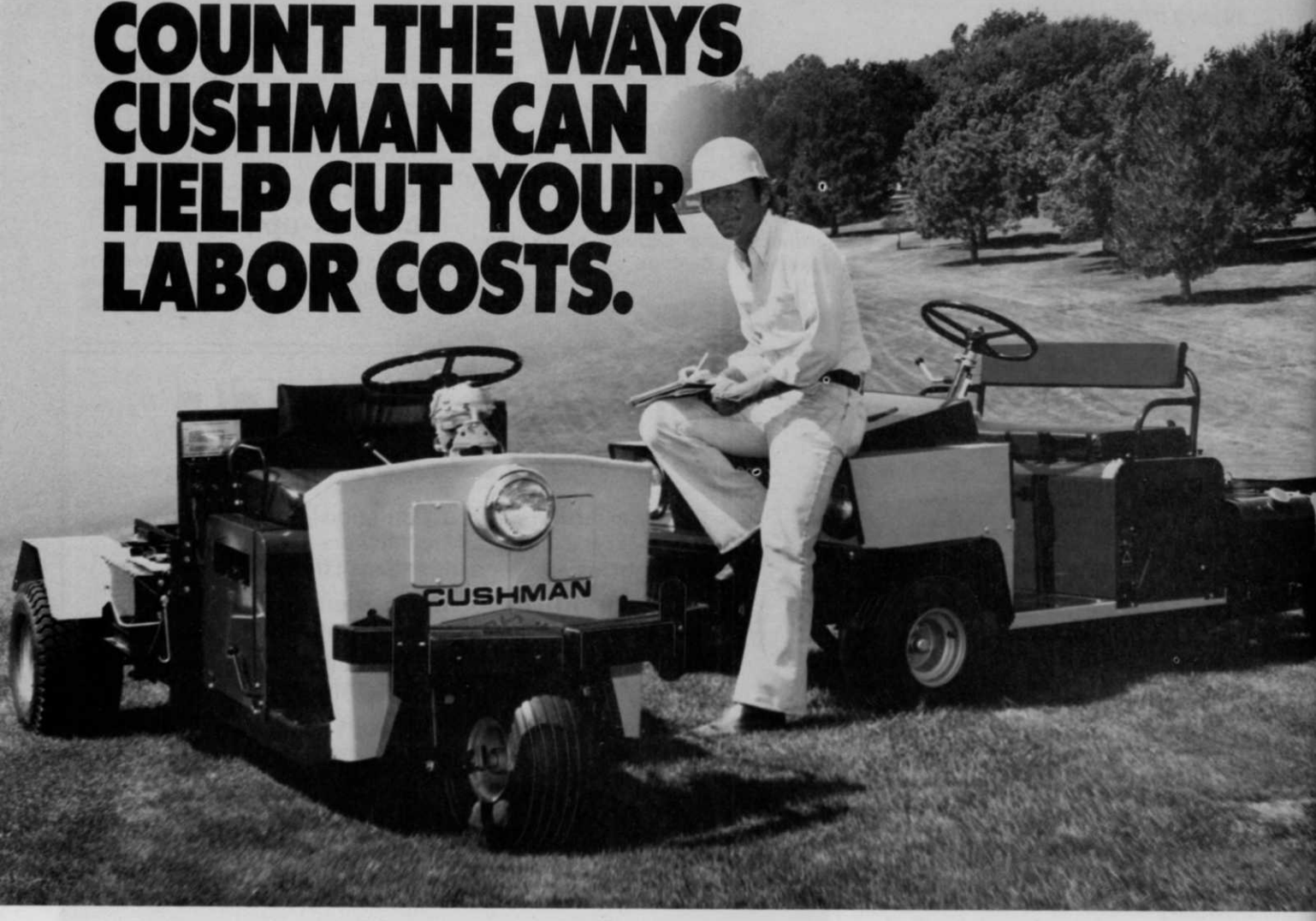
TRENDS

Scotts research shows home fix-up to rise

A nationwide survey conducted for O.M. Scott & Sons by Home Testing

Continues on page 68

COUNT THE WAYS CUSHMAN CAN HELP CUT YOUR LABOR COSTS.



With inflation driving up your labor costs, you've got to find new ways to get more work done in less time.

That's what the Cushman Turf-Care System is all about.

At the heart of our system is the Cushman 3- or 4-wheel Turf-Truckster vehicle. With a rugged 18-hp engine, and a transmission designed to allow the optional PTO to attach directly to it, the Turf-Truckster moves people, tools and equipment quickly and economically.

But the real beauty of the Turf-Truckster is that it also helps your crew finish most turf jobs fast, thanks to a full line of optional Cushman attachments.

Each attachment secures to your Turf-Truckster's chassis in minutes, through Cushman's pin-disconnect system. You don't bolt or hitch, but just put the attachment in place, snap-in two or three pull pins and you're ready to hit the turf.

And every optional Cushman Turf-Care attachment is engineered to get its job done neatly and in as little time as possible.

1. GREENSAVER® AERATOR.

The Greensaver lets you aerate greens, tees or other turf areas up to 10 times faster than walk-type units.

It attaches easily to either the 3- or 4-wheel Turf-Truckster. Choose the drum best suited for your turf: ½" coring tines, ⅜" coring tines or slicing tines—they are all interchangeable. What's more, both coring drums collect cores as you aerate. Or remove the side plates and return the cores to the turf to be broken up as top dressing.

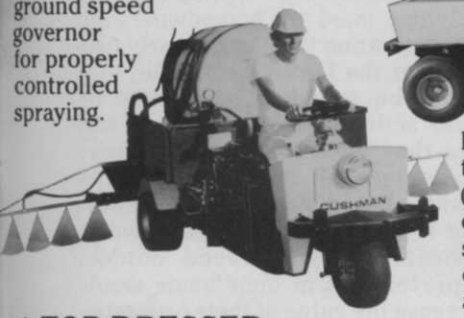
2. SHORT BOX & FLATBED/BOX.

Your Turf-Truckster becomes a flatbed hauler with just two pull pins in place. Bolt on the optional side panels and tailgate to the flatbed, and you've got a 1,000-lb. capacity* box that can be dumped manually or hydraulically.

Write **121** on free information card

3. SPRAYER.

It's a 100-gallon polyethylene tank that holds liquids for spraying greens, trees, bushes or roughs quickly and accurately. Team it with the Turf-Truckster equipped with a standard 2 to 1 auxiliary transmission, optional PTO and ground speed governor for properly controlled spraying.



4. TOP DRESSER.

Compared to self-powered or walk-type top dressers, this unit pays for itself in the hours it can save your crew. A rubber fabric moving bed and rotating brush are regulated by

the vehicle's ground speed to maintain an even spreading pattern over a 31½" swath. And the hopper holds up to 1,000 lbs. of material from rock salt to powdered fertilizer.

5. SPREADER/SEEDER.

Mounted on the optional Short Box or Flatbed/Box, its cyclone action spreads up to 300 pounds of seed, sand, salt or fertilizer over areas up to 40' wide. The Spreader/Seeder is powered by the Turf-Truckster's optional PTO with extension shaft. And since all controls are operated from the driver's seat, one man can get the job done.

6. QUICK AERATOR.

We call it the Quick Aerator because its 46" wide swath lets you finish big aerating jobs fast. It can also move from job to job fast, because it can be

hydraulically lifted by controls from the driver's seat for ground transport (optional hydraulic system and dump set required). Three tine styles are available for different soil conditions: slicing, coring (2 sizes) and open spoon.

7. GRADER/SCARIFIER.

Now you can groom non-turf areas with your Cushman Turf-Care System. Attach the new Grader/Scarifier to your Turf-Truckster and you're ready to break up compacted dirt on ball diamond infields or golf car pathways. As a professional grading tool, it will keep your grounds even, or create new surfaces. There's a built-on dragmat holder, driver-operated controls and an optional scarifier replacement bar with extra-close 1½" tooth spacing.

8. POWER CONVERTER.

The Cushman Power Converter turns your Turf-Truckster into a mobile power plant for electric tools, floodlights . . . anything with a universal motor that draws up to 120 volts DC. So, instead of bringing every repair job back to the shop, your crew can handle them in the field. The Power Converter is inexpensive, easy to install and makes your Cushman System even more versatile.

9. CUSHMAN RUNABOUT.

If you need a vehicle for moving people and equipment efficiently, consider the Cushman Runabout. Either the two-man 18-hp Runabout, or the one-man 12-hp model. Both give you maneuverability and feature a big pick-up box, and 3-speed transmission. And both Runabout models let your crew get to the job without tying up a golf car that could be on the course earning a profit.

The Cushman Runabout. The Cushman Turf-Truckster. The Cushman Turf-Care System. They're all designed with the kind of quality you've come to expect from Cushman. And common sense engineering for less downtime, helping you hold down rising operating costs.

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80-CUT-1

News *from page 65*

Institute indicates that homeowners will spend more time at home and spend more money on lawn and garden material.

Lawn care and gardening were the activities cited by homeowners for extra attention this year. Nearly two-thirds of the family heads said they would be spending more time on these activities and more than half said they would be spending more money on their lawns and gardens. Beside the enjoyment of an attractive lawn and garden, homeowners indicated they believed outdoor improvements to their home would increase the value of their property.

More women indicated a role in the care of lawns, nearly 40 percent, compared to 68 percent of the men. Sixty percent of women indicated a role in gardening.

Other surveys have predicted a significant increase in gardening this year, especially vegetable gardening.

TURF

Awards given at Midwest Conference

Two students, a leader in the turf industry, and the director received recognition at the Midwest Regional Turf Conference at Purdue University.

Stephen Biggers IV and David Shifley received Purdue turf scholarships and checks for $250 from the TUCO Div. of Upjohn Co., Kalamazoo, MI. Ben and Dorothy Warren of Warren's Turf Nursery, Palos Park, IL, were recognized for their educational efforts in the sod industry and Dr. W. H. Daniel, director of the conference, was given a surprise roast and recognition for his 30 years in turf.

Stihl participates in lumberjack contests

For one week in July, the Annual Lumberjack World Championships bring the sound of axes striking wood and thousands of people to little Hayward, Wisconsin.

Stihl Inc. has decided to participate with a full sponsorship in the contest after a limited sponsorship last year. The company will be involved this way for the next three years.

Introducing the W4

Tough little mudder.

The go-anywhere articulated loader with 35 hp diesel engine.

Now you can handle more tough loading chores around the jobsite with a new breed of loader for today's construction...the Case W4!

New center-pivot steering joint means 70° articulation...plus 16° oscillation. This rugged new joint protects vital drive components from damage ... means high ground-clearance. It lets W4 crawl through mud and muck. And climb over ruts and hilly areas. The front and rear wheels always follow the same track.

With 35 horses (26.4 kW) inside a stout 5-main bearing, liquid-cooled diesel engine, the W4 loader is always ready to go. And for sheer brute capacity, W4 boasts an operating load of 778 kg (1715 lbs) with the .38m³ (½ yd³) standard bucket.

Easy operation and articulated design make the W4 easy on the operator. Hydrostatic drive lets him work at speeds up to 7 kph (4.4 mph) ...20.4 kph (12.7 mph) in transport.

A simple hand lever selects forward, neutral or reverse — while a foot pedal controls power and speed.

The self-leveling mechanical loader automatically levels the bucket in raise cycle...lets you concentrate on maneuvering. And W4's hood swings up for easy access to all routine maintenance areas.

Check out this "Tough little mudder" soon at a Case Underground dealer near you. It's the first loader that's ***doing something about it*** to get more work done on the jobsite.

J I Case
A Tenneco Company

TENNECO

Light Equipment Division
PO Box 9228 Wichita, KS 67277 U.S.A.

W4C-2-380

W4 with new forklift option increases job versatility.

case®

VEGETATION MANAGEMENT

By Roger Funk, Ph.D., Davey Tree Expert Co., Kent, Ohio

Q: *What can you tell me about Pine wilt ? It was suggested as a possible cause of the death of a client's red pine, but I have not been able to find any information.*

A: Pine wilt disease was first reported in the United States in Missouri in 1979 and has now been identified in 15 states from Missouri to the East Coast. The disease is caused by the pine wood nematode *Bursophilenchus lignicolus.* Austrian, red, Scot's, white, slash, Virginia, and Swiss stone pines are particularly susceptible.

The only external symptom is wilting, followed by yellowing, then browning of the needles, starting at their base and extending to the tips. A pine that has been killed will generally retain the needles for a period of time because death is so rapid. When infested trees are cut, the wood, rather than being pitchy, appears dry with little or no resin.

The nematodes are spread by one of the long-horned beetles or roundheaded borers. The adult beetles principally attack freshly cut, dying or recently dead trees, although when the adults first emerge they seek fresh tissues of healthy pines for their first feeding. The boring wound is inoculated with nematodes as the beetles feed. The nematodes multiply to enormous populations, migrate to the vascular system and plug the conducting cells.

Once the disease has been confirmed, remove the dead tree as soon as possible to reduce the source of nematodes. There are no other control procedures at this time.

Q: *Is it true that only the current season's wood conducts water in trees? Would this be the best area to inject chemicals for protection from insects and fungi?*

A: Angiosperms are classified as ring-porous or diffuse-porous. In ring-porous trees, such as oaks, ashes, and elms, the diameters of the xylem vessels formed early in the growing season are much larger in diameter than those formed later. In diffuse-porous trees, such as poplars, maples, and birches, the vessels generally are approximately the same diameter throughout the growing season.

There is considerable difference of opinion concerning how much of the sapwood is actually involved in water conduction. In at least some of the ring-porous trees, most of the water moves in the outermost annual ring, although some movement may occur in the late wood of the preceding year. In diffuse-porous trees and conifers, a considerable number of annual rings usually are involved in water conduction.

Injection of pesticides should be made in the outermost annual rings for best absorption and translocation. The pattern of sap ascent, that is, whether it is a spiral pattern or direct vertical ascent, will also affect the distribution of pesticides throughout the crown.

Q: *What cultural practices will help develop a better root system so turfgrass will be less susceptible to damage during hot, dry weather?*

A: Excessive nitrogen, close mowing, frequent light watering, compacted soils, and heavy thatch reduce rooting and/or decrease rooting depth. Any cultural practices which correct these problems will help turfgrass develop a more extensive root system.

Q: *What would make a fruit tree break off at the graft union? The tree was over 10 years old and appeared healthy.*

A: Symptoms of graft incompatibility may range from complete failure of the root stock and scion to graft to vigorous growth the first year followed by slow decline. In some cases, symptoms of incompatibility such as chlorosis and leaf shedding may not be apparent until many years after grafting.

Q: *How safe is Dipel and how effective is it against gypsy moth?*

A: Dipel contains spores and crystalline endotoxin produced by *Bacillus thuringiensis* Berlinger. It is considered harmless to humans and animals and is safe for the environment. At the present time there are no clearcut opinions on its effectiveness.

Q: *After a lawn has been sprayed with fertilizers and pesticides, is it safe to use the grass clippings on my vegetable garden?*

A: Broadleaved weeds are herbaceous dicots, and chemicals which control these weeds will also affect vegetables. Tomatoes, beans, and cucurbits are particularly susceptible. Therefore, it is not safe to apply fresh clippings from a treated lawn to a garden, although it should be safe to use the clippings after they have been composted for a season.

Q: *Can fritted trace elements be used along with fertilizers in a liquid spray system?*

A: Fritted micronutrients are special glasses that are not soluble and are very abrasive. You would not want to spray frits through conventional piston pumps.

Send your question or comments to: Vegetation Management c/o WEEDS TREES & TURF, 9800 Detroit Ave., Cleveland, OH 44102. Leave at least two months for Roger Funk's response in this column.

SOD PRODUCER NEWS

U.S. Dept. of Labor prosecutes sod grower for hiring practices

The Department of Labor recently cited and assessed a penalty of $8,000 to Warren's Turf Nursery Inc. for the way it obtains workmen for its nurseries.

The action centers on Warren's Sullivan, Wisconsin nursery, one of the firm's largest with more than 1,000 acres. The nursery annually hires 25 to 30 itinerate workmen from Mexico for the growing season.

The Department of Labor filed a complaint against Robert Milam, Warren manager at Sullivan, and assessed him with a penalty of $7,000 for not registering as a labor broker. A citation was also issued against the Warren Corp. with an assessment of $1,000 for hiring an unregistered labor broker, who is the firm's own manager, also Milam.

"The immigration people have made things very difficult for us," said Ben Warren, president of the company. "They have entered our bunkhouses, without warrants, at 3 or 4 am. They have driven over newly irrigated sod fields, doing serious damage, in their zeal to arrest "wet backs." They have demanded proof of citizenship from native born Americans, a practice which I understand is illegal."

Warren was also critical of trade associations whom he says have done nothing to help. "So far neither the Sod Growers Association or the American Association of Nurserymen have done anything except feel sorry for us. They act like they think 'Warren is guilty of breaking the law so we can't help them.' We have broken no laws."

William Harding, legal counsel for the American Sod Producers Association, said, "The decision made by ASPA was that the resolution of the problem would come about quicker through legislation than through litigation. Our primary thrust is to get the legislation changed." He said the litigation would take a long time.

Lofts Seed and Southern Turf establish Sunbelt Seeds, Inc.

Lofts Pedigreed Seed, Inc., NJ, and Southern Turf Nurseries, Tifton, GA, have formed a new company based in Tucker, GA, called Sunbelt Seeds, Inc.

Peter Loft, chairman of Lofts, and Charles Nash, president of Southern Turf, said the company initially will specialize in marketing programs to the southern recreational turf market, particularly golf courses during the overseeding season. Sunbelt Seeds will also provide supplemental seed treatment for disease control as well as a blending service for those requiring special blends of seeds to fulfill their seeding needs.

The Land Reclamation Report

Interior approves funding for mine projects

Projects in various states have received federal monies for mining and reclamation contracts from the Department of the Interior.

The Water and Power Resources Service has awarded $11 million to a California construction firm for work on the Southern Nevada Water Project. This entails construction of flow control facilities, tanks, and a chlorination station.

Joan M. Davenport, Assistant Secretary of the Interior for Energy and Minerals, has approved a mine expansion plan on some 6,680 acres of land in northern Colorado which will produce 31.2 million tons of steam coal over the next eight years.

Along with approval of this construction, the Interior has committed money to some reclamation projects. These include:

- An abandoned coal mine site that is causing air pollution in western Illinois at an estimated cost of over $450,000,
- A $2.4 million project to reclaim the abandoned Zayre strip mine and coal refuse bank in Wilkes-Barre Township, PA, and
- A plan to reclaim some 219 acres of abandoned coal mine lands in the Little Kyger Creek watershed in Gallia County, OH.

OSM gives statement on reclamation funds

The Office of Surface Mining has issued the Final Environmental Statement (FES) on the proposed use of the federal portion of fees collected from active coal operations to reclaim abandoned coal mine lands.

The FES examines five possible approaches for the allocation of the 20 percent federal share of the fees collected.

The preferred alternative is based on a goal-oriented approach which directs funds toward the most extensive abandoned mine land problems and toward those which most affect people.

Other alternatives are:

- Funding eligible projects in the order received, regardless of the location.
- Allocating funds based on the percentage each state or Indian tribe contributes to the fee collection system.
- Allocating based on the percentage of national historic coal production from a given area.
- Allocating on a state's or tribe's share of the Abandoned Mine Lands problems nationwide.

Standard's new Duo-Rake...a real "smoothie" in any sand trap!

For the first time, a trap rake that extra-smoothes sand. Just the way your golfers want it!

Unique Standard Duo-Rake lets user rake out deep footprints, other indentations — then turn rake over and blade out — absolutely smooth — the grooves or ridges that can be a menace to good play.

Golfers find Duo-Rake a delight to use because it's so light-weight and easy to handle.

You'll love Standard's Duo-Rake, too. Because it's so maintenance-free.

Its high-impact molded plastic head is practically in-destructible.

Add to this the no-rust, heavy-duty aluminum handle and chrome-plated 3-inch stand-up spike — and we ask — **how can a rake be more maintenance free!**

Choice of bright yellow or uncoated natural-aluminum-color handle.

Duo-Rake head is interchangeable with head on other Standard Trap Rakes.

The Standard Touch makes the difference.

Why not bring your sand traps up to snuff now?

Contact your Standard Distributor. Or write or phone for new Standard Duo-Rake Bulletin DR-'78. Standard Golf Company, 220 East Fourth Street, Cedar Falls, Iowa 50613. 319/266-2638.

STANDARD GOLF Pro-Line

WT&T PRODUCTS

Fastgrass, a varietal blend of fine-leafed perennial ryegrasses, forms a dense stand quickly and blends in well with other desirable grasses, such as Kentucky bluegrass, Creeping Red, or Chewing fescue. This variety, from Otto Pick & Sons Seeds Ltd., has a dark color, mowes easily, withstands low mowing heights, and resists many turf diseases. It holds up well to traffic and can be used on golf course fairways, tees, and greens in the South, football fields, and other highly tread areas.

Write 701 on free information card

Efficient handling of hose and electric cable saves time and convenience. Hannay Reels on Wheels handle fluids, gases, cable with electrical connections, or rope and chains. They adapt to a wide variety of maintenance applications, such as spraying, watering, fertilizing, edging, trimming, and pruning.

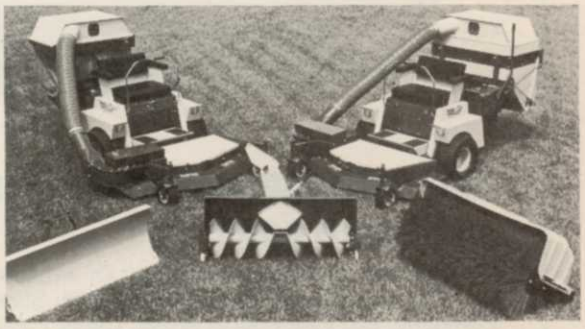
Models 1100 and 1200 are continuous flow reels and handle ⅜ through 1-inch inside diameter hose. They are equipped with swivel joint inlets, fluid hubs and outlet risers, and are made with steel handles, rubber-tipped front legs, and rubber wheels for easy transport over uneven surfaces. Models for dry storage handle 2,000 feet of ⅜-inch outside diameter cable, rope, etc. Another model transports electric cable and comes with a 6-foot lead of Type SO cable with a 3-prong male plug.

Write 703 on free information card

A quick disconnect of the 44-, 52-, and 61-inch mower decks makes for easy attachment of optional equipment on Grasshopper's 12- and 16-horsepower riding mowers. Attachments include a 48-inch dozer blade, adjustable to bi-directional angles; snow thrower with 12-inch auger and rotating discharge chute; and rotary broom with protective cover.

A vacuum grasscatcher discharges into a self-contained, rear-mounted collection hopper. A fan assembly powered by the mower deck drive conveys clippings to a catcher. Dual hydrostatic drives power each drive wheel independently, providing maneuverability that saves labor and fuel.

Write 705 on free information card



Correction: The Kleco drift-proof sprayer listed in March "Products" is manufactured by Kinder Lawn Equipment Co., Denton, TX.

Dicoa Irrigation Systems, a division of Raindrip, Inc., has introduced Turbo-Flush in-line emitters which have a wide flow path to prevent clogging. They are available in ½, 1, and 2 gph capacities for tubing sizes of .520 inch and .400 inch inside diameter.

Write 708 on free information card

A 60-inch rotary mower attachment provides a clean, even cut over most terrain because of its adjustable anti-scalp caster wheels in front and anti-scalp rollers in the center of the mower in the front and rear. The Gravely mower for 16 to 19.9 horsepower tractors comes with gauge wheels in the rear and an all-gear drive from tractor to mower gear box for efficient transmission of power.

Write 709 on free information card

A modular combine can seed, fertilize, dispense insect and weed controls, and aerate, all at once. The combine, called Trac'n Combo, by a manufacturer of the same name, can increase productivity and reduce costs by accomplishing several tasks in one pass. It mounts directly onto any tractor and its modular design allows good maneuverability, especially in confined areas.

A patented drive system allows the combine to dispense and aerate in either forward or reverse. Other features include retractable aerator and spinner plate for travel over rough terrain or curbs. The combine aerates up to 2 inches deep and dispenses over a 5 to 12 foot area.

Write 715 on free information card

A complete line of backhoe loaders come with sideshift to permit digging right next to barriers, medians, fences, and property lines. It reduces interruption to traffic flow by leaving all lanes open except the one in which the loader is working. Sideshift also gives the operator an unobstructed view of the trench and anyone working in and around the trench. With the backhoe tucked in, there is greater road stability to and from the job.

Front loading provides up to 6,500 pounds lift, 13,800 pounds breakout, 1⅜ cubic yard bucket, and 10 feet 11 inch loadover height. Digging depths range from 13 feet to 19 feet 2 inches. JCB Inc. makes the line.

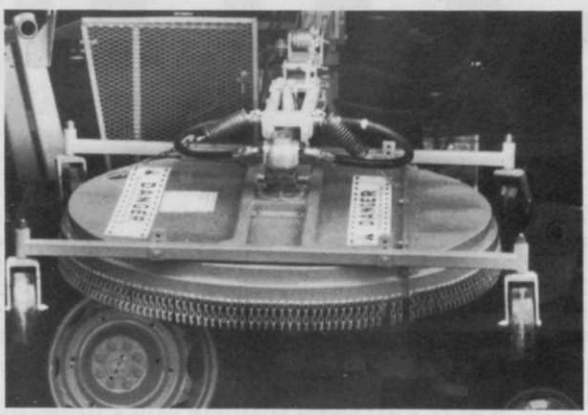
Write 707 on free information card

A grass seed product, ProTurf Utility Mixture, from O.M. Scott & Sons, establishes turf quickly, wears well, and covers throughout the year. It was developed especially for golf course roughs, school grounds, athletic practice fields, cemeteries, general landscape and utility areas, and where soil needs to be stabilized against erosion. It contains Victa Kentucky bluegrass, perennial ryegrass, and creeping red fescue.

Write 704 on free information card

Slope and ditch mower by Auto Specialties Mfg. Co. floats on a boom that extends to 28 ft. from its tractor mount. It solves problems by cutting vegetation in water-filled ditches, steep slopes, and along fencelines. A brake keeps the head from creeping under its own weight. More than 1,000 units are currently used for right-of-way work.

Write 716 on free information card



Fiber-Lock, an acrylic emulsion binder developed by Superior Fiber Products Co. locks in soil stability in landscaping and land reclamation. It has been designed to control erosion, minimize sediment loss, keep down blowing dust, and act as an efficient binder. It can be used in hydroseeding or hydrograssing projects in either a one-step or multi-process. The product comes in 5-gallon pails and 55-gallon drums.

Write 719 on free information card

A soil salts meter from Advanced Marketing, Inc. indicates soluble salts in soil at a "Safe" or "Danger" level in a 5 second test. It is permanently calibrated and requires no battery. Simple directions tell how to correct imbalance.

Write 720 on free information card

EVENTS

The current issue of WEEDS TREES & TURF carries meeting dates beginning with the following month. To insure that your event is included, please forward it, 90 days in advance, to: WEEDS TREES & TURF Events, 9800 Detroit Ave., Cleveland, OH 44102.

Residential Landscape Design Course I, Milwaukee, WI, **June 18-20.** Contact John Shaw, Executive Director, ALCA, 1750 Old Meadow Rd., McLean, VA 22101, 703/821-8611.

Metropolitan Tree Improvement Alliance papers on "Urban Trees and Their Soils," Rutgers University, New Brunswick, NJ, **June 18-20.** Contact Dr. David F. Karnosky, Cary Arboretum, Box AB, Millbrook, NY 12545, 914/677-5343.

26th Grass Breeders Work Planning Conference, Utah State University, Logan, UT, **June 18-20.** Contact K.H. Asay, Research Geneticist, Crops Research Laboratory, U.S.U.UM63, Logan, UT 84322.

Residential Landscape Design Course I, Tucson, AZ, **June 23-25.** Contact John Shaw, Executive Director, ALCA, 1750 Old Meadow Rd., McLean, VA 22101, 703/821-8611.

Lawn Institute Annual Meeting, Del Coronado Hotel, San Diego, CA, **June 23.** Contact Robert W. Schery, Director, 991 W. 5th St., Marysville, OH 43040, 513/642-1777.

American Seed Trade Association, Del Coronado Hotel, San Diego, CA, **June 23-25.** Contact Dr. Harold D. Loden, Executive Vice President, Turfgrass Div., 1030 15th St. NW, Washington, DC 20005, 202/223-4080.

Dutch elm disease training course, Sault Ste. Marie, Ontario, **June 23-26.** Contact Dr. Peter F. Rice, c/o Royal Botanical Gardens, Box 399, Hamilton, Ontario, Canada. L8N 3H8, 416/527-1158.

University of Massachusetts Field Day, South Deerfield Plot, South Deerfield, MA, **June 25.** Contact Dr. Joseph Troll, Dept. of Plant and Soil Science, Stockbridge Hall, Amherst, MA 01003, 413/545-2353.

Residential Landscape Design Course II, Phoenix, AZ, **June 26-28.** Contact John Shaw, Executive Director, ALCA, 1750 Old Meadow Rd., McLean, VA 22101, 703/821-8611.

Minnesota Park Supervisors Association spring meeting, Northrup King Co., Eden Prairie, MN, **June 27;** summer meeting, Duluth, MN, **Aug. 15-16;** fall meeting, Red Wing, MN, **Oct. 10-11;** and winter meeting, Washington County Park Dept., **Dec. 2.** Contact Thomas Feltl, M.P.S.A. Secretary, 8200 Wayzata Blvd., Golden Valley, MN 55427.

Niagara Falls Convention & Trade Show, Niagara Falls Convention Center, Niagara Falls, NY, **June 30-July 3.** Contact Margaret Herbst, Executive Secretary, NY State Nurseryman's Assn., Inc., 101 Park Ave., New York, NY 10017.

American Association of Nurserymen's 105th Annual Convention and Trade Show, Radisson Muehlebach Hotel, Kansas City, MO, **July 13-16.** Contact Harry C. Kiely, Ad-

ministrator, American Association of Nurserymen, Inc., 230 Southern Buidling, 15th & H Streets, N.W., Washington, DC 20005, 202/ 737-4060.

Aquatic Plant Management Society annual meeting, Sarasota Hyatt House, Sarasota, FL, **July 13-16.** Contact International Plant Protection Center, Oregon State University, Corvallis, OR 97331.

Plant Growth Regulator Working Group meeting, Dallas Sheraton Hotel, Dallas, TX, **July 13-16.** Contact Dr. Louis G. Nickell, Program Chairman, Velsicol Chemical Corp., Research & Development, 341 E. Ohio St., Chicago, IL 60611, 312/670-4740.

Athe National Association of Cemeteries annual maintenance meeting, Indianapolis, IN, july 17-19. Contact Russell P. Rager, Washington Park Cemetery, 10800 E. Washington Street, Indianapolis, IN 46229, 317/898-6611.

American Sod Producers Association summer convention & field days, Four Seasons Hotel, Alberta, Canada, **July 20-22.** Contact ASPA, Bob Garey, Executive Director, 9th & Minnesota, Hastings, NE 68901, 402/463-4683.

Wisconsin Park and Recreation Association tour and equipment demonstration, Washington County, **July 24-25.** Contact Jerry Adams, County Park Dept., 515 E. Washington St., West Bend, WI 53095, 414/338-4445.

North American Forest Tree Nursery Soils five-day workshop, State University of New York College of Environmental Science and Forestry (ESF), Syracuse, NY, **July 28-Aug. 1.** Contact Dean, School of Continuing Education, SUNY College of Environmental Science and Forestry, Syracuse, NY 13210, 315/473-8711.

Penn Allied Nursery Trade Show, Hershey Convention Center, Hershey, PA, **July 29-31.** Contact S. Howard Davis, Executive Director, Pennsylvania Nurserymen's Assn., 234 State St., Harrisburg, PA 17101, 717/238-1673.

Southern Nurserymen's Trade Show, Atlanta Convention Center, Atlanta, GA, **Aug. 2-6.** Contact Tommy Henegar, Southern Nurserymen's Assn., 3813 Hillsboro Rd., Nashville, TN 37215, 615/383-5674.

Roadside Vegetation Management and Manipulation Program, San Antonio, TX, **Aug. 4-8.** Contact Robert Guinn, Engineer of Maintenance, Texas Department of Highways and Public Transportation, Highway Building, Austin, TX 78701.

Ohio State University Turf Field Day, OSU Turfgrass Research Facility, Columbus, OH, **Aug. 5.** Contact Keith Karnok, OSU Dept. of Agronomy, 1827 Neil Ave., Columbus, OH 43210, 614/422-2591.

Fertilizer Institute Trade Fair, Roe Vartle Hall, Kansas City, MO, **Aug. 5-6.** Contact Barbara Schoen, 1015 18th St., NW., Washington, DC 20036, 202/ 466-2700.

Rutgers Turfgrass Research Day, New Brunswick, NJ, **Aug. 6.** Contact Ralph E. Engel, Research Professor of Turfgrass Management, Rutgers University, P.O. Box 231, New Brunswick, NJ 08903, 201/932-9427.

Illinois Landscape Contractors Association annual summer field day, Chicago Horticultural Society Botanic Gardens, Glencoe, IL, **Aug. 6.** Contact Lucile Little, 202 W. Main, Box 1049, St. Charles, IL 60174, 312/584-5770.

Residential Landscape Design Course I, Seattle, WA, **Aug. 7-9.** Contact John Shaw, Executive Director, ALCA, 1750 Old Meadow Rd., McLean VA 22101, 703/821-8611.

International Society of Arboriculture, Sheraton-Hartford Hotel, Hartford, CT, **Aug. 10-14.** Contact Ervin C. Bundy, ISA Executive Director, P.O. Box 71, 5 Lincoln Square, Urbana, IL 61801, 217/320-2032.

American Association of Nurserymen management seminar, St. Louis, MO, **Aug. 10-15.** Contact Robert S. Fortna, 230 Southern Building, Washington, DC 20005, 202/ 737-4060.

Residential Landscape Design Course II, Seattle, WA, **Aug. 11-13.** Contact John Shaw, Executive Director, ALCA, 1750 Old Meadow Road, McLean, VA 22101, 703/821-8611.

Iowa State University Turfgrass Field Day, Horticulture Research Station, Ames, IA, **Aug. 12.** Contact A.E. Cott, Extension Horticulturist, Dept. of Horticulture, Iowa State University, Ames, IA 50011, 515/294-1870.

Central Plains Turfgrass Foundation Field Day, Kansas State University Turf Conference, KSU Union, Manhattan, KS, **Aug. 13.** Contact Dr. R.N. Carrow, Secretary/Treasurer, Horticulture Dept., Waters Hall, Kansas State University, Manhattan, KS 66506, 913/532-6170.

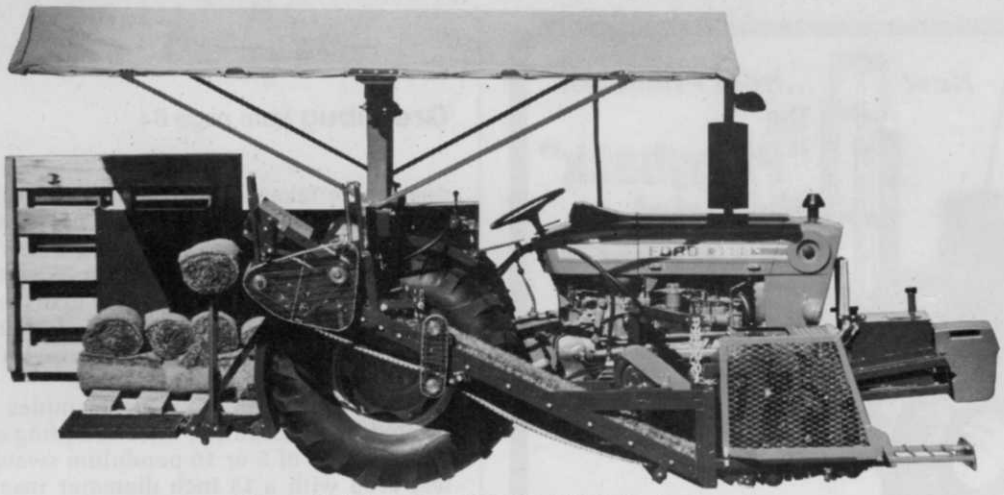
Massachusetts Nurserymen's Association and the New England Nurserymen's Association summer meeting, Weston Nurseries, Hopkinton, MA, **Aug. 13.** Contact Deborah M. Fanning, Associate Director, MNA, 715 Boylston Street, Boston, MA 02116, 617/266-6800.

Lawn, Garden Outdoor Living, Div. National Hardware Show, McCormick Place, Chicago, IL, **Aug. 13-16.** Contact National Hardware Show, Charles Snitow, 331 Madison Ave., New York, NY 10017, 212/682-4802.

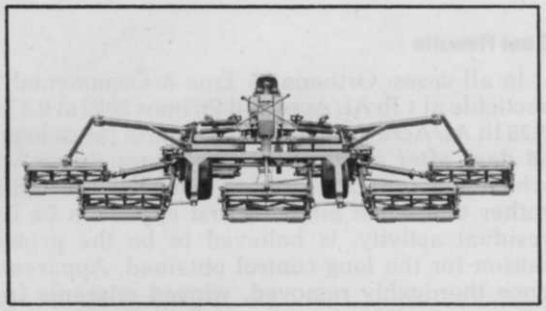
Tan-Misslark Trade Show, Astro Hall, Houston, TX, **Aug. 16-19.** Contact Bill Fullingim, Texas Assn. of Nurserymen, 512 E. Riverside Dr., Austin, TX 78704, 512/444-74 89.

International Arboricultural Conference, University of Sussex, Brighton, England, **Aug. 18-21.** Contact Mrs. Moira Allan, Latchetts, 23 Portsmouth Lane, Haywards Heath, Sussex. RH 16 1SE, England, Tel: 04447-3344.

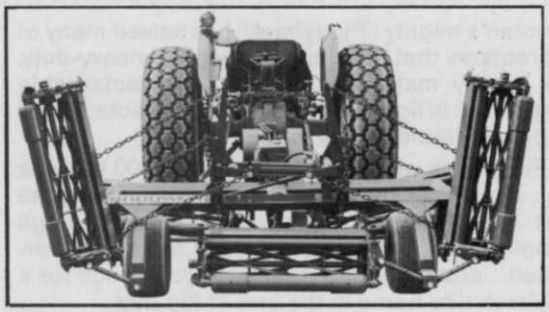
Rhode Island Turfgrass Field Day, Turf Research Farm, University of Rhode Island, Kingston, RI, **Aug. 20.** Contact Professor C.R. Skogley, Plant and Soil Science Dept., University of Rhode Island, Kingston, RI 02881, 401/792-2570.



Brouwer Sod Harvesters—Cut, Roll, Slab, Fold, all grasses, all seasons, all conditions in 15, 16, 18 and 24 inch widths and choice of pallet sizes.



Brouwer 7 gang P.T.O. mowers—cuts up to 7 acres per hour at normal speed with 30 HP Tractor. Unique Positive P.T.O. Drive uses less horsepower, successfully operates in varying grass conditions.



Brouwer 5 gang hydraulic lift P.T.O. mowers offer all standard Brouwer mower features plus hydraulic lift.

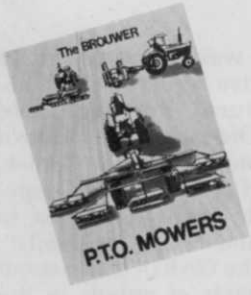
With an all Brouwer package, you can improve your bottom line.

Brouwer Harvesters give you a more uniform cut, less down time, less top soil removal and a harvester that operates off the uncut turf. Over 1000 Top Turf men around the world use Brouwer Harvesters to assure themselves top profit.

Brouwer Mowers give a smoother cut at lower cost. The lightweight high-stress steel frame combined with the simple, "no-wheel and gear" P.T.O. drive minimize flattening and avoid wheel tracks. The new Brouwer hydraulic lift mowers add another time saving innovation at a very low cost.

The Brouwer Package is easy to buy, easy to maintain, and fuel efficient. That means money in your pocket—a better return on your investment.

Write for our free Brouwer Harvester and Mower brochures.



BROUWER

The Turf Equipment People

Brouwer Turf Equipment Limited, Woodbine Ave., Keswick, Ontario, Canada L4P 3E9 Tel: (416) 476-4311

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Greenbug *from page 64*

deep were taken from areas on the test lawn with high numbers of greenbugs or those showing symptoms of damage. Each sample was placed in a Berlese funnel, a device with a 25 watt incandescent bulb which generates heat to drive the aphids out of the sample. Over a period of 24 hr the aphids were driven into a jar of 70% ethyl alcohol, and later counted under a microscope.

Since the number of turf samples taken was limited by practicality, later sampling consisted of taking 3 sets of 5 or 10 pendulum sweeps over the test area with a 15 inch diameter insect net. The aphids collected in the net were placed in 70% ethyl alcohol until counted.

Test Results

In all cases, Orthene 75 Tree & Ornamental Insecticide at 1 lb AI/Acre and Pirimor 50W at 0.5 and 0.25 lb AI/Acre gave excellent control for as long as 68 days after application. The thoroughness with which the initial treatment removed the aphids rather than what might at first appear to be long residual activity, is believed to be the primary reason for the long control obtained. Apparently, once thoroughly removed, winged migrants from other areas did not cause reinfestation. A word of caution, however, the tendency for reinfestation by migrants could increase in years when rain is scarce from July through September.

Using the data gained from these tests as the basis, a petition for 24(c) Special Local needs labeling (state label) to use these products **in Ohio only** was approved in 1979. **This labeling must be in possession of the user at the time of application.** Data from these tests are also presently being used to support similar labeling in other states where the greenbug has caused damage.

Application

The greenbug has already demonstrated the capability of developing resistance to OP insecticides, therefore, it would be wise to alternate between Orthene (an OP) and Pirimor (a carbamate) when treatment is necessary. This action should forestall the aphids developing resistance to Orthene for at least a few years.

Cooperation the Key

Obtaining the 24(c) label was accomplished as the result of a truly cooperative research effort between the Ohio Agricultural Research and Development Center, Mike Dietrick of ChemLawn Corporation Research Center, Milford Center, Ohio, and Doug Halterman of Leisure Lawn Corporation, Dayton, Ohio. Much credit also goes to Kevin Power, Technician, and "Harry's Angels", Abby, Debbie and Gayle, of the OARDC, who spent many hours counting thousands of aphids in the hundreds of samples taken. We are pleased that these two effective tools have been labeled for control of this pest and, at the same time, proud that "we," the OARDC and you, the lawn care industry, accomplished it working together. **WTT**

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Coming Next Month in WTT

July marks the beginning of a 6-month special supplement on sod and seed. In this issue, we will take a look at turf seed, its history and situation in the turf industry today. This edition through the December one will provide technical research as well as practical tools and techniques relevant to the growing turf market.

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