DETECTION AND CORRECTION OF TREE ROOT DISORDERS

By Michael J. Walterscheidt, Ph.D.

To understand the problems of root suffocation, strangulation and surface rooting, it is necessary to know a little about the function and purpose of roots for a tree or other plant.

Most of the water absorbed by trees enters through their roots. This process of water absorption is dependent on several factors including the diffusion pressure in the tree, the efficiency of the root system and availability of soil moisture.

The root is also responsible for absorption of nutrients from the soil, which are found in the form of salts and are absorbed by the intimate contact of roots with soil solutions. The availability of these salts to the plant root can depend on several factors such as pH, concentrations of the salts and soil aeration.

Another function of roots is to conduct the absorbed water and nutrients to the stem of the tree where they are distributed to other parts of the tree. The conducting tissue is also necessary to move the manufactured plant foods downward to the roots. This downward movement of plant foods leads to another function of roots: the storage of carbohydrates.

An additional important function of roots is the anchorage of trees. Through their close contact with soil the roots permit a large tree to remain standing during severe environmental conditions.

Now that we have noted the four primary functions of roots: absorption, conduction, storage and anchorage, let's look at various problems which can hamper one or more of these functions and cause symptoms which are exhibited by the upper portion of the tree, the part we see most often. It has been estimated that over half of tree problems are directly related to roots, yet these are the most difficult to diagnose. A little knowledge of some of the basic root problems and possible corrective action may allow you to "save" some trees which are in a state of decline.

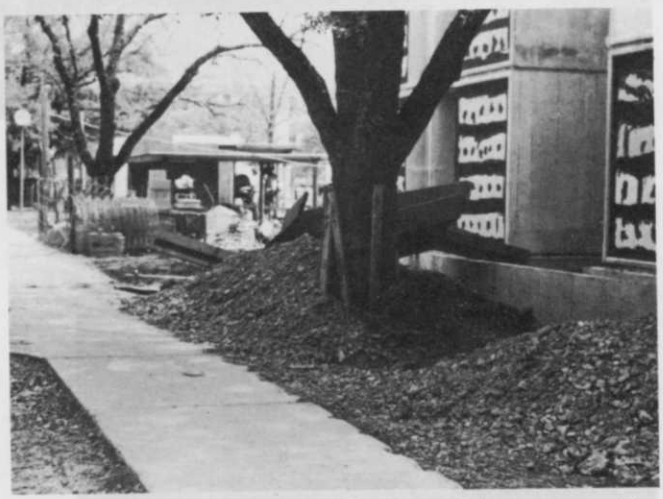
Girdling Roots

Girdling roots of trees are a problem that has received considerable attention in recent years. Quite often decline in the upper portions of trees can be attributed to the presence of girdling roots on a tree. Smaller leaf size, leaf scorch, twig dieback and even the death of large branches can result from this type of root damage.

The cause of girdling roots is not always known. It is suspected that quite often girdling roots result from poor planting of trees. If the planting hole is too small a tree can be twisted slightly in a corkscrew fashion and most of the roots will then fit into the hole. Unfortunately most of the roots will also then be growing in a circular fashion often twisted around one another. As the tree grows and the roots enlarge they tend to crow the stem of the tree. This enlargement often causes one root to girdle or restrict the flow in the conducting tissues of the root, hence a portion of the tree may suffer due

Girdling roots on surface (top) and dieback (bottom) are two of the more obvious indications of root problems.

Dr. Walterscheidt is Extension Forestry Project Leader at Texas A&M University, College Station. He earned a B.S. in Forestry and M.S. in Plant Pathology at the University of Missouri and a Ph.D. in Plant Pathology at Texas A&M. He is Editor of the Texas Chapter, International Society of Arboriculture.



Trunk protection cannot offset the root damage caused by sidewalk and foundation construction. Dieback is already evident before construction is completed.

to this restriction. The symptoms are usually not expressed until the tree is quite large, perhaps 10 inches caliper, because it takes this long for the roots to enlarge enough to grow into one another.

Reasons other than poor planting may lead to girdling roots. Root injury due to soil compaction, paving or other factors may cause a proliferation of roots near the trunk of the tree and as they enlarge and compete for space they may girdle one another.

Girdling roots on the surface are relatively easy to detect and correct. The root can be seen growing around the trunk of the tree or across a large lateral root at the base of the tree. Quite often removal of the girdling root with a hammer and chisel will allow further development of the root that was girdled and perhaps a decrease in the decline symptoms of the tree crown. Removal of the girdling root should not be done however just because it appears to be a girdling root.

Girdling roots which occur below ground level are usually difficult to diagnose. Often they are first noticed by decline in the above ground portions of the tree, which is difficult to attribute to construction, paving or other detrimental factors. The best indication of below ground girdling roots is the presence of the telephone pole effect. Normally a tree flares at the point it enters the soil, but often a below ground girdling root will disrupt this flare and the tree will look like a pole. In some cases, the tree will be narrower at ground level than it is a short distance above ground. Usually the lack of root flare will be present on only one side of the trunk.

Below ground girdling roots have been removed with success in some instances. If a tree is rapidly declining and a below ground girdling root is found it probably should be removed. A mallet and chisel can be used to cut the girdling root on both sides of the restricted root and then it should be removed. Wound paint should be applied to the cut ends prior to refilling with dirt.

Girdling roots should not be removed as a matter of routine tree care. Only if there are symptoms in the crown of the tree should they be removed, and only then after considerations are given to other factors that may be causing the symptoms. If in doubt a competent diagnostician should be called in.

Surface Roots

Surface roots can become a problem in some tree species, especially several of the elms, silver poplar and Chinese tallow. Surface rooting seldom is directly harmful to the tree but can cause maintenance problems when the roots appear above the surface of the soil. When turf areas are well manicured the surface roots may be a hindrance to mowing. Likewise the aesthetics of a well manicured lawn can be destroyed by abundant surface rooting. If all the roots of the tree are near the surface the tree could be subject to windthrow during storms.

Many people attempt to remedy surface rooting by cutting the roots close to the tree and removing them. This should be done with extreme care because if too many roots are removed it could be detrimental to the health of the tree. The remaining root supply may not be able to provide the water and nutrients necessary to maintain the health and vigor of the tree. Also the cutting to too many roots could make the tree subject to windfall during a storm.

The most successful treatment of surface rooting is to spread sand to the level of the top of the root. If the roots are exposed to a great extent the top-dressing of sand should be done over a several year period. By carefully spreading the sand the soil level can be raised so the roots are once again underground. Do not attempt to indiscriminately place 4 inches or more or soil over the root surfaces completely around the tree as a remedy. This may result in suffocation of root systems and a decline or death of the tree.

Surface rooting can be caused by several factors some of which can be easily controlled and others which we have little control over. Frequent, light

watering of lawns under trees can cause an abundance of tree roots in the upper soil surface and may cause surface rooting. Improper fertilization can cause surface rooting, particularly when combined with the light watering. Heavy fertilization combined with low rainfall and light watering will result in a concentration of the nutrients in the upper several inches of soil which allows for vigorous grass growth, but also may cause an abundance of tree roots very near the surface.

Oftentimes surface rooting may be caused by soil structure. A heavy, shallow claypan can result in a concentration of roots near the surface. Likewise, a high water table can cause tree roots to concentrate near the surface of the soil. These soil factors are often difficult to correct to an appreciable degree, but if the claypan is not too thick it can be fractured by compressed air. Sometimes better drainage of an area will allow tree roots to penetrate deeper in waterlogged soils.

Since most surface rooting problems occur on older established trees, the corrective action is sometimes difficult. Care must be taken to do nothing that would seriously damage the roots or the corrective action may destroy the tree. The best long range solution is to plant the proper species on the proper site. Sometimes we are forced to plant on adverse sites. Subsoiling methods to break up the claypan, installation of drainage tiles or hauling in of topsoil prior to planting should be considered for these adverse sites.

Construction Injury

Perhaps the most perplexing problems encountered by grounds managers are associated with construction injury. All too often a recently completed facility is turned over to the grounds maintenance supervisor for care and during the next several years many of the trees on the site begin to decline and die. Some of the problems may not be evident for 3 years or more after a facility is completed. Seemingly there is no logical explanation because all of the trees were "protected" during construction. There are no scrapes or bruises on any of the trees, so equipment was kept away from the trunk. Problems of this kind can often cast a doubt on the management's minds about the grounds maintenance supervisor's abilities. After all, the management saw how well the trees were protected during construction.

Most individuals do not realize that just keeping the equipment away from the trunks of trees is not enough. Most of the damage occurs when heavy equipment and trucks run over the root systems of trees and compact the soils. Studies have shown that one trip across wet soil with a heavy tractor can reduce the infiltration rate 80%. Heavily compacted soils may become impervious to rainfall and the tree will then suffer from oxygen starvation and also from drought.

Quite often the roots of trees are severed when foundations of buildings are dug, when sidewalks are prepared, when utilities are brought into the site or when grading is done around the site. Often this root damage is quickly covered again, if severe enough the tree will die suddenly or begin a typical decline.

Much of the damage due to construction can be avoided. First, however, one must realize that if a building is constructed in a heavily wooded area the loss of some trees is unavoidable. A common mistake often made is to remove all the small trees and leave a few large mature trees. This is not always the best method because these mature trees will likely be more susceptible to construction injury than younger vigorous trees. Obviously all trees on the actual building site may be removed. Also trees that are located just a few inches from the foundation of a building are difficult to save. It can be much less expensive to remove these trees during construction than after the building is completed. In some cases the building placement can be changed to spare a valuable tree or group of trees.

Underground utilities often cut many tree roots and cause a decline in nearby trees.

Several actions can be taken on sites where the grounds supervisor has control prior to any construction activities. All trees located close to the site should be fertilized with a low nitrogen, high phosphorous fertilizer. This will stimulate root growth and have the tree in as healthy condition as possible. On these trees where there will be certain root damage the tops should be thinned out to compensate for the root loss. Care should be taken not to have the soil too wet prior to construction because wet soils tend to compact more easily than dry soils. A heavy mulch of chipped tree trimmings spread over the site will help prevent severe soil compaction.

Unfortunately grounds supervisors are not often hired until after a project is completed and most of the root damage is done. If trees situated near newly constructed areas show a lack of vigor or decline while nearby trees look healthy there is a good chance the decline is due to root injury. Some corrective action can be taken. A thinning of the crown of the tree coupled with a fertilization of the roots may help the tree recover. If, however, the root damage was severe even this action may not help.

Be alert to discover declining trees early. The sooner corrective action is taken the more likely the tree will survive. Things to look for include a

Poor drainage around construction areas can be very damaging to trees.

shortening of the nodes, i.e. shorter twig growth each year; smaller leaves than nearby trees of the same species; and off-color leaves, generally a yellowing. Oftentimes trees with root damage will exhibit a thin crown and gradual branch dieback. If these symptoms are noticed early and corrective action taken the tree may be saved. It must be remembered that any corrective action taken is generally much less expensive than removal of a dead tree and replacement with a new tree.

Soil fill around trees can be as deadly as cutting the roots. Decline of the tree can be rather fast or it may take a period of years. Soil fill symptoms generally resemble other root problems such as smaller leaves, reduced twig growth and top dieback. Soil fill is often relatively easy to detect by a trained individual because of the absence of root flare around the entire base of the tree. Quite often the depth of the fill can be ascertained by careful digging through the soil until a definite, sharp change in color is noticed. As little as 3 to 4 inches of fill can be damaging to some trees. Heavy clay fill generally is more damaging than sandy fills.

Corrective action for trees recently filled around consists of thinning of the crown and fertilization. If the fill is shallow the soil can be periodically broken up and fertilizer and water added, which encourages root growth into the filled area. If the fill is moderately deep the soil should be removed from around the trunk and a well formed. Holes should be made into the root zone every few feet and tiles placed vertically into them to allow air exchange at the original soil level. If a deep fill is made the well should be constructed around the trunk of the tree and then trenches dug radiating out from the well around the tree out to the drip line. These trenches should have 6 inches of coarse gravel placed in them, and a layer of straw placed on top of the gravel and then the soil refilled. A vertical tile should be placed at the end of each trench to allow air flow and the trenches should slope slightly away from the trunk for water drainage.

The best way to prevent fill damage is by taking preventive action prior to the fill if possible. Before the soil is placed around the tree a layer of coarse gravel should be placed in the area to be filled, then tiles can be laid in a radiating fashion around the tree to the drip line and vertical tiles placed at the ends. The coarse gravel should then be covered with a layer of straw to prevent the fill from clogging the spaces between the gravel. The soil fill can then be placed on the straw. A well is constructed around the tree which should allow good air circulation from the trunk through the coarse gravel to the vertical tiles. It would be wise to fertilize the tree prior to beginning the fill work.

A common type of root suffocation in developed areas is caused by paving. Quite often the paved area will go to within several feet of the trunk of large trees or in some cases within several inches of the trunk. When paving covers the roots of trees there is a severe disruption of the normal air exchange. The oxygen concentration of the soil air is reduced from a normal 18% to 3% and the carbon dioxide level is rapidly increased. Roots need the oxygen for respiration and therefore they die and soon the tree dies or declines. If paving is necessary it is often better to save a grouping of vegetation than to leave individual trees scattered in an area such as a parking lot. If paving close to a tree is unavoidable, an aeration system can be placed under the paving with perforated plastic pipe connected to vertical pipes at the edge of the paving. The paving must be put on grade level; no grading and damaging of roots should be done.

Most of the problems associated with declining trees can be attributed to root disturbances. Roots of trees are the most susceptible portion to injury during construction. They are not readily visible hence they are easy to ignore. Roots of trees need to be given the proper care especially on large trees because their root systems may spread over a very much larger area than most people believe. If tree roots are properly cared for the tree will be more vigorous and therefore be more likely to survive many of the other problems it encounters.

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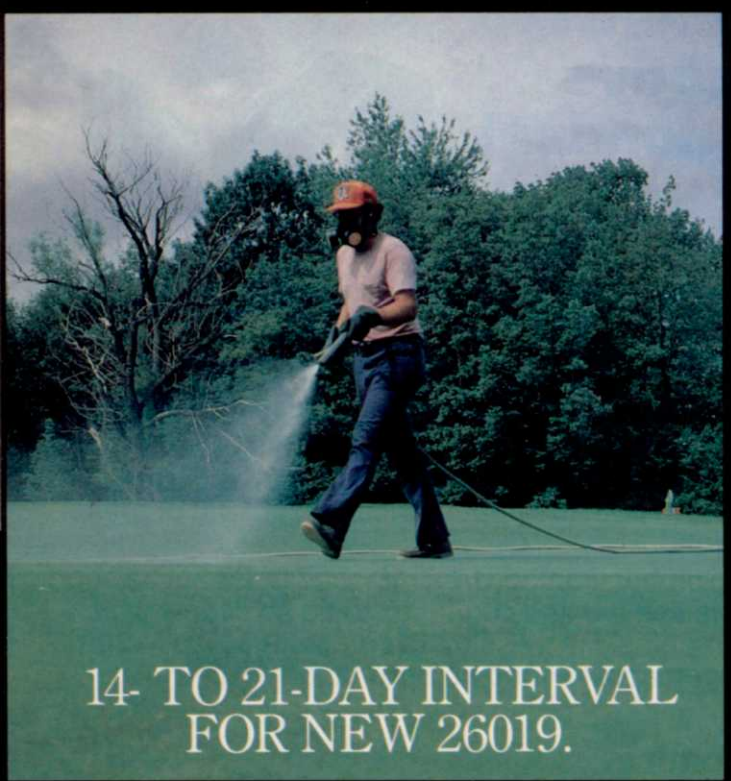

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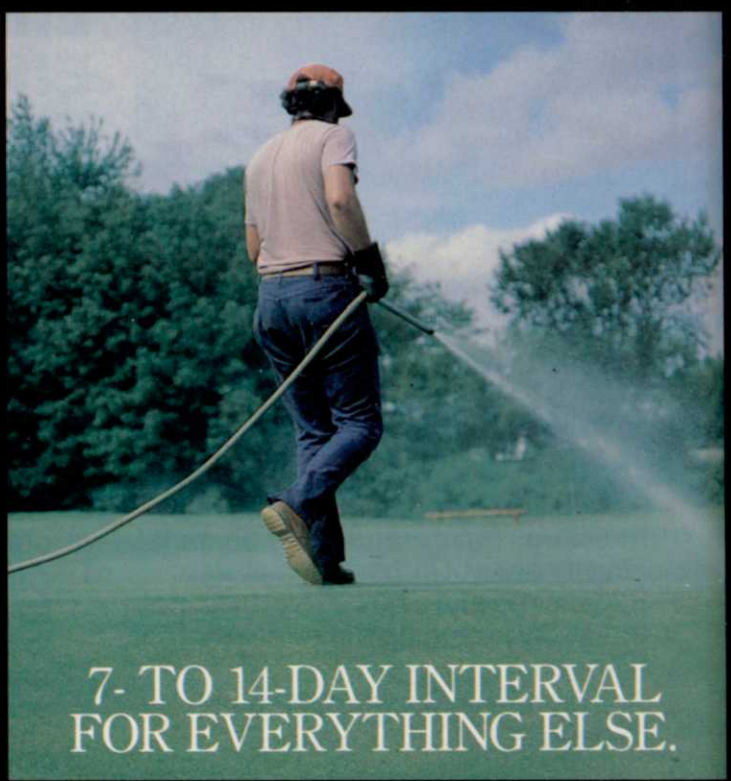

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—Bob Dickison, golf course superintendent
Upper Montclair Country Club, Clifton, N.J.

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—Paul Boizelle, golf course superintendent,
and John Fenwick, foreman,
Fiddler's Elbow Country Club, Far Hills, N.J.

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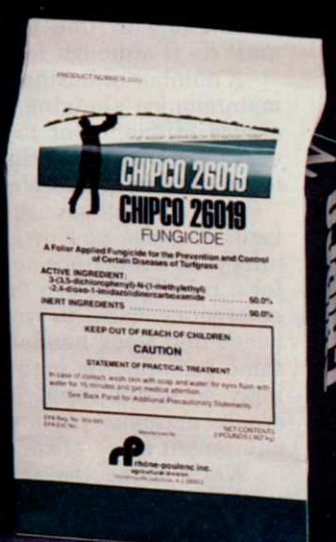
—Randy Wahler, golf course superintendent
Glen Flora Golf Course, Waukegan, Ill.



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MAKING THE MOST OF EQUIPMENT MAINTENANCE

By Bruce F. Shank, Editor

Loan institution advertising on television points out that once you get caught up on bills, someone in the family gets sick, or a storm damages your house, or your car needs EXPENSIVE REPAIR.

Maintaining complex pieces of machinery is a fear of the American public. It may be even a bigger fear of small businessmen who must maintain numbers of complex machines to provide a reliable service to customers.

Undeniably, regular maintenance prevents serious breakdowns in equipment. When a mower needs an oil change after each 25 hours of use, it is impractical to run to the equipment dealer everytime. The businessman must provide for certain levels of maintenance on his own and stock the parts required for such maintenance.

Also undeniable is the responsibility of the manufacturer to make replacement parts available to purchasers of his equipment for the purpose of regular maintenance. Keeping stock of every little component of every equipment model tends to be an inefficient and complicated task for manufacturers. Inefficiency many times leads to high prices to make repair part supply profitable or at least break even.

Combine the fear of breakdown by owners with the complexity of parts supply to the manufacturer and you get a less than perfect situation. Furthermore, companies manufacturing repair parts which can be substituted for original equipment parts add to the manufacturers woes.

That's not all. Many Green Industry markets such as mowing/maintenance, cemeteries, and nurseries are forced to customize machinery made for golf courses and parks to make it fit their requirements. These businessmen doubt the concern that equipment manufacturers have for their particular business.

The result is a situation similar to paying taxes or standing in line for license plates, everyone must do it although few enjoy it.

A number of businessmen derive pleasure from maintenance planning by developing a scheme to assure efficiency or to cut repair part costs. The very challenge of beating the odds can make maintenance more palatable.

It's like waiting until the last minute to pay your taxes because you owe the government, or planning your deductions ahead of time and filing early for a rebate. You can deal with repair parts on an emergency basis or you can predict repair part needs and stock needed parts ahead of time. The same goes for the manufacturer, he can begrudgingly go about supplying repair parts or he can create a repair parts program which makes his equipment more attractive to the buyer.

While doing the research for this article we mailed a letter to every equipment manufacturer in the Green Industry. It's obvious that the companies responding and mentioned in this article have pride in their repair programs. They are making an effort to improve the repair parts situation.

There are forty-five blades to sharpen on this gang mower, a true maintenance challenge.

Following are suggestions made by equipment manufacturers regarding what repair parts to stock and maintenance that can be handled by the user.

Engines

If you don't know how to repair anything else, you should learn the basics of engine maintenance. Changing points, timing, and adjusting the carburetor are necessary skills for anyone using mowers, spray equipment, edgers, and just about anything used in the Green Industry. Valve and ring work might be left to an engine specialist or dealer's repair department.

Basically, if kept clean for proper air cooling, tuned for correct operation, and religiously lubricated, an engine can last years.

Kohler Company's product service manager Paul Scholten has written numerous trade publication articles on small engine maintenance. He recommends the following service based upon hours of use:

Each Day
check oil
clean air intake screen
use fresh fuel

Every 25 hours
change oil (usually SAE 30)
clean fuel filter
clean air intake filter

Every 100 hours
clean or replace spark plug, check gap (usually 025 in. for gasoline engines)

Every 500 hours
check or replace points (gap usually .020 in.)

Dust or dry clippings from summer mowing should be cleaned from engine fins and air intake and not allowed to accumulate. The operator must be instructed as to his responsibility of engine maintenance.

Many distributors and manufacturers offer engine maintenance instruction. Each person operating a device with an engine should attend such sessions and learn to perform basic replacement and adjustment service. It is not true that point replacement takes alot of time. With a few simple tools to simplify flywheel removal, changing points and cleaning should take no more than half an hour.

There are three theories of maintenance, one is to have a maintenance staff doing just maintenance. The second is to assign responsibility for each piece of equipment to its primary user and train the user to perform maintenance. The third way is to send everything to the dealer for maintenance.

A maintenance staff is not the most efficient use of personnel for smaller firms. Dealers will tell you of workers coming to their parts departments for simple parts just to goof off. If recognized high repair parts are stocked and each operator is responsible for maintenance of his machine and given a half hour each day to perform maintenance, none has an excuse to goof off. Furthermore there should be a sense of pride in the condition of his equipment if he is a good employee.

As always, if you would like to pass on your experiences with equipment repair and maintenance write us and we'll publish your thoughts on the subject.

A basic list of parts to stock for engines:
plenty of good SAE 30 oil
spark plugs
fuel filter element
air filter element (to use while other is being cleaned)
set of points, condenser, and rocker arm with spring, shear pins for flywheel, ignition coil

Mowers

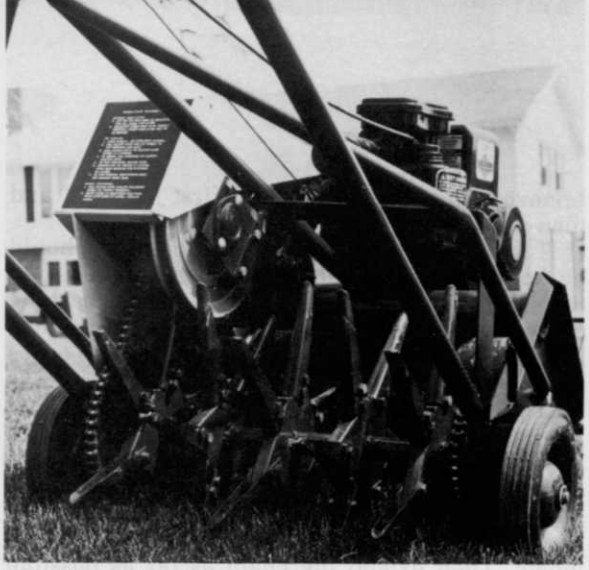
Roy Eldred, group director of parts for the Outdoor Products Group of Toro, recommends that turf managers stock the following "wear parts":

Walk Rotaries
- cutter bars
- belts
- collection bags
- oil

Riding Rotaries
- belts
- cutter bars
- filters for hydraulic equipment
- oil

Riding Reel Mowers
- bed knives
- bed knife screws
- belts
- oil
- filters for hydraulic equipment

Eldred says that stocking beyond these materials is wasteful and that operators should perform only that maintenance included in procedures described in the owner's manual.



Extra tines, drive belt, and core deflector should be stocked for aerifiers.

Eldred suggested that grinders, lapping machines, and blade balancers are useful additions to a maintenance department.

Sod Cutters

Ivan Vagts, Cushman-Ryan's national service manager, said sod cutters have very simple service needs. Vagts suggests owners stock one spare spark plug, a drive belt and one extra blade. He said the blade must be either 12- or 18-in. wide depending upon the model.

Aerifiers

Vagts recommends extra tines, one core deflector kit, a spark plug and drive belt for the Greensaire II. "Occasionally the tines will be damaged or break if they strike a rock underground," Vagts said. "But very little time will be lost if replacement tines are on hand since the job usually can be handled in less than five minutes."

Top Dressers

For top dressers Vagts suggests stocking connecting link assemblies and PTO roller chains. "If the link goes out the entire spreading operation can be shut down until another one is purchased," says Vagts. "I think an 80 cents investment in parts is a pretty good insurance policy."

Trucksters

Simple maintenance procedures such as oil changes help guard against field breakdowns of turf vehicles according to Vagts. Further protection can be achieved by stocking a set of points, a condenser, two extra spark plugs, an oil filter, an air cleaner element, and an alternator belt per vehicle. Special service charts are available for Cushman trucksters from Vagts, P.O. Box 82409, Lincoln, NEB, 68501.

Trenchers

Chains are the key to trencher maintenance beyond engine service. Maintenance should include checking chain tension, chain tooth wear, and using the right chain in the right circumstances.

Ditch Witch suggests lubricating chains between jobs to prolong chain life. If a chain is

removed and stored it should first be oiled and then hung in a dry place.

Tooth wear is fairly obvious and extras should be kept in stock. Chains are designed to sharpen themsleves, and good chains have tungsten carbide outer edges to keep the chains sharp and to prolong life. When this coating is worn off and the tip edges becomes dull, teeth should be replaced.

The chain overall can wear at the links. Ditch Witch suggests the chain be removed and measured to check free play between links. This free play should not exceed ½-in. per foot of chain length. The way to tell is to lay the chain on the floor, push the chain together, and measure the length. Then extend the chain as far as possible and measure again. The difference between measurements should not exceed ½-in. per foot, or an eight foot chain should not have more than four inches of free play.

A chain designed for standard soils should not be used in rocky soil. Special chains are available for frozen and rocky soil.

Regular lubrication of moving parts and rust prevention will extend the life of heavily used trenchers. Safety shields should be kept in good order and never removed. Heavy vibration of trenching equipment requires frequent tightening of bolts.

Ditch Witch offers a free brochure on chain care. The address is Ditch Witch, Charles Machine Works, P.O. Box 66, Perry, OK 73077.

Blowers

Carl Rinker, general manager of Atwater Strong, stresses, "With liability for injury today at an all time high, do it yourself repairmen quite often are their own worst enemy."

"We strongly recommend that major service or repairs on any of our equipment be handled by capable service dealers or distributors from which the equipment was purchased."

The key to a blower is the fan. Rinker suggests stocking of handle bars, fans and fan hubs. "Servicing of our equipment," says Rinker," should follow the service manual. The machine should be regularly oiled, greased where specified, and all fasteners should be kept tight. No safety guard provided on the equipment should be removed, permitted to deteriorate or become loose. Proper wrenches should be purchased for the fasteners on the equipment. Vice grips and pipe wrenches should not be used to remove fasteners."

Irrigation Equipment

An irrigation system is a carefully designed and balanced system. Changes to the original specifications should not be made without consulting the designer. Replacement parts must match the original specs. Rain Bird offers troubleshooting and design courses and has published four mainte-

Continues on page 61

Tools for Maintenance

Maintenance is more controlled if a place and set of tools are available. Harley-Davidson's golf car service manager Tom Falcone suggests the following materials for a maintenance department:

Spare Parts

1. Assortment of fasteners — cotter pins, washers, lock washers, bolts and nuts.
2. Ignition keys.
3. Lubricants — engine, differential and drive flange oils, a dry silicone or graphite lubricant.
4. Tire and wheel assemblies "spares".
5. Air cleaners.
6. Spark plugs.
7. Spare batteries, 12 volt for gas cars and 6 volt for electric cars.
8. Drive and generator belts

Tools

Available from numerous manufacturers for approximately $75 to $85. Tool sets should minimally include:

1. Screwdrivers (several sizes, including Phillips).
2. Pliers.
3. Needle nose pliers.
4. Vice grips.
5. 10" adjustable wrench.
6. Hacksaw and supply of blades.
7. ⅜" and ½" ratchet drives.
8. ⅜" and ½" breaker bars.
9. Sockets sets, ⅜" through 15/16", ⅜" and ½" drives.
10. Rubber hammer.
11. Brass hammer.
12. Set of open end wrenches, ⅜" through ¾".
13. Set screw keys.
14. Feeler gauge.
15. ⅜" electric drill and drill bits, 1/16" through ⅜".

Specialized Tools

1. Air compressor.
2. Battery load tester.
3. Cleaning solvents.
4. Compression gauge.
5. Grease gun.
6. High pressure washer.
7. Hydrometer.
8. Vehicle jack and jack stands.
9. Wheel chocks or blocks.
10. Log book — wall charts.
11. Low pressure tire gauge — 0 to 40 P.S.I.
12. Sensitive volt — ohmmeter.
13. Service and parts manuals.
14. Tachometer.
15. Towing device or trailor.