natural organic ones is the percentage of nitrogen related to volume. Activated sewage sludge may be five or six percent nitrogen, while ureaform products can contain nearly 40 percent. Higher concentrations also simplify shipping, storage, and application.

All nitrogen fertilizers eventually break down to nitrate. In this form they have the potential to be carried into the soil by water, either from irrigation or rainfall. The potential for leaching is greatest in high-sand soils and lowest in clay or loam soils. Still, there is no evidence to support a charge that greens or fields containing a high proportion of sand are prone to significant nitrate leaching.

Dr. Martin Petrovic, turf specialist at Cornell University in Ithaca, NY, recently recommended the following strategy for protecting groundwater from nitrate contamination. First, apply light rates of nitrogen or use slow-release sources. Avoid fertilizing when turf is naturally slow-growing, especially in cool weather.

Irrigation systems should be capable of accurately applying only the amount of water needed by the turf to reduce the chance of leaching. Petrovic suggests reducing the size of "heavily managed" areas, planting low-maintenance grasses where practical, and amending soils to retain nitrogen. In cases where nitrates from fertilizers are found in drainage water, the water should be recycled through the irrigation system. It's important to note that a certain amount of nitrate is typically found in natural water sources.

Phosphate is the other contaminant occasionally linked to fertilizers. However, in turf applications, phosphorus is so immobile that core aeration is frequently recommended to get this important nutrient deeper into the root zone where it is needed. In some instances, phosphorus is so tied up by clay and minerals such as iron and aluminum that not enough is available for uptake by the roots. Phosphorus deficiency is also common in soils with either high alkalinity or high acidity.

Many soils are rich in phosphorus, but sometimes it's just not available. Plants absorb this nutrient when it is broken down into oxide ions. The phosphorus source must placed on the surface for seeding and incorporated into the root zone for established turf.

Superphosphate and treble superphosphate are frequently used during establishment. The oxide content of treble superphosphate is considerably higher than standard superphosphate, making it more practical for fertilizer mixes.

Both products reduce the acidity of soils and can increase problems in alkaline situations. For this reason, fertilizer manufacturers treat superphosphate with ammonia to create monoammonium and diammonium phosphates. These products have an acidifying effect on soils and can also serve as an added source of nitrogen. Turf managers with acid soil conditions should use the superphosphates or calcium metaphosphate, a product with a high oxide content that also decreases acidity.

There is no evidence that greens or fields containing a high proportion of sand are prone to significant nitrate leaching.

Unlike phosphorus, potassium is soluble in water and will leach. Frequent use of nitrogen sources containing ammonia will also reduce the amount of available potassium in the soil. For these reasons, potassium levels need to be restored on a regular basis, especially for turf receiving heavy wear.

Two things to look for in potassium carriers are the amount of chlorine and nitrogen they contain. Chlorine increases the salt index and burn potential of the fertilizer.

continued on page 22

Sports Turf Nutrition

continued from page 21

Muriate of potash (potassium chloride) is almost 50 percent chlorine. Potassium sulfate contains very little chlorine but has an acidifying effect on soils due to its sulfur content. Sulfate of potash (potassium magnesium sulfate) also has a low salt index, will acidify soils slightly, and is a good source of magnesium, one of the frequently overlooked macronutrients.

Potassium nitrate is incorporated in fertilizer mixes, since it contributes both potassium and nitrogen. It also has a low salt index and does not have an acidifying effect on soils. However, it is considered a fire hazard and repeated use can cause a breakdown in soil structure.

Nitrogen, phosphorus and potassium are the "big three" in turfgrass fertilizers. When they are all incorporated into a fertilizer that product can be called complete. Early complete fertilizers were mixtures of individual granular products. Keeping the mix uniform during shipping, storage and application was a problem.

To solve this problem, manufacturers of complete fertilizers treated inert carriers, such as crushed corn cobs or perlite, with each nutrient. In this way, all particles had the same analysis. The same uniformity can also be achieved with coated, slow-release products. A benefit of homogeneous fertilizers is that they can also be used to carry herbicides, fungicides, or insecticides.

One limitation of dry products is that you have to accept the analysis of the fertilizers available. You can adjust the rate during application, but not the relative percentage of the components. You also have to depend on factors such as irrigation and weather to get the nutrients into the soil where the plant can utilize them.

Liquid chelated source of nutrients other than nitrogen.

This is not a problem for most sports turf managers. However, some golf course superintendents want more control. They want the ability to "spoon feed" nutrients to the turf at low rates. To do this, they require soluble products that could be applied with a sprayer or injected into the irrigation system. A number of companies today offer an assortment of soluble fertilizers for this purpose. In most cases, superintendents use solubles to supplement applications of slow-release fertilizers. They may also use solubles to give turf a slight nutrient boost when spraying for diseases or insects.

As sports turf managers strive for greater control over their swards, they are discovering the importance of other nutrients. For example, sulfur isn't just an acidifying agent, it is also a nutrient required by turf for growth. Since you may be applying sulfur already as a component of other nutrients or gypsum, additional amounts are probably unnecessary. Acid rain and organic material in the soil are sources of sulfur. If you do apply elemental sulfur, just be aware that it must be watered in immediately to avoid foliar burn.

Calcium is a major nutrient for turfgrasses as well as a factor in the utilization of potassium and magnesium. It has also been credited with reducing the loss of nitrogen to volatilization.

A calcium deficiency hampers root development and resistance to diseases such as *Pythium* and red thread. Perhaps its most important role is its beneficial effect on soil structure and chemistry.

Dolomitic limestone is the main source of calcium in turf maintenance. Since lime is needed to raise the pH of acid soils, it makes sense that calcium tends to be deficient in such soils. Sports turf managers with acid soils should use nutrients such as superphosphate that contain calcium. Those with alkaline soils can provide calcium by applying gypsum.

Magnesium is the sixth macronutrient required by turfgrasses. Plants use magnesium to make chlorophyll, so a lack of this nutrient can affect turf color. They also use magnesium to help distribute phosphorus throughout the plant. Phosphorus applied in fertilizers will be wasted if there is a deficiency of magnesium.

Problems with magnesium are seen most often on sandy, acid soils that are heavily irrigated. The problem can be solved in many cases by correcting soil pH. Supplemental magnesium is readily available from fertilizers such as sulfate of potash, superphosphate and potassium sulfate. Dolomitic limestone provides a slower release of magnesium.

Some turf managers today may question why iron is considered a micronutrient. Many find themselves applying more iron than sulfur, calcium or magnesium. They often use it to gain a deeper green color without applying more nitrogen. Stadium managers and golf course superintendents use iron to improve color before major events.

Liquid slow-release fertilizer.

The term "micro" really applies to the amount of nutrient required by the plant. Normally, turf does not need significant amounts of iron. However, golf and sports turf is not normal turf.

Iron, like most of the other micronutrients, is mainly a problem in alkaline soils. Lower the pH, and you frequently solve the problem. High pH makes the micronutrients unavailable to the plant.

Since iron is fairly soluble, it is easily leached out of soils and can be absorbed by turfgrass leaves as well as roots. The problem is keeping available iron around. Foliar applications of iron sulfate or ferrous ammonium sulfate provide a fast, short-term solution to iron deficiencies. For a longer-term solution, the iron must enter the soil in a form that releases slowly.

Some natural organic fertilizers contain slow-release iron. However, if you want to apply such iron alone the answer is chelated iron. Basically, this is iron tied up with other organic materials. As the organic material breaks down, the iron is released into the soil solution.

If soil tests indicate that your soil lacks other micronutrients, such as boron, copper, chlorine, manganese, molybdenum, or zinc, consult your extension turf specialist or manufacturer's technical representative before making any moves. They will know how to handle micronutrient problems, especially in cases of high-sand greens or athletic fields.

Some professional turf fertilizers contain trace amounts of micronutrients. Chelated forms of iron, copper, maganese and zinc are also available. Iron is relatively safe. However, the other micronutrients can build up to toxic levels if you aren't careful.

Take a close look at the labels of fertilizer products you buy to discover the nutrient sources they contain. Compare them to the characteristics above.

Only you know the special needs of your turf. Adjust your fertilization program to fit these needs. Not only will you achieve better control over your fertilization program, you will also have a better understanding of the effects of fertilizers on the environment.

EDMUND B. AULT

Edmund B. Ault, one of the country's leading golf course architects, passed away recently at Holy Cross Hospital in Silver Spring, MD. He was 81.

Ault, a pioneer in designing economical municipal and public golf courses, was president of Ault, Clark & Associates, Ltd. Wheaton, MD. He was elected a member of the American Society of Golf Course Architects in 1973, and a fellow in 1984.

Ault believed that "an important feature [of a good golf course] is visibility, so that the player can see the entire hole from tee to green whenever possible. Another is to have a sufficient degree of challenge so that when a golfer makes a par he feels he has accomplished something.

"Greens should be of adequate size and contoured in a subtle manner so that a good putt is a performance of skill, not luck. The approach to the green should be sufficiently trapped to present some challenge, but seldom should be entirely blocked off."

Among Ault's many designs are the Country Club of Las Vegas, Las Vegas, NV; Palmetto at Myrtlewood Golf Course, Myrtle Beach, SC; Carrollwood Village, Tampa, FL; Tournament Players Club at Avenel, Potomac, MD; and Toftrees Golf Course, State College, PA.

COOK TO JOIN ALLSTARS ON TOUR OF RUSSIA

Murray Cook, head groundskeeper for the spring training baseball complex in West Palm Beach, FL, becomes a U.S. ambassador of sports turf this month when he accompanies the Double A Eastern League allstars to the Union of Soviet Socialist Republics for a two-week, four-city tour of exhibition games.

The producers of the Diamond Diplomacy Tour asked Cook, one trainer, and one doctor to travel with the players. A total of 110 players, coaches, and support staff will board a plane heading for Moscow on September 20.

"We will be playing mainly in soccer stadiums," said Cook, "including Moscow University and the stadium in Kiev. It will be a great experience to share our baseball heritage with the Russians. I'm really looking forward to meeting the groundskeepers at each location."

NICKLAUS JOINS ASGCA

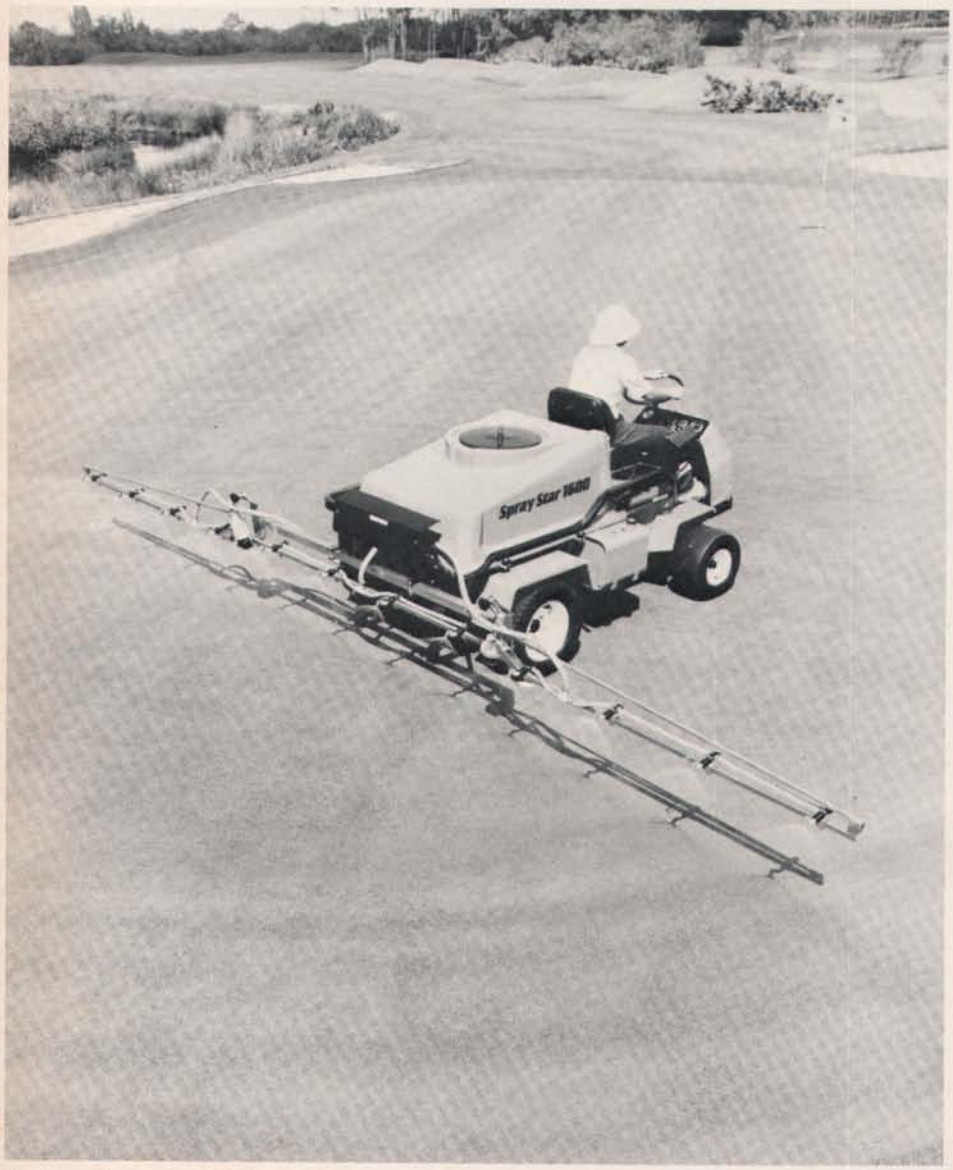
Professional golfer Jack Nicklaus has been an established golf course architect for nearly two decades, yet he has just recently been accepted as a member of the American Society of Golf Course Architects. Nicklaus has been accepted as an associate, but is not yet a full member.

"As in most organizations, you have to be an associate member before you can be a full member," said Paul Fuller, executive secretary of the ASGCA. "Jack's never applied before."

Beside the minimum five-course requirement, an applicant must be recommended by three members, who for Nicklaus were Ron Kirby, Robert Trent Jones Jr., and Pete Dye.

Spraying Systems:

Proper Performance Saves Chemicals



Smithco Spraystar 1600 boom sprayer.

Who would have thought ten years ago that an automobile could get the same gas mileage as a motorcyle? Back then if you were on a trip you'd have to stop every 200 miles to fill up your tank.

Today most cars and small trucks can go twice as far on a tank of gas. And their tanks are smaller, not larger, than before. You still get where you're going, but you are saving gas in the process. The point is, if we set a goal to conserve anything, we can achieve it through technology. Gasoline is just one example.

According to a recent survey, the average reader of *sportsTURF* spends $25,000 each year on turf chemicals. If you were able to reduce the amount of chemicals you need to maintain turf in its present condition by 20 percent, you'd save $5,000 in the first 12 months. In fact, that is probably what you're wasting if you are applying chemicals with a sprayer without certain precautions or adjustments.

Spraying chemicals is not just an economic issue. It has become an environmental one as well. Whether you overapply or underapply herbicides, fungicides, insecticides or fertilizers, you are wasting money and possibly misusing extremely valuable turf management products. The only way to be sure that the safe and effective rate of a chemical is being applied is to stay on top of the condition and calibration of spray equipment.

Spraying systems can uniformly apply ounces of solubles, emulsifiable concentrates, and wettable powders to acres of turfgrass. At such low rates, small variations in equipment performance, the applicator's concentration, or weather can effect pesticide performance.

Still, sprayers are the closest thing the turf industry has to a syringe for precise, target-only treatment for diseases, insects

and weeds. They are a tool which when used properly, allows you to put down just the amount of pesticide necessary to do the job with the least impact on the environment.

Like other aspects of turf management, sprayers have been adapted from agriculture. They have evolved from high-pressure, high-volume units to lower-pressure ones where droplet size and spray pattern are carefully regulated to improve distribution and coverage. Like an irrigation system, each component must fit certain specifications to achieve the desired results.

The ultimate goal is to apply a precise amount of pesticide to a target site. Depending upon the type of insect or disease, this may be either the leaves, thatch, or soil. For postemergence herbicides the material needs to coat the leaf surface of the weed. In the case of preemergence herbicides, the material must be placed in the soil where weed seeds are located.

Manufacturers determine rates for each of their products based upon the target pest and its location. These rates are listed clearly on the package label along with a recommended amount of water to carry the pesticide.

For contact or foliage-absorbed pesticides, they may include a sticker with the pesticide or recommend that you add one to the tank mix. For pesticides which work in the thatch or soil, manufacturers will often advise irrigating with up to one-half inch of water immediately following application. Some fertilizers may also need to be watered in, while others can be absorbed through the foliage.

Broyhill self-contained spray unit mounted on skid fits on most turf vehicles or trailers.

From this point on, it's up to you, the applicator, to deliver the fertilizer or pesticide to the target site at the appropriate rate. That's where a properly working spray system comes into play.

The first step is to calculate the area to be treated. This is essential to determine the amount of pesticide you need. If all goes

continued on page 26

continued from page 25

well, you will run out of tank mix at the end of the job, not before and not after.

Whether you use a knapsack sprayer or an automatically self-adjusting spray vehicle with booms, the basic components are the same. First there is the tank where the material(s) are mixed with water.

Since applicator exposure to the concentrated chemical is greatest during mixing, manufacturers have created various methods to protect him. Self-contained measuring spouts for liquids and water-soluble packets of premeasured dry materials are just two examples. Lesco, Inc., has developed a closed chamber that fits over the mouth of spray tanks. Bags of dry material are broken open inside the chamber, protecting the applicator from dust.

An agitator is important to keep suspensions and emulsions uniformly mixed. A line strainer between the tank and the nozzles is essential to avoid clogging. If you are using a diaphragm, piston or roller pump, the strainer should be installed upstream. It can be placed downstream with centrifugal pumps. The strainer should be checked and/or cleaned daily.

Two things are critical to spraying system performance: flow and pressure. Nozzles are designed to spray a given pattern of liquid, usually a cone or flat fan-shape, within a certain range of pressure. The flow rate increases with pressure, while the droplet size decreases. When pressure exceeds the nozzle's range, the pattern will "blow" or become deformed. This results in poor coverage and increased drift.

Pressure also influences the spray angle of nozzles. Since boom height and nozzle spacing are based upon spray angle, you don't want pressure to change to any great extent.

Manufacturers offer a variety of nozzles so that you can match pressure with flow rate while maintaining proper droplet size and spray angle. You may need one set of nozzles for high-volume materials such as fertilizers, preemergence herbicides and soil insecticides, and a separate set for low-volume products such as herbicides, fungicides and growth regulators.

Applicators must gauge their speed when using a walking boom sprayer.

Nozzles should be inspected often and replaced if necessary.

"It's not practical to change the application rate by adjusting the pressure," explains Richard Gould of Spraying Systems, Inc. "You'd have to multiply the pressure by four to double the application rate. Turf nozzles just don't have that type of range."

The current heightened concern over drift has inspired a trend toward nozzles and spraying systems with lower pressure. Manufacturers such as Spraying Systems and Delavan have begun to make low-pressure nozzles that provide the same flow rate, coverage and spray angle as higher-pressure nozzles.

A second approach to low-pressure technology is controlled droplet application. North American Micron markets a type of applicator developed in England, which uses a revolving disc after the nozzle orifice to break the spray solution into uniform size droplets.

"We know that droplets of 400 microns will roll off foliage and end up on the ground," states Roger Burtner, vice president of the company. "We also know that droplets much below 140 microns tend to drift. By regulating the speed of the disk, we can control the droplet size, reduce drift or runoff, and lower the volume of material applied."

Both Gould and Burtner point out that nozzle orifices don't last forever. After a certain period of time, especially under high pressure, their shape and size change. This not only deforms the pattern, it increases the flow rate. The problem is most severe with brass orifices used for wettable powders. Stainless steel nozzles are more durable, and for this reason are most common on spraying systems today. Research into ceramic and plastic nozzles is underway to extend nozzle life.

Whether you have a spray wand with one nozzle, or a boom sprayer with 20, it should be calibrated before each use. The idea of calibration is to gauge the flow rate of every nozzle to assure that you are applying the correct amount of material uniformly over the turf surface. The flow rate must be balanced by the speed of the sprayer to apply the volume of liquid specified on the product label to a given area.

Start with a close check of the nozzles. Information from the nozzle manufacturer will give you the flow rate of each type of nozzle at certain pressures. Check the pressure of your sprayer, then check the flow rate of each of your nozzles by placing a container under the nozzle and letting the sprayer run for one minute. If the rate is not close to the manufacturer's specifications, and it isn't clogged, it needs to be replaced.

The flow rate of all nozzles on the spray boom should be within ten percent of each

continued on page 28

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continued from page 26

other. If more than one nozzle on the boom is defective, you should probably replace all of them.

Once all of the nozzles have the same flow rate, you can calculate the proper sprayer speed to apply the volume of chemical specified on the label. There is a mathematical formula for this purpose. Special calculators with these formulas built in are also available.

Since there is a practical limit to the speed at which a sprayer or individual using a walk-behind sprayer can travel, it is important to determine a sensible speed first, one that can be maintained fairly consistently. Then use the formula to calculate a nozzle flow rate that provides the correct volume for the turf area being treated. It's simpler to change nozzles than it is to adjust either speed or pressure.

It takes practice to use a wand, walking boom or backpack sprayer with reasonable accuracy. Applicators should mark off an area of 1,000 square feet and practice spraying with water to apply a consistent amount of volume each time. For small areas, you may want to use a precalibrated push sprayer such as Wheel Spray's Greens Wheelie. The pumps in this sprayer are driven by the wheels. If the applicator changes speed, so does the pump speed, to keep the application rate the same.

For large areas where spray vehicles are necessary, new accuracy is possible with sprayer control systems. These units can automatically adjust flow rate to the speed of the vehicle.

Sensors feed information on speed and flow rate to a small computer which constantly calculates application rate. If the vehicle slows while going uphill, the units either alert the operator that the application rate has increased or change the flow rate so that the sprayer maintains the right application rate at all times.

One great advantage of these systems is the warning they provide if a hose comes loose or a nozzle clogs while spraying. Sensors on each boom section, or for each nozzle if desired, alert the operator immediately so repairs can be made. This assures a uniform application of material, eliminates chemical waste, and saves the time usually required for reapplication.

Companies such as Broyhill, Cushman, Deere, Hahn, and Smithco offer the control systems as options for their sprayers. You can retrofit your present sprayer with kits from companies such as Micro-Trak Systems in Mankato, MN, or Raven Industries in Sioux Falls, SD. Spraying Systems has a system which alerts the sprayer operator of changes in pressure.

With any spraying system it is wise to use a spray pattern indicator in the tank mix. These colorants provide a short-term visual indication to help applicators avoid gaps or excessive overlaps in coverage. In some cases, they can also give a quick indication of a clogged nozzle or leaking hose.

Sprayer control mounted on Hahn 435.

There are two other developments which can lead to savings in your chemical budget. The first is a multi-tank spraying system, like the one manufactured by Green Pro in Hempstead, NY. Geared toward integrated pest management, the system enables the applicator to apply a specific pesticide only where it is needed.

For example, if you are spraying fertilizer to a fairway or athletic field and you notice an outbreak of weeds in one area, you can add herbicide to the spray mix with a control on the spray gun. You don't have to come back to treat the area separately, nor do you have to treat an entire site when the problem is localized. A second hose to the spray gun from a separate tank allows you to inject the herbicide just where you need it.

The second system is under development primarily for soil pesticides. This work is being carried out by Dr. Harry Niemcyk at Ohio State University in Wooster. Instead of applying soil insecticides or fungicides to the turf and watering them in, the material is injected directly into the soil. The pesticide lost by adhering to thatch or foliage is eliminated completely, so lower rates of application can provide the same results.

Niemcyk points out that thatch is a major factor in hampering the effectiveness of turf pesticides. Thatch traps up to 95 percent of most turf chemicals. On one site, the depth of thatch may vary from 1/4 inch to an inch or more. This can result in a wide range of pesticide effectiveness for control of insects, such as grubs, mole crickets, chinchbugs, and billbugs.

He also points out that uniform coverage of foliage is essential for the control of the greenbug aphid, black vine weevil adult, leafhoppers and caterpillars. A poorly functioning spraying system can greatly reduce the effectiveness of pesticides.

Dr. David Kudney, weed control specialist at the University of California at Riverside, states that coverage is essential for the

Sprayer control system by Micro-Trak monitors flow rate and ground speed to maintain a desired application rate.

effectiveness of postemergence and contact herbicides. Nearly all postemergence herbicides must come in contact with weeds to work. A sufficient volume of the material must be absorbed through the weed foliage to enter the plant and kill it. That includes herbicides such as 2,4-D, mecoprop, dicamba, and MSMA. Poor coverage due to small droplet size and inadequate volume can result in wasted chemicals.

There is no doubt that a small investment in equipment and maintenance can result in big savings in chemicals. It also allows you to gain the greatest control of weeds, diseases and insects with the least amount of pesticide. That is important from both an economic and environmental standpoint.

It will be a long time before automobiles can travel without gasoline, and it will be just as long before sports turf managers can provide durable, healthy turf without pesticides. However, we can begin to cut waste and increase efficiency through technology. First we need to make conservation a goal and support products which help us achieve that goal. We did it for automobiles and we can do it for turf management.

CHALKBOARD

TIPS FROM THE PROS

COMPUTER-ASSISTED IRRIGATION SYSTEM MAINTENANCE

By Sal Genito

By using a lap-top computer, the irrigation specialist can determine repair needs from the field.

Water conservation is an important concern for anyone managing golf courses or other large recreational complexes today. Superintendents, grounds managers, maintenance supervisors, and water managers have the responsibility of using our precious water resource wisely.

To help us achieve our water management goals, manufacturers have developed tools, including low precipitation sprinkler heads, drip irrigation, computerized control systems, and moisture sensors. However, even the most efficient irrigation system can waste water without proper irrigation system maintenance. This entails rountine checking, cleaning, adjusting, and verifying that the system is applying water to the intended targets on a specified basis. The size and complexity of sports turf irrigation systems makes this process a record-keeping nightmare.

At Clovis Unified School District (in Clovis, CA), I am responsible for many different irrigation systems located at schools throughout the district. As each new school site is completed, making sure that all the different irrigation systems and their components function to design specifications grows more complicated. Inspecting every system thoroughly once a week used to be hard to manage from both personnel and procedure standpoints. In some cases we were forced to wait for complaints from principals before we could make necessary repairs.

I needed to get a better handle on irrigation system maintenance. Using a computer to organize irrigation inspections and maintenance reports was an obvious solution. After making a list of common problems and ways to stay on top of them, I approached a computer programmer to put these ideas into software. Together we devised a program that has saved both water and money for the school district.

The program, called the Irrigation Manager, takes information gathered from the field and compares it to the design specifications. By recognizing inconsistencies between intended and actual performance, the program can generate a report that identifies problems with clocks, valves or sprinklers for needed repair or adjustment.

By entering simple commands, the program can be customized to fit any organization's needs. It has been designed for grounds managers and golf course superintendents who have never used a computer. Once the program is installed in an IBM-PC type computer, it takes approximately one hour each week to run reports. The computer is free to handle other projects the rest of the time.

These are some of the problems with irrigation systems that can be detected and corrected by using the program: worn sprinkler wiper seals, clogged nozzles, stuck or misdirected sprinklers, low head drainage, leaking pumps, sprinkler head obstruction, damaged valve diaphragms, and improper pressure. The program helps me schedule important tests and repairs, eliminating much of the guesswork involved in maintenance.

An integral part of performing maintenance and repairs is attaining the right information related to field equipment, such as valve size and description, sprinkler nozzles, location, and warranties. This information can be provided to maintenance personnel in the form of computer-generated valve and sprinkler reports. Before they leave the shop, they know exactly what parts will be needed to restore the component to design specifications.

In addition, the computer keeps a history of repairs so maintenance can be preventative rather than curative. We use this information to put together our budget each year. It's just a more businesslike way of planning. The reports give me the documentation I need to support important purchases.

Once valves and heads are brought back to design specifications, the focus can switch to water conservation. The Irrigation Manager contains the start and run times of all clocks for quick reference. With this information, we can make adjustments to achieve savings in water and pump energy use.

The program is a source of information, a data base that helps the sports turf manager make his own decisions. It is not linked directly to the irrigation system. The maintenance staff is still the eyes, ears and hands of the program. But by organizing irrigation maintenance, we have been able to manage our system efficiently and conserve water in the process.

This past year, I took the program a step further by providing my irrigation manager with a laptop computer he can use in the field. By copying the program onto a floppy disk, he has important information with him at all times and can record changes or repairs that have been made. At the end of the day, the new information is downloaded into my computer at the maintenance office.

If nothing else, the Irrigation Manager has given us time to study the feasibility of system-wide computerized irrigation control. When and if we do make the switch, we will already have the information needed for a new program. In the meantime, we are seeing definite advantages in water, energy and staff use. Furthermore, the irrigation system is running the way the designers intended it to.

Sal Genito is grounds and landscape service supervisor for Clovis Unified School District in Clovis, CA. The program he helped create is available from Irrigation Management Systems, Fresno, CA.

RESEARCHERS COMPARE RYEGRASSES

Perennial ryegrass and a mix of perennial ryegrass/intermediate ryegrass produced better turf quality than intermediate ryegrass alone or annual ryegrass, in University of California at Riverside Cooperative Extension overseeding trials on common bermudagrass.

The field trial was conducted on a common bermudagrass fairway at a golf course. Bermudagrasses are commonly used on Coachella Valley, CA, golf courses. These grasses are overseeded in the fall with cool-season grasses to maintain the attractiveness of fairways and playability during the winter months, when the bermudagrasses turn brown and go dormant.

Grasses tested were annual ryegrass, Palmer perennial ryegrass, Agree intermediate ryegrass, and a 50/50 mix of perennial ryegrass and intermediate grass. The study was conducted by John Van Dam, University of California Cooperative Extension farm advisior for San Bernardino County with regional responsibilities, aided by Victor Gibeault, Extension environmental horticulturist at UC Riverside, and Richard Autio, Gibeault's staff research associate.

Each of the grasses and the mix were established in late September on 50-square-foot plots and seeded at a 100, 200, 300, 400, 500, or 600 lb. per acre rate. Treatments were evaluated for color, uniformity, and percent ryegrass. Data was subjected to an Analysis of Variance and differences determined by the Duncan's Multiple Range Test.

In addition to the perennial ryegrass and mix of perennial and intermediate ryegrass looking best, Van Dam and his colleagues reported these conclusions from the study:

- Annual ryegrass was the fastest to establish and the first to transition in the spring.
- The initial stand of the overseeding grass was directly dependent on the seeding rate, irrespective of species, with the higher seeding rates giving a quicker acceptable grass stand.
- A seeding rate had little effect on the mature overseeding in terms of percent cover.
- A reasonable seeding rate, irrespective of species, was the 300 or 400 lb-per-acre-rate, recognizing that a faster establishment can be achieved with a higher rate and also that a slower but ultimately mature overseeding can be achieved with a lower seeding rate.

Full results from the study are reported in *California Turfgrass Culture*, Volume 38, Numbers 3 and 4, 1988, published by UC Cooperative Extension.

JONES CALLS FOR FOCUS ON COURSE CONTRIBUTIONS

At a time when certain environmental groups are targeting golf course developments, Robert Trent Jones, Jr., president of the American Society of Golf Course Architects, believes that the golf industry should focus on the many benefits associated with greenbelts.

Jones, a former chairman of the California State Parks and Recreation Commission, believes all those who love the game should unite and explain more vigorously that golf courses serve as an animal habitat, bird sanctuary, oxygen-generating resource, and water conservation area, as well as a much needed recreational area.

"Golf courses lessen the density of a new real estate development," Jones said. "Together with other parks, golf courses, by the oxygen renewal process, are the lungs for many communities. The golf course, then, serves as a positive environmental element for everyone, not just for those who enjoy the game of golf."

The ASGA president pointed out that golf courses lessen air pollution, and one 150-acre golf course actually provides the oxygen required by a town of 7,000 people. He added that golf courses also serve to moderate the effects of noise pollution.

Jones stated that trees also serve to cool the air through transpiration, evaporation, and shade in the summer. In the winter, they reduce wind velocity and protect homes and buildings from heat loss. Trees absorb polluted air and release air richer in oxygen and more free of contaminants. Their foliage also screens dust and other solid pollutants from the air.

Golf courses can also be used as firebreaks and sources of water during fires. An example was the huge forest and residential fire at Pebble Beach, CA, where water from the lakes at the Poppy Hills Golf Course was retrieved by helicopter and dumped on the roofs of threatened homes.

In France, irrigated parks and golf courses have the highest environmental priority in order to protect both human and animal habitats against fire.

Jones added that plant material protects the soil, sheltering it from rainfall and reducing the burden of silt in rivers and streams by holding topsoil in place. Vegetation keeps surface pores of the soil from sealing up, and it promotes infiltration and minimizes land runoff.

Studies have also shown, Jones noted, that turf is 20 percent or more cooler than any pavement or artificial turf. Jones added that the creation of ponds and lakes for the dual purpose of enhancing beauty and playability of the course, as well as supplying a source of water for irrigation, is a valuable conservation measure.

"By capturing excess runoff into reservoir areas, golf courses contribute to a community's water conservation program," he said.