GREEN INDUSTRY NEWS

ARBORIST

Urban forestry suspected as intrusion

The private sector should be wary of the possible consequences of the Cooperative Forestry Assistance Act, according to a spokesman for the National Arborist Association.

Robert Felix, NAA executive secretary, said the act could lead to the formation of a federal agency to regulate the "urban forest" industry.

The Forestry Assistance Act distributes about $70,000 to each state to provide technical assistance to municipalities for urban forestry. The funds are distributed to the states by the U.S. Forest Service through state foresters.

The technical assistance provided includes:

- Planting and maintenance recommendations for tree ordinances.
- Insect and disease control recommendations.
- Development and utilization of urban tree inventories.
- Development of and recommendations for tree ordinances.
- Recommendations for the establishment of municipal forestry departments.
- Recommendations for the protection of the environment during new home or building construction.
- Multiple use management recommendations and plans for municipally owned forest lands.
- Workshops, programs, and slide shows on urban forestry.

"All of these suggested programs are valid, and where such assistance is appropriate is of great value to the public," he said. "However, suppose this assistance . . . begins to infringe on the private sector? Suppose new regulatory agencies, federal or state, were created to administer all of this?"

Felix added that government concern has historically resulted in the formation of regulatory agencies such as the Occupational Safety and Health Administration and the Environmental Protection Agency. "Regulatory agencies have become the fourth branch of government and cost American taxpayers over $100 billion last year to operate," he said. "Indeed we should be cautious."

According to Felix, much of the technical assistance provided in the act is unwarranted. "Many arborists, commercial and municipal, are perfectly capable of providing all of the technical assistance that is necessary with respect to the care of existing trees and many with respect to the planting of new trees . . .," he said.

"We do not need another layer of government bureaucracy imposed on us either as practitioners or as taxpayers," he added.

Thomas V. Bruns has been named president of the Jacobsen Division of Textron, Inc.

CHEMICALS

Velsicol appoints former EPA official

John M. Rademacher, a former senior official of the United States Environmental Protection Agency, has been named vice-president of environmental, health, and regulatory affairs for the Velsicol Chemical Corp.

He and his department will have direct operating control over environmental and health related matters, along with the company's relationship with the appropriate regulatory agencies.

A long-time federal environmental executive, Rademacher most recently served as a special assistant to EPA's assistant administrator for enforcement, in Washington, D.C. While a special assistant he provided technical evaluations of all EPA enforcement action, including air, water, and hazardous and toxic waste programs.

Rademacher has also served as a regional adminstrator for EPA and its predecessor agency, the Federal Water Quality Administration. A registered professional sanitary engineer, Rademacher obtained his bachelor's degree from Purdue University and his graduate degree from Northwestern University.

He is currently serving as president of the Federal Water Quality Association, an affiliate of the Water Pollution Control Federation.

IRRIGATION

Toro to expand irrigation division

The Toro Co. has announced that it will invest more than $3 million over three years in a new expansion program for its Irrigation Division in Riverside, Calif.

The expansion plans call for the addition of 118,000 square feet of factory, office, and warehouse space at an estimated cost of about $3.4 million. Toro's current facility in Riverside totals about 159,000 square feet.

Toro Chairman David T. McLaughlin said Irrigation Division sales have increased more than 100 percent during the past two years. In the last fiscal year, which ended July 31, irrigation sales accounted for $24.2 million of the company's $227 million in total sales.

SEED

Oregon seed groups repair Capital turf

The Oregon Grass Seed Industry rallied to the aid of the 24 acres of lawn in the Nation's Capital which were damaged during the farmers' occupation last winter.

A combined effort of the Oregon Seed Council, Seed Trade Association, and Seed Grower's League produced the 7200 pounds of special grass seed mixture which was required for the project.

The seed, all Oregon grown, is a special mix which was requested by the National Parks Service. It is Kentucky Bluegrass, Penn Lawn Red Fescue, and Fawn Tall Fescue. It is a mixture designed to be most effective for the climate and the specific needs of the area to be planted.

The idea was born during an Oregon Seed Council meeting. It was noted that nurserymen were going to replant the shrubbery and Maryland farmers were going to prepare a seedbed. C. M. "Brownie" Brownell, Treasurer of the Council, coordinated an effort that brought the other seed organizations into the picture.

Landscape Contractor News

Operating cost survey developed

An operating cost ratio survey of the landscape contracting industry is currently being conducted by the Associated Landscape Contractors of America (ALCA). The survey is completely confidential and will focus on operating cost data, along with pertinent data on standard financial reports.

John Shaw, ALCA president, said the survey is being sent to about 3800 landscape contractors across the United States. "The purpose of the survey is to develop statistical information about the industry," he said.

The survey is constructed so the complete confidentiality of the reported information is guaranteed through a response verification system. Further responses are directed straight to the data processing firm which will compile the data.

The report information will be broken down into a variety of areas including company size and geographical area covered, along with an analysis of department and division data. The final report will also include a narrative analysis of the data.

The survey report, to be published this fall, will be sent directly to all landscape contractors who participated in the survey and will be available for sale to all others. Additional survey information is available from ALCA, 1750 Old Meadow Road, McLean, VA 22102.

Judges named in CLCA competition

The California Landscape Contractors Association recently named the judges for its 20th Annual Landscape Beautification Awards Program, according to Bill Vandergeest, 1979 program chairman and owner of Vandergeest Landscape Care, Santa Ana, Calif.

Judges include Keith French, landscape coordinator for S & S Construction Co.; Jerry Driscoll, manager of California Trees, Inc.; and Fred Ridge, president of PCM, Inc.

Judging for the annual awards will be held June 2-3 and the awards will be presented at the organization's annual banquet, June 27, at the Revere House Restaurant, Tustin, Calif. Winners will not be announced until the awards banquet.

Commercial and residential landscaping projects which have been completed since May 1, 1978 qualify for the competition. For further information contact the Landscape Beautification Awards, c/o Bill Vandergeest, 3342 Castor St., Santa Ana, CA 92704.

Residential design program planned

The ALCA Residential Design Short Course will be held in Phoenix, Ariz. and Seattle, Wash. in late June. The three-day program features lectures, problem-solving sessions, and board exercises on all aspects of residential landscape design.

The program will again be conducted by Jot Carpenter, chairman of the Ohio State University Landscape Architecture Department. Additional OSU resource personnel will also participate in the sessions.

The Phoenix program, co-sponsored by the Arizona Landscape Contractors Association, will be held June 21-23 at the Townhouse Hotel. The Seattle program, co-sponsored by the Washington Nurserymen's Association, will be held June 25-27 at the Lutheran Institute of Seattle.

The course is intended for landscape contractors involved in landscape installation who don't have any formal training or previous experience in design. All phases of landscape design will be discussed including scaling, lettering and graphics, functional diagrams, form and composition, plant functions, design principles, plan development, and final designs.

The program is open to all interested persons. For further information or registration materials contact the Associated Landscape Contractors of America, 1750 Old Meadow Road, McLean, VA 22102.

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LANDSCAPE

Three more groups affiliate with ALCA

The Wisconsin Landscape Contractors Association, the Landscape Contractors of Utah, and the Arizona Landscape Contractors Association have become Sponsoring Members (state affiliates) of the Associated Landscape Contractors of America. They join seven other state/regional associations, bringing the total to ten.

The Sponsoring Member category is the term for organizational membership in ALCA, and is the mechanism through which state and regional groups may affiliate with ALCA. Under the Sponsoring Member arrangement, member firms of WLCA, LCU, and AzLCA gain direct access to all ALCA publications and meetings.

Other state/regional groups holding Sponsoring Membership in ALCA are: California, Illinois, Colorado, Washington, D.C., New York, Texas, and Florida.

PESTICIDE

Orthene registered for California scale control

Orthene Tree and Ornamental Spray has received a California Special Local Need (SLN) registration for control of scale on ice plant ground cover along highway rightofways. The registration allows the use of Orthene as needed for scale control in the crawler stage at the rate of two-thirds pound of formulation per 100 gallons of water, applied with conventional hydraulic sprayer.

ARBORISTS

ASCA names Schultz as 1979 President

The American Society of Consulting Arborists recently elected new officers to serve in 1979. Those elected included Jack A. Schultz, New York, president; John Z. Duling, Indiana, president-elect; William J. Griffin, California, vice-president; and Edwin E. Irish, Michigan, secretary-treasurer. Spencer H. Davis, Jr., New Jersey, was named executive director.

GOVERNMENT UPDATE

Dow withdraws from suspension hearings

The Dow Chemical Co. recently announced its withdrawal from EPA's 'suspension' hearings concerning the herbicides 2,4,5-T and Silvex. At the same time, Dow filed several motions with EPA's chief administrative law judge seeking prompt initiation of a broad fact-finding hearing on EPA's proposed cancellation of the registration of the herbicides.

Dow attorney Michael J. Traynor said the company withdrew from the 'suspension' hearings because the "fundamental issues" of the long-term safety and benefits of the products were not being considered by the panel.

"This action is not an abandonment of the products or their defense," he said, "but simply a means to expedite the final resolution of their futures by beginning the cancellation hearings immediately."

"Specifically," Traynor said, "our requests are that EPA promptly assign an Administrative Law Judge (ALJ) and schedule a pre-hearing conference so we can move forward with a full examination and ultimate government decision on the risks and benefits of these products." A pre-hearing conference was scheduled for June 5 in Washington, D.C.

In related news, agency officials said the major issue now confronting EPA is how they will pay for and carry out the Silvex indemnification agreement it signed with the Chevron Chemical Co. Agency enforcement officials said if the agency doesn't obtain additional funding through supplemental budget requests, the issue will likely end up in the courts. One official said, "I don't know why the government should agree to pay for products that the companies probably knew were hazardous to begin with."

EPA rules Evergreen an applicator

Evergreen Pest Control is not a "distributor" based on the definition of the word in FIFRA Section 14(a)(1), according to Paul De Falco, EPA regional IX administrator. The decision reaffirms an earlier ruling by EPA Judicial Officer Anthony O. Garvin, but contradicts a decision by Administrative Law Judge Gerald Harwood.

De Falco's ruling that the company is an "applicator" of pesticides versus a "distributor" means that Evergreen Pest Control will be subject to less stringent FIFRA penalty provisions for its alleged misuse of methyl bromide. Further, the ruling could have an affect on future court rulings concerning the distributor vs. applicator debate.

In making his final decision, De Falco said, " . . . although the evidence indicates that Evergreen regularly kept stock of pesticides on its premises for use in its business, there is no evidence in the record to indicate that Evergreen ever resold or otherwise distributed these pesticides to other companies or individuals."

Drinking water regulations proposed

EPA has proposed regulations designed to prevent pollution of the underground sources of drinking water that now serve one-half of the United States population.

EPA will provide up to $6 million this year to help states set up and enforce programs to insure that the underground injection of liquid wastes and other fluids does not endanger subsurface drinking water.

The agency has estimated that there are more than 500,000 injection wells that now have the potential to contaminate groundwater and that number increases by about 5,000 each year.

Basically, EPA's regulations call upon the states to set up programs to review all underground injection operations and take any remedial action necessary to protect groundwater. Injection wells would be inspected to make sure they are properly constructed and maintained. Safe injection operations that are not potentially dangerous could continue, but they would have to comply with permits and rules issued by the states or EPA.

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SYMPTOMS AND CONDITIONS OF ENVIRONMENTAL TREE DISEASE

By Eugene P. Van Arsdel

Environmental diseases are those caused by the adverse effects of the environment on the tree.

The maladies fit my definition of diseases better when they are more or less continuous, but many authors include lightning as a non-infectious disease. The adverse environmental conditions can be physical or chemical and can affect the plant directly or through the soil, water, or air. Direct physical disturbances can be mechanical injuries to the above ground parts of the tree, but more commonly they are to the roots because people are not very much aware of the part of the tree that is underground. Physical changes in the level or drainage of the soil are often harmful. Harmful chemicals can be in the soil, the water, the air, or may be applied by people. Physical changes in the atmosphere such as adverse weather (e.g. early or late frost) or sudden changes in the microenvironment (e.g. changes in a nearby structure), or the introduction of chemicals (air pollution). Environmental maladies involve several species of plants more often than infectious or biological diseases do, and they often stop at the property ownership lines.

Eugene Van Arsdel is Associate Professor of Forest Pathology at Texas A & M University's College of Agriculture. Dr. Van Arsdel is a member of the Weeds Trees & Turf Advisory Board.

Sycamore seedling showing salt injured lower leaves caused by watering with high chloride content water. Newer leaves grew in rainy period and have no chloride symptoms.

Trees Affected

All trees can be affected by environmental maladies at some level of almost anything; e.g. live oaks are resistant to salt, but enough salt is frequently accumulated to poison them. Some species of trees are more susceptible to one environmental factor than another: American elms withstand excess water much better than many other trees (since most people water too often, this contributed to their success as a shade tree before the Dutch elm disease epidemic); however, in sub-humid regions (central Texas) where slightly saline irrigation water is common the elms usually die from the salt before oaks do. Evergreen trees are often more susceptible to air pollutants than deciduous trees, generally because the evergreen leaves stay on longer to be affected by the pollutants.

Occurrence

Environmental diseases can occur anywhere, but they are particularly prevalent in the urban environment where man has had the greatest influence. Frost and sunscald are widespread, other maladies are often confined to particular areas; e.g. there is almost always a great deal of sulfur dioxide pollution injury around a copper, lead or zinc smelter. Locations are important in the diagnosis of environmental diseases. The coastal areas have special problems with storms blowing sea water inland to injure trees with salt. The damage can cover large areas, but only within a few miles of the coast.

Damage

The damage ranges from hardly noticeable to widespread death of the trees. Salt in the irrigation water can cause a slight dwarfing of leaves that is hardly noticeable to all but the most careful observers, but certain smelters are famous for being surrounded by miles of dead trees and denuded land (Linzon 1968).

Symptoms

The symptoms showing that environmental injury is occurring are varied, but many can be detected from leaf symptoms. These have been presented in another paper (Van Arsdel 1978). Some specific symptoms of the particular groups of maladies are presented later. Some generalized symptoms are those of root smothering: the leaves

turn yellowish with no definite lines between color changes. Nearly all of the leaves are involved and the injury is not restricted to either new leaves or old ones. These symptoms are characteristic of natural gas leaks, earth fill over the roots, flooding or interrupted drainage, or daily watering. Gas leaks probably involve several species of plants, and usually involve the grass too.

Control

The key to controlling environmental diseases is to determine the cause, then the cure often becomes evident. If a natural gas leak is the problem, much of the injury is permanent, but additional injury can be prevented by fixing the leak and aerating the soil (by pumping compressed air through, leaving the excavation hole open, etc.). To control air pollution, usually the source must be controlled. At times raising the stack height helps, but often that merely transfers the problem to another location. Other more specific controls will be discussed in the detailed sections of the paper handling the particular environmental disease.

Causes

The causes of environmental disease are many, and more are discovered each year, particularly as the human population increases, and the works of man encroach upon the natural environment more and more. A list of some of the more common ones are listed below.

Soil Disturbance — Construction Injury

Some builders and developers do many acts that often injure trees in the vicinity of their work. With their heavy equipment, such as bulldozers, the trees do not have much of a chance of surviving unless special care is taken to preserve the trees.

A partial list of these damages follow — roughly in the order of the amount of damage they do: (1) The worst is where they mean to kill the tree, and they push it over with a bulldozer and run heavy equipment over it. (2) Not quite as bad, but just as fatal is when they push the whole tree aside with the bulldozer along with a small island of attached dirt and leave the tree standing in a new location with only a small part of its roots to absorb water from the ground to supply the leaves with their required water. (3) They fill soil over the ground at the base of the tree which contains its roots. (4) They interrupt the drainage with a house, a wall, a sidewalk, or a mound of earth that makes the water back-up and suffocates the roots by flooding. (5) They cut the roots off when they excavate for foundation walls, service lines, sidewalks, streets, etc. (6) They crush the roots and break them up by running heavy equipment over the soil that contains them. (7) They wound and skin the bark on the stem by running tractors, trucks, etc. over them. (8) They drip oil from the crankcases and gear boxes onto the soil. This is both poisonous to the trees and prevents rainwater penetration. (9) They permit the ready-mix concrete trucks to dump concrete onto the soil, then they spread a thin layer of fill over it so you can not see where it is. (10) They run

Causes of environmental diseases:

1. Meteorological effects
   - A. Frost (low temperature)
   - B. Sunscald (high temperature)
   - C. Light
   - D. Drought
   - E. Lightning
   - F. Winter kill (warm wind with frozen ground)
2. Air pollution
   - A. Reducers
     - (1) Sulfur dioxide
   - B. Oxidizers
     - (1) Ozone
     - (2) Peroxy-acetyl-nitrate (PAN)
     - (3) Flourides
     - (4) Chlorides
   - C. Combinations (synergists)
     - (1) SO_2 and Ozone
   - D. Growth modifiers
     - (1) Ethylene
     - (2) 2,4-D, 2,4,5-T and other herbicides
   - E. Salts
     - (1) Blown seawater in natural salt storms
3. Water problems
   - A. Changes in amount or level
     - (1) Dams or other flooding (root smothering)
     - (2) Too frequent watering (sprinkler irrigation flooding — most common with automatic sprinkler systems) (root smothering)
     - (3) Complete change in watering cycle (stop watering for vacation trip)
   - B. Water pollution
     - (1) Salts in the irrigation water (common with many city water systems — often worst on house plants)
4. Soil modification
   - A. Mechanical (Bulldozer blight)
     - (1) Earth filling over the soil surface above the roots (root smothering)
     - (2) Cuts, ditches, sidewalks, and street grades (root cutting)
     - (3) Building foundation cuts (root cutting)
     - (4) Covering surface with asphalt, concrete or plastic (root smothering)
     - (5) Lowering water table by ditching
   - B. Chemical injuries (soil pollution)
     - (1) Salt injury
       - a. Irrigation water
       - b. Road salt
       - c. Oil wells (brine pools, etc.)
       - d. Mine tailings
       - e. Dog urine (male dogs on the corner shrubs)
     - (2) Excess fertilizer
     - (3) Illuminating or heating gas
       - a. coal gas (Ethylene)
       - b. natural gas (lack of oxygen = root smothering)
     - (4) Herbicide injury (Atrazine in grass fertilizer, or deliberate application — may be to driveway or fence)
5. Mechanical injuries to plant
   - A. Logging injuries
   - B. Lawnmower skinning
   - C. Rubbed spots, bumper skins, etc.
   - D. Broken branches
   - (1) Snow and ice breakage
     - (2) Bad pruning
     - (3) Truck breakage to branches.

the big trucks through the trees so they break up the branches, leaving exposed jagged branch stubs to serve as perfect entry courts for disease and decay fungi. (11) Lastly they cut the trees up for firewood and leave it there in a pile next to the base of a living tree. The fungus-bearing wood borers come out of the wood and enter the adjacent tree and transfer the local wilt fungus to the tree.

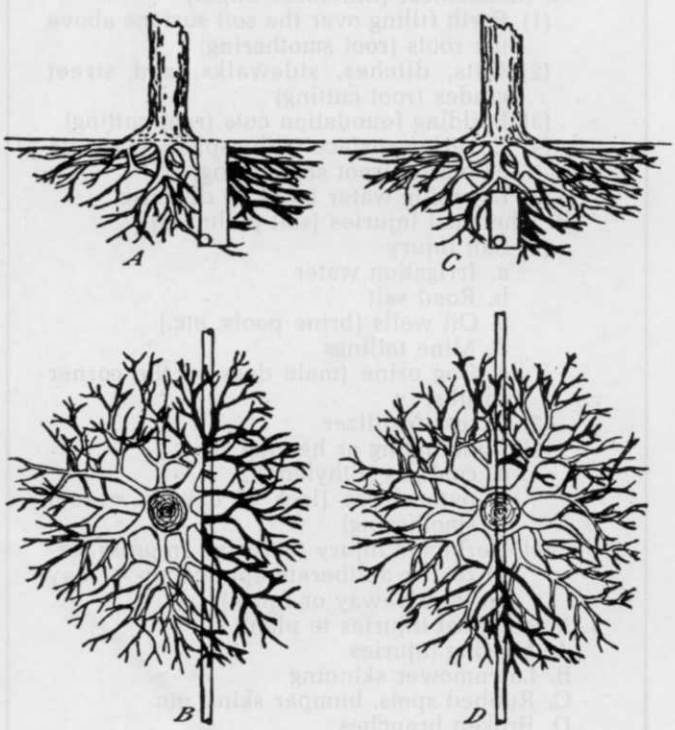
Symptoms

The symptoms of construction injuries often do not show until after the damage has been done, and often not until it is too late to save the trees. The symptoms of root suffocation (earth fill over the roots and dams raising the water level) are that the leaves turn yellow, with a general discoloration, the transitions from discolored to green parts are gradual.

Elms will die from saline irrigation before oaks will. Evergreens are often more susceptible to pollutants.

Control

The control of some of the construction injuries is possible after the damage has been done. It is expensive and difficult, and involves the excavation around the trees, the sterilization of the bark (some use alcohol, I have used 10% bleach), and the recreation of proper drainage by the installation of the drain tiles and French drains as shown in the following section on prevention. The drainage must be returned to the original soil level; this is usually easy to detect by the organic matter layer (or dark soil layer) at the original soil line. These construction injuries are much easier to prevent than to cure, so the major emphasis is placed on the prevention.



Root severing from trenching near tree. Fewer roots are severed by trenching directly to the trunk of the tree (D) and tunneling under the base (C) then trenching alongside (A,B). Severed roots are shown as black.

Reducing damage to trees during construction

A. Maintenance of the original soil surface and drainage level is the most important part of preserving the living tree.

1. Maintain the original soil surface if possible. The duff is full of fine roots. Removing the duff layer removes the fine roots and removes important sources of nutrients and important structural features.

2. Maintain the original drainage level. The roots are in one or two narrow strata (one in the surface duff, the other just above the normal water table) any change in drainage either smothers the roots by inundation, or leaves them high and dry without moisture.

3. Where the grade must be lowered for a street, maintain the surface around the tree and build a retaining wall.

4. When filling, use drain tiles or French drains (covered ditches partially filled with coarse gravel) to maintain the original drainage level.

5. Avoid creating dams. House foundation footings are the most common dams. Trees die on the uphill side of the house, or in the courtyard.

B. Protect trees during construction.

1. Protect against skinning, barking, bumping, and the like.

2. Protect against soil compaction by tractors, trucks, etc.

3. Protect against root smothering from earth fill over the roots. Planks or slabs fastened to the tree do not protect the roots.

C. Keep root cutting to minimum. Keep the trenches beyond the crown drip-line, or tunnel under the tree. The figure on this page illustrates how cutting beside a tree cuts more roots off than going directly under it.

D. When fill around the tree is necessary, maintain the bark free from soil contact by constructing a mortarless wall around a well.
Do not fill to reduce brush killing for sod establishment. Sod only where necessary construction fill demands. To preserve the soil level and the trees, mow the brush and insert grass cuttings without fill. Keep the brush mowed until grass crowds out the woody plants and weeds.

E. Maintain original drainage line at the old soil surface by drain tiles, French drains or both.

F. Trees must be watered at the original soil line where there is fill. Therefore the bell tile openings should be lower than the surface to allow rain-

water to flow in. Well water and public water supplies usually have enough salt to cause injury when the amount of rainwater is reduced for prolonged periods. Tile tops should be protected from debris.

G. A superior type of well for preserving the tree roots through earth fill is the open dry well.

H. After the construction and change in grade, prune the leafy crown to reduce the leaf area by the same amount that the root area has been reduced. Assume a fifty percent reduction as the usual minimum. Prune by cutting out twigs. Cut every other twig to reduce the crown 50 percent.

Excess Watering and Saline Irrigation

Excess water can damage trees in three ways: (1) Daily watering smothers the roots by keeping them wet and sealing the soil surface which prevents the oxygen in the air from getting to the roots. (2) Slightly saline irrigation water that is satisfactory for irrigating lawn grass and many annual crops causes a buildup of salt in the leaves of perennials until toxic levels (more than 3000 ppm chloride) are reached. The salt is left behind in the leaves similar to the residue left behind in distilation. (3) The third type of excess watering problem is a longer term result that becomes evident after a few years. Water with high sodium content leaves residues of sodium in the soil. The plants take up the chloride, but the sodium is left behind. The pH of the soil goes up to more than 8.3 as the sodium accumulates. The condition that develops is called "black alkali", the structure of the soil collapses and the trees die.

Most chemistry laboratories can test the leaves for chloride and the soils for pH and sodium content. The soil can be tested for chloride as well, but we have not found the chlorides accumulating in the soil. The irrigating water can be checked in laboratory tests as well, but there are probably published data on the salt contents of the water.

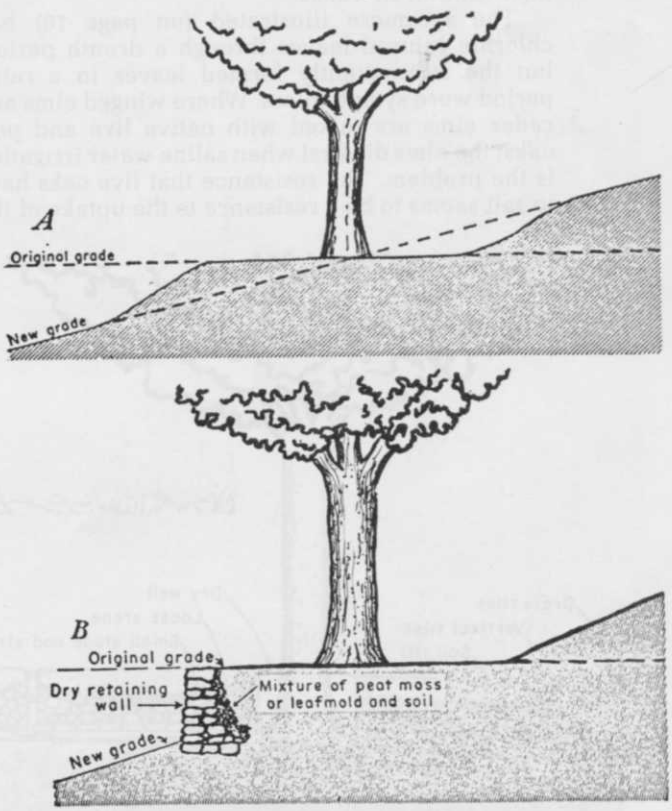
To determine what salts are present in the irrigating water, check the state reports of water quality. In Texas the Department of Health, Division of Water Hygiene has the salt contents of all public water supplies and publishes these analyses in a book (Texas Board of Health 1977). For information on salt in private water supplies, The Texas Department of Water Resources has books on water quality for most counties (Texas Department of Water Resources 1977). The salt contents of waters in most aquifers and many individual wells are listed.

The level of salt content in the irrigation water which is sufficient to start injuring the perennial vegetation is dependent upon the evaporation rate, the amount of rainfall, how long the plants have gone without rain, and the habits of the homeowner who is doing the watering. All of the public water supplies with their dissolved ion counts presented in the following table have been associated with salt injury and high salt contents in the leaves. On the basis of this information, it would seem that outdoor watering in a subhumid region with water containing more than 45 ppm chloride is likely to produce toxicity problems in trees. House plants, greenhouse plants, and other plants in containers under roofs where rain cannot fall usually have salt problems unless they are watered with rain water or condensation water from air conditioner coils.

In the northern parts of the United States and in the mountains where snow is common, salt is often spread on the roads to melt the snow and ice; this is concentrated by snowplows and in drainage-ways. The salt injury is common in parking lots where the salted snow is piled up around the ornamental trees and shrubs. On curvy mountain roads and switchbacks the salted snow is pushed off the roads

Table 1. Concentrations of selected ions in public water supplies.

County and City	Reaction	Calcium Ca	Magnesium Mg	Sodium Na	Sulfate SO_4	Chloride Cl	Total Dissolved Solids	Total Hardness
	pH	ppm	ppm	ppm	ppm	ppm	ppm	
BRAZOS CO.								
Bryan	8.4	2	<1	188	<4	48	670	34
College Station	8.5	2	1	317	<4	99	1100	10
TAMU M. Camp.	8.4	4	1	205	7	56	730	12
TAMU Annex	8.5	3	1	239	<4	63	840	12
TAMU Univ. Ac.	8.3	10	<1	456	220	329	144	26
DE WITT Cuero	8.8	10	2	255	42	152	860	31
KERR Kerrville	7.8	72	36	27	27	47	590	340
LIVE OAK Geo. West	8.1	54	14	319	227	272	1260	195
Three Rivers	7.2	274	1	121	356	249	1290	690
TRAVIS Austin	9.5	18	14	28	33	52	201	103
WICHITA Wichita Falls	7.7	43	7	72	27	137	404	137



Preserving a maximum number of roots through a general grade lowering by terracing (A) and erecting a dry retaining wall (B).

on the outside of the curves and tree injury or death is often found in such places.

Symptoms

The symptoms of root suffocation from too frequent watering are the same as those for earth fill and natural gas leaks. The leaves turn yellow, the discoloration is generalized, and there are no rapid gradations between the different colors seen on the leaves.

The symptoms from salt vary somewhat between plant species, but the peripheral scorch is quite characteristic. There is some variation between geographical regions. If saline irrigation water is applied after the leaves have reached full size in the spring where rainwater permitted full size growth, a grey or brown perimeter scorch with a definite edge on the discolored part develops.

This sharp edged peripheral burn usually has a dark line along the edge of the scorched area in Texas. Michigan chloride injury from snow melting salt has a similar distribution of scorched area on the leaf, but the color change is more gradual and there is more yellow between the brown and green areas. In Texas, leaves formed after the irrigation season starts are often dwarfed. No such dwarfing was seen in about 20 comparitive samples of Michigan leaves.

The high chloride content leaves were the same size as the symptomless check leaves which contained no measurable chloride. High chloride contents in leaves do not persist through periods of high rainfall in Texas.

The sycamore illustrated (on page 16) had chloride injured leaves through a drouth period, but the subsequently formed leaves in a rainy period were symptomless. Where winged elms and cedar elms are mixed with native live and post oaks, the elms die first when saline water irrigation is the problem. The resistance that live oaks have to salt seems to be a resistance to the uptake of the salt in the water by the roots of the tree. The elm leaves in a mixed stand always have much higher salt contents, but both elms and oaks start showing necrotic symptoms when the choride reaches 3,000 ppm in the leaves. Other species that are susceptible to salt and thus are good indicators of salt problems are sycamores, American elms, maples, ginkgo, sweet gum, and American holly. Yaupon, citrus, live oak, Chinese holly, Chinese tallow, and yuccas are among some of the more salt resistant trees.

Where there is a continuous source of saline water, such as by a leak in a water pipe, the leaves will often be dwarfed, even those that form in the spring. This can happen where the chloride levels in the leaves reach 1,000-2,000 ppm. Live oaks can develop thin crowns and dieback in addition to the dwarfed leaves where a continous source of saline water is available. Trees next to drainage-ways may get more salt than their neighbors.

Where there is an excess water problem on a lawn, the first symptom is often a yellowing of the leaves. This may indicate root suffocation, salt injury, or both. Next there are usually peripheral scorches present on the leaves from the salt. In cases where black alkali develops from excess sodium in the soil, in addition to the perimeter-scorch-chloride symptoms there will be dark brown discolorations. These dark brown discolorations have a sharply defined margin.

The damage and dieback of the trees takes a few years to develop. It usually starts in the center of the area to which the excess of water is being applied. The trees at the edge of the perched water pool live longer, since they have less root smothering and total water than those in the center. The effects of the alkali from the sodium build-up also seem to be worst in the center of the perched water pool. The alkali build-up is indicated by pH's above 8.3 in soil tests (The highest pH calcium can

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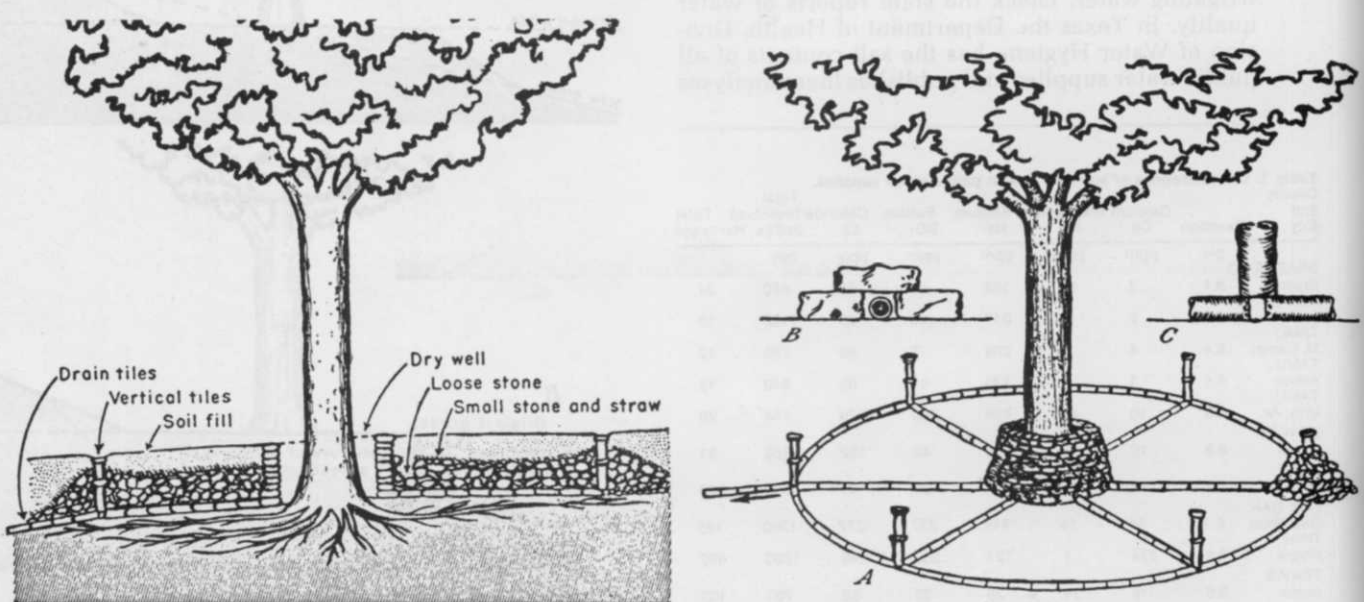

Completed dry well and fill cross section (left). Construction layout prior to filling (right). Tiles on ground are sloped away from trunk and roots. Vertical tiles permit additional air circulation. Stones around tiles provide support during fill placement.