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Deep Cultivation:
When and Why

By Gil Landry

With the development of effective cultivation programs to relieve surface soil problems, interest has naturally shifted to programs that improve conditions deeper in the soil profile. Equipment that can penetrate six to 16 inches include the Aerway Slicer, Deep-Drill Aerofier, Hydroject, Turf Conditioner, and Verti-Drain. Research conducted by Bob Carrow at the University of Georgia and Paul Rieke at Michigan State University, and supported by the equipment industry, has led the way to developing these deep cultivation programs.

Riding aerator with hollow tines at work. Photo courtesy Ransomes America Corporation.

SPRING PRODUCT SHOWCASE

The steps in formulating a program include identifying the problem, choosing the method(s) for correcting the problem, deciding on the correct timing and frequency of cultivation, and evaluating the results.

Identifying the Problem

The most common detrimental conditions on sports fields is the presence of fine-textured soils or soils with significant silt and/or clay. Such soils are sometimes referred to as "heavy soils" because they are difficult to till.

Common soil problems that can be relieved by cultivation include:

1. Poor water movement (drainage), air exchange and rooting.
2. Soil layers (i.e., clay or sand layer) that reduce water and air movement and rooting.
3. High salt levels, particularly in sodium soils.
4. Subsurface soil compaction.
5. A high water table formed by a compacted layer.

Poor drainage caused by low surface areas should be corrected at the surface rather than by deep cultivation.

Identifying the problem can be difficult and requires accurate evaluation of surface and subsurface conditions using a soil probe or shovel. Look at the soil texture and soil color, note rooting patterns and the soil resistance when probing or digging. Abrupt changes in soil texture or color, poor root development, rooting patterns inconsistent with normal growth, strong resistance to probing or digging — all are indicators of compaction problems. If no apparent soil physical problems are present, perhaps soil fertility/chemistry should be tested.

Once the problem is identified, the most effective method for correction must be determined. Cultivation may not be the answer. Perhaps improved drainage or soil modification is necessary. Maybe better traffic and irrigation control will be sufficient. In most cases, a combination of these practices is needed.

Methods of Attack

When choosing a cultivation method consider the following:

1. *How much surface damage will occur?* The more severe the damage, the more important active turf growth is to reduce turf recovery time. The more disruptive the procedure, the less often the practice will be used.
2. *How long will the effects last?* The longer the benefits last, the more turf damage can be tolerated.
3. *How deep in the soil is the problem?* Be sure the cultivation reaches the problem area.
4. *Is soil-loosening important?* Soil loosening occurs from vibratory or lifting actions such as those produced by the Verti-Drain, Aera-Vator, Shatter-core, Aerway, and Yeager-Twose Turf Conditioner.
5. *Will topdressing be used to fill holes or is subsurface incorporation needed?* In most cases, once holes are made, the longer they remain open to the surface, the longer lasting the effect. Once a hole is sealed, even if only at the surface, the benefits of air and water movement significantly, if not totally, eliminated by sealing. Topdressing with a porous material keeps the holes open. If topdressing is prohibitive, more frequent cultivation will be needed to overcome surface sealing.

The most common detrimental conditions on sports fields is the presence of fine-textured soils or soils with significant silt and/or clay.

Subsurface incorporation of less heavy soils (sandy) alters the soil profile, makes it less susceptible to compaction. Such procedures can be costly, time-consuming, and disruptive. They should only be undertaken as scheduling and budget permit.

6. *Will soil be brought to the surface?* The ideal situation would normally be to use hollow tines or spoons that remove soil and cause less compaction around and below the tine than do solid tines.

Any tool used to penetrate the soil will cause some compaction. The question should be whether it relieves more compaction than it causes. Also, cultivating with different types of equipment and to different depths should minimize any compaction from cultivation.

Generally, an effective cultivation program will use a number of methods, and the timing will differ with the equipment chosen. Logically, it seems that combining normal depth cultivation with deep cultivation will provide both surface and subsurface cultivation.

Cultivation timing and frequency are generally influenced most by the damage caused and turf recovery time. But other factors to consider include soils moisture needs, turf rooting patterns, turf conditions, pests and stress problems.

The most common soil moisture problem is having enough moisture present to allow satisfactory penetration. Soils that are too dry resist penetration, limit effectiveness of procedures and put excessive stress on equipment.

Cultivation methods that cause loosening work best when soil moisture is just below field capacity. This generally means one day after normal irrigation or rainfall. If the soil is too moist, no loosening (vibration) will occur. Soil moisture closer to field capacity is best for practices that penetrate with minimal loosening like vertically operated tines.

Evaluating cultivation response can be difficult because of the more indirect effects that result and because multiple treatments may be needed to obtain a significant response. Regardless, effective cultivation should result in improved infiltration/percolation, looser and more penetrable soil, fewer dry and/or wet areas, better rooting and reduced turf stress. Leaving an untreated area can help evaluate cultivation effects.

Although evaluation may be difficult, it is important to monitor a program through the year, and from year to year. Since wet soils compact more quickly, rainfall in relation to field use will require program adjustments.

As previously mentioned, there are a host of deep cultivation machines on the market. However, many of the more sophisticated units are quite expensive. Bringing in an outside contractor for deep cultivation procedures is a viable option.

Deep cultivation programs should provide a natural progression for sports turf managers to use more innovative approaches for developing and maintaining high-quality facilities. ❑

Editor's note: As Extension Turfgrass Specialist with the University of Georgia, Dr. Gil Landry provides leadership in the development of statewide educational program in turfgrass management. He is the president of the national Sports Turf Managers Association.

PRESIDENT'S MESSAGE

By Gil Landry

Sports Turf Managers Association

The Challenge of Communication

Communication is a major challenge for me every day. Trying to describe the intricacies of sports turf management to someone who thinks I just "grow grass" can be a difficult and time-consuming task.

I believe communication in our industry is a major challenge we all face, particularly communication with those who do not have or understand our expertise.

"We Don't Want to Ruin the Field"

I recently had a conversation with a physician about a facility that would not allow the soccer league his child participates in to use the main stadium. The physician had trouble with the field management group simply saying that soccer "would ruin the field." He wanted further explanation.

During our conversation, the disgruntled doctor said. "We don't want to ruin the field, we just want to play soccer on it. The field can be repaired, so what is the problem?"

I explained that the additional traffic would cause wear and compaction on the turf, and that someone would have to pay for the additional management required to maintain a quality field. After our conversation, he understood why playing a few games of soccer could result in major turf problems for the facility.

Explain Your Position

Just as the physician learns to explain very complex functions of the body to patients, we must learn to explain our complicated and ever-changing science to our clients. Refusing field access to team sports or concert attractions merits explanation. It may be as simple as stating the results and the costs, but explanations help lay people understand what it takes to develop and maintain a good field.

Our industry has long stood in the shadows of others, whether it be the teams who play on the field or the stadiums our fields are housed in. In order to gain importance, we must communicate the value of safe, quality athletic surfaces. Whenever the opportunity arises to explain your profession and the turf you manage, take it. You will be doing the person to whom you are talking, the industry you represent and yourself a great service.

STMA Chapter News

Midwest Chapter, STMA — A preseason football turf maintenance clinic will be held on May 20 at the Department of Athletics, University of Notre Dame, Notre Dame, IN. Events begin at 9:30 a.m. For more information contact: Don Michaels or Kathy Counley, Lake-Cook FS (708) 526-0007 or Dale Getz, University of Notre Dame (219) 631-7962.

On Wednesday, June 30, the Midwest STMA Chapter, in cooperation with Wheaton College, is sponsoring the National Midwest Regional Sports Turf Institute. This institute offers the opportunity to take part in educational sessions, gain up-to-date information from suppliers at the Trade Show and share ideas with other sports turf professionals.

New for 1993 will be an infield rodeo, a two-person team competition in infield-dragging and line-marking to determine who's the best in the Midwest.

Further details on the institute will be announced soon.

For information on the chapter, these meetings or other chapter activities, call: the Chapter Hotline (708) 439-4727; Marc Van Landuyt, Van's Enterprises (708) 367-7828; or Jesse Felix, West Chicago Park District (708) 293-0770.

STMA Florida Chapter #1 — On Tuesday, May 18, a meeting and tour will be held at the Palm Beach Polo Grounds from 9 a.m. to 2 p.m. Further details on this meeting will be announced shortly.

For information on the South Florida Chapter or for details on this meeting or other chapter activities, contact: John Mascaro (305) 938-7477 or Ed Birch (305) 938-0217.

Chesapeake Chapter, STMA — For information on the chapter and its activities, contact: the Chapter Hotline (301) 865-0667.

Iowa Sports Turf Managers Association — ISTMA is developing the program for a June Sports Turf Workshop in the eastern Iowa area. An August 4 workshop will take place in Des Moines, IA, at Sec Taylor Stadium, home of the Chicago Cubs AAA affiliate. This workshop will "cover the field" on baseball field maintenance. Further details on these workshops will be announced soon.

For information on these workshops or other Iowa Chapter activities, contact: Gary Peterson (515) 791-0765.

Colorado Chapter, STMA — The Colorado Chapter is planning a late spring workshop on topdressing, a summer institute for care of soccer fields and a fall workshop on football field maintenance.

For additional information on these meetings contact Mark Leasure (719) 597-1449. For information on the Colorado Chapter and/or upcoming activities contact Ron Marten, Falcon Colorado School District 49 (719) 495-3601.

The New England Chapter, STMA — Future plans for the New England Chapter STMA include an all-day meeting to be held during August in the mid-New England area. Further details will be announced soon.

For information on the meeting or other chapter activities, contact: Mary Owen, University of Massachusetts Cooperative Extension System (508) 831-1225.

Carolina Chapter, STMA — For information on the Carolina Chapter and its activities, contact: Marc Farha, facilities manager for the Charlotte Knights (704) 332-3746. ❑

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CHEMICAL LOG

Correcting Saline & Sodic Soil Problems

By Carl Spiva

In order to understand and correct salinity/sodicity problems on any soil, it is necessary to understand a few fundamentals of soils, water and the plants that are grown.

The first order of business is to obtain a good representative soil sample and a sample of the water that is used or expected to be used. On greens, the depth of sampling should be slightly deeper than fertility testing, since non-fertilizer salts generally are somewhat more mobile than other fertilizer elements.

A test consisting of a soil core of zero to eight inches, *minus the grass and accompanying thatch*, from 10 to 15 locations in the suspect area, is recommended. Though the area may be relatively small, such as a golf green, greater sample numbers improve the overall statistical significance so that a truly "representative" sample is obtained. These 10 to 15 cores are combined to form a composite sample.

A water analysis is much easier to obtain; simply fill a clean glass pint jar (preferably) from the source outlet.

An understanding of the mobility of the elements in question is most important. Of the elements we will discuss, sodium is immobile and the most difficult to displace. Boron has moderate absorption and chloride is quite mobile and relatively easy to move.

As a general statement, grasses are more tolerant of salinity than most ornamental plants but bentgrasses, the predominant on greens, have the lowest tolerance of the grasses in the golf course category. They require a salinity of less than four mmhos/cm or dS/m (deciSiemen per meter, a term having exactly the same value numerically; i.e., one mmhos/cm = one deciSiemen/meter). As a goal, the E.C. (Electrical Conductivity, as measured by the above values) should be about 1.5 mmhos/cm (or 1.5 dSm/m). To reduce the salts in the root zone, *drainage is essential!*

Examine the soil profile for clay layers, cemented layers, sand lenses and compaction, or a combination of two or more of these conditions. Physical alteration of the soil profile may be necessary. Once drainage has been eliminated as a possible limiting factor for reclaiming a saline soil, it is simply a matter of applying good quality water to the soil in quantities greater than the plants can use, thereby leaching the soil. In general, for each foot of soil to be leached:

- Six inches of irrigation water will leach out about one-half of the salt.
- 12 inches of irrigation water will leach out about four-fifths of the salt.
- 24 inches of irrigation water will leach out about nine-tenths of the salt.

Good quality irrigation water is also an essential requirement and a good test will reveal answers to our questions concerning:

1. Salinity
2. Permeability
3. Specific ion toxicity
4. Foliar absorption

Sodium is the major culprit in our western soils. It affects soils in two ways. First, it can be toxic to plants if present in sufficient quantity. Second, it can cause permeability problems by deflocculating the soil particles. These potential problems can be predicted fairly well by looking at the S.A.R. values on soil and water tests. S.A.R. is an acronym for Sodium Absorption Ratio: the comparison of the amount of sodium in a soil or water to the sum amount of calcium and magnesium. The higher the S.A.R., the more that problems are likely to occur.

If sodium is high, it must be replaced with calcium and leached from the profile. This can be accomplished in two ways. If there is free lime (calcium carbonate) in the soil, an acid-forming material can be added, which will react with the calcium carbonate to form calcium sulfate. The calcium in calcium sulfate is far more soluble than calcium carbonate and the calcium ion, having a greater absorption affinity for the soil particle, replaces the sodium ion and allows it to be leached out as sodium sulfate.

If there is no free lime in the soil to be

reclaimed, there is no alternative except to add soluble calcium. Gypsum is generally the amendment of choice. It might be noted that free lime, along with a great deal of irrigation water, will provide a modest amount of soluble calcium. However, it takes a great deal of time since the free lime is only very slightly soluble in water. This author chooses to rely upon acidifiers and gypsum, depending on whether sufficient free lime is present or not, to achieve good reclamation. For every milliequivalent (230 ppm) of sodium that needs to be replaced, 80 pounds of 100 percent gypsum would be needed per thousand square feet to a depth of one foot. Again, extra water (leaching) is required to provide good reclamation.

If free lime is present in adequate amounts, sulfur materials can be used and for each milliequivalent of sodium needing replacement, 15 pounds would have to be applied per every thousand square feet to reclaim a depth of one foot. Sulfur takes a little longer and depends upon warm temperatures, plenty of water and *finely ground* product, or a product that has plenty of reactive surface (i.e. "popcorn" sulfur and similar materials). Gypsum should be finely ground to be the most efficient and fast acting.

Boron is toxic to plants in high concentrations but can be leached from the soil profile over time. It is intermediate in its mobility and often a modest amount of gypsum will aid in the leaching of boron by assuring good soil flocculation. Many grasses are fairly tolerant of boron but the amount in the soil should be kept to less than one ppm and the water should have less than .5 ppm for optimum growth.

Carbonate and bicarbonate ions in water tend to precipitate calcium and magnesium as calcium and magnesium carbonates and sodium tends to take their places on the exchange complex. This obviously can lead to a problem. For that reason, monitoring of carbonate and bicarbonate in irrigation water is important.

Some success with acidifying irrigation water to about pH 6.0, to keep the calcium and magnesium in solution rather than having the precipitate out, has been accomplished. A simple titration can determine the amount of acid formers that are needed. Some of the new acid fertilizers, applied in the irrigation water, show great promise and their use should increase where alkaline waters and high sodium are problems.

Some caution is in order: Don't apply more than 50 pounds of gypsum per thousand square feet of green or tee at one time, even though the amount needed to do the job requires more than that. Wait a few months, and apply up to 50 pounds if needed, and wait again until the total amount needed is applied. On greens and tees, gypsum (and lime, if an acid soil is treated with it) dissolves quite slowly, and a "sludge" can form at the soil surface if more gypsum is applied than can be dissolved in a few weeks time. Also, the amount of elemental sulfur applied should be restricted to about five pounds per 1,000 square feet per application, with the same waiting period if more is needed to accomplish reclamation. Burning can be a problem under some circumstances if more is applied at one time. ❑

Editor's Note: Carl Spiva is an agronomist and consultant in Modesto, CA.

Aerator Maintenance Tips

Preventive maintenance is extremely important for today's self-propelled, walk-behind aerators. A rolling-type aerator can punch almost 200,000 holes per hour. A reciprocating aerator can punch nearly 300,000 holes per hour. That's a lot of work — and a lot stress on the machine.

The overall wear and tear on a walk-behind aerator operated eight hours a day, five days a week for 20 weeks is roughly equivalent to that sustained by a car pulling a trailer at 55 mph for the same periods of time, covering 44,000 miles. In situations where the ground is relatively hard, the process of making each holes is comparable to pushing the coring tine against a grinding wheel thousands of times per hour.

A quality aerator is built to handle this type of workload. But to keep your machine in good working order, proper maintenance is essential. The following daily maintenance procedures, recommended by Ransomes America Corporation, help keep aerators in top operating condition:

- Pressure wash the entire machine with water. For best results, wash after the day's work is finished and the engine has cooled. If left overnight, dirt and grit can start eating away at vital parts, especially aeration tines. Rust is the worst enemy of core aeration tines. Rust in tines can cause cores to stick, plugging the tines and causing a variety of related problems. (Steam cleaning is not recommended. If the aerator has sealed bearings, steam may get past the seal and cause the bearing to rust. A rusty bearing can put an aerator out of work and into the shop.)
- Closely inspect all chains and sprockets for wear. Replace or adjust as needed. Do not overtighten roller chains, as this will shorten life. To ensure reliable performance, use only manufacturer-specified parts.
- Closely inspect all sealed bearings. Make sure the bearings are straight and the seals in place.
- Closely inspect all tines for wear, cracks, bending and other damage. Don't forget to inspect the tine mounting (nuts and bolts). Tighten all hardware according to the torque specifications in the operator's manual.
- Make an overall inspection of moving parts and fasteners. Replace or tighten as necessary. Because of the extreme vibration generated by walk-behind aerators, this is a very important part of the preventive maintenance program. Again, manufacturer-specified hardware is recommended — it can withstand the vibration and other stresses common to hard-working aerators.

Proper aerator maintenance takes time, but it's time well spent.

Here's a useful tip that can help save inspection time: After installing a new bolt, give it a coat of paint. (Paint from a spray can works fine.) If the bolt starts to work loose, the paint on the thread will crack, providing an easy-to-see sign that tightening is needed.

- Lubricate all moving parts including tines and chains. A lubricant such as WD-40 does an effective job in most cases. However, O-ring sealed chains should only be lubricated with a lubricant specifically designed for them.
- Lubricate all fittings. Wipe fittings before and after greasing.
- Inspect all belts for wear and proper adjustment.
- Check for proper oil levels. Follow the manufacturer's recommendations for the type and grade of oil required.
- Check the engine air filter system and clean, if necessary, following the manufacturer's recommendations.
- With a pressure gauge, check the air pressure of the tires. Keep tire pressure at manufacturer-recommended levels. Improper inflation can considerably shorten tire life, as well as change the performance of the machine in some cases.

All of these maintenance procedures apply to both reciprocating and roll-type aerators. Refer to your operator's manual for specific recommendations.

With roll-type aerators, also be sure to check the rolling tine wheels for side-to-side movement. If a tine wheel can be easily moved back and forth by hand, it is likely that the bushings are badly worn. Replace them.

Preparing for Storage

The following procedures are recommended for aerator storage of more than 30 days:

- Remove fuel from the system, according to the engine manufacturer's recommendations.
- While the engine is still warm, drain the crankcase oil and replace with the grade and weight of oil best suited to the season in which the aerator will be next used.
- Remove the spark plug from the engine and squirt a small amount of oil into the cylinder. Turn the engine over a few times to distribute the oil, then replace the spark plug.
- As necessary, touch up all hardware with spray paint.
- Refer to the operator's manual for other specific recommendations.

Tine Tips

As part of a good preventive maintenance program for aerators, tines should be cleaned and inspected for wear after the day's work has been completed.

Cores left in tines for extended periods of time can cause pitting on the inside of the tines. These pits may keep a tine from ejecting the core properly. As a result, the tine must be replaced. Pitting also cuts down on the service life of tines.

If a core becomes stuck in a tine, use an electric drill with a half-inch bit to bore it out. To polish the inside surface of a tine, try using a shotgun bore brush in