tially of infectious origin. With the ultimate discovery as infectious agents, of those self-duplicating submicroparticles, the viruses, the infectious disease acquired a new dimension that reinforced the association between disease and infection. Often the terms infection and disease were, and still are, linked together as essentially interdependent.

From that time, the concept of disease, resulting from any other cause than infections, has had but grudging acceptance by both pathologists and laymen. But the discovery that viruses and other infectious agents may be transmitted by insects, and that insects are much affected by the environmental influence of temperature and moisture, led to a reappraisal of the influence of the environment as a primary cause of disease without infection.

Later, it was discovered that certain plant vitamins are necessary to prevent certain human diseases, and that nutritional elements are needed to prevent plant disease.

With this information and the knowledge that availability and absorption of such elements are dependent on the chemistry of the soil, the concept of noninfectious disease was strengthened. More recently, a continuing series of new and troublesome tree diseases have been found for which there are no known infectious agents.

Examples of such diseases studied intensively within the past two decades are: White Pine Needle Blight, Birch Dieback, Pole Blight of Western White Pine, Sweet Gum Blight, Little Leaf Disease of Southern Pine, Ash Dieback, and Maple Blight, Dieback or Decline.

Disease Cause Twofold

Even more recently the knowledge that natural (as well as manmade) radiations may cause diseases of noninfectious origin, has emphasized the point, that a perfectly valid concept of tree disease must include the noninfectious as well as those truly infectious. The purpose of this paper is to explore some of the basic factors, which are the direct or indirect causes of noninfectious disease and how they operate. Considerations of time and space make it necessary to limit the discussion to the imbalances of temperature and water. Cold injury and freezing are discussed in this installment.

Cold Injury

Which of the natural environmental factors significant in direct plant injury is most harmful to trees in causing disease? Probably low temperature brings the most trouble, because it is known to be a limiting factor in geographic distribution of species of trees as well as other plants. In addition, temperatures damaging to trees occur over wide geographic areas and affect millions of individuals of many species. Over an extended period of time, in temperate zones, almost all species of trees may be affected, but there is much variation both between and within species and strains.

Depending on latitude and climate, freezing damage may and does occur at any time of the year. With numbers of trees affected, it is probably most significant on trees in the spring, and is rather rare in summer. After growth has begun, late spring frost may be sufficiently light, so that only thin tissues at leaf margins or between veins may be killed, or it may be severe enough to kill all leaf and stem tissue of new growth.

In the former case, leaves of deciduous trees may appear ragged with interrupted margins and uneven holes. In the latter case, all the new tissue is collapsed, is discolored brown or black, and may break off and fall within a short time. Terminal growth of the year will be lost, and the growth pattern of the tree may be distorted.

Early frost in the fall is much less serious. In its mildest form, it may cause nothing more than premature defoliation, especially to those species whose buds for the next year are set, whose growth has ceased, and whose gradual period of hardening off is well advanced. Species whose growth continues until actually stopped by frost will have succulent stem tissue killed back. With such trees this is considered to be a natural phenomenon. With early frost then, these species are little affected from normal onset of cold weather. Between these extremes, however, are trees whose growth has stopped, terminal buds having been set, but whose tissues are still succulent because hardening has not occurred to any degree. With dieback occurring on this type of species, the terminal buds for the following year often will be lost, and growth may be distorted, as with late spring frost.

For the individual tree, midwinter freezing is probably the most injurious of all cold damage. Trees so affected may suffer dieback of twigs and roots, radial cracking of trunk or branches, or killing of cambial tissue between bark and wood of stems. Since all freezing injury involves drying of tissues as water leaves the cells, such tissue collapses if soft, or contracts if hard. Some tissue is killed outright, some is weakened sufficiently to be susceptible to easy invasion by weakly parasitic fungi, and some is so altered, that it may develop abnormally when growth begins. As the name implies, "dieback" results from death of small, thin terminals, and with increased severity extends inward toward larger stems or roots. Extent of dead tissue is easily detected before new growth begins, by a line of sharp demarcation at the interface of living and dead tissue.

Cold Causes Radial Cracks

Radial cracking or "frost cracking" of stems is, of course, a well-known and conspicuous indication of excessive or sudden cold. Under such conditions a woody stem is affected in a curious way. As the outer tissues of the stem freeze, this tissue contracts faster than deeper, inner tissues. In a vertically oriented stem, such as a standing tree trunk, shrinkage of woody tissue from loss of water is greatest in a horizontal plane. Contraction, through drying of the outer shell, creates a tensile force on these outer cells. At the same time, because of their insulated location in the stem, the inner lying cells are not under such extreme tensile forces. The dynamic stresses between differential contraction of inner and outer wood, force the outer tissues of the stem to separate, and separation occurs along radial lines where cleavage is easiest mechanically. Such cracks occur suddenly with an explosive force and a sharp cracking sound. They may extend from one to

(Continued on page 22)

Encouraging the "V-type" growth in this elm did not add to its natural beauty, and put additional strain on the main crotch.

A Review of

Shade Tree Pruning Practices

For Streetside Line Clearance

BECAUSE of a seeming lack of foresight either on the part of power companies which did not put electric wires underground, or on the part of city street planners and tree planters, there exists today a major need for tree service companies to keep power lines free of encroaching vegetation. This job involves, for the most part, pruning or trimming tree branches so they do not grow into energized wires.

Pruning shade trees prevents, corrects, or improves an undesirable situation. With power line clearance, the problem is tree contact with elevated wires. Contact can: 1. break the wires; 2. cause the wires to "pit" and become weakened; 3. burn the tree; 4. cause a short circuit; or 5. otherwise cause power outage and lack of service.

While it is true that telephone companies are also concerned with tree plantings along their streetside rights of way, their interest is involved mainly with branches which can fall and break wires, and branches which rub wires. Reasons 1 and 5 apply to telephone line clearance also, but it should be remembered that communication wires are not "hot" as are power lines and do not require clearance because of short circuit danger. Telephone wires are often cabled and covered with insulation so any light contact has no effect on transmission. While some operations are done only for electric power line clearance, others apply equally to communication line clearance. In this article, we will concentrate on power lines, because their reasons for streetside clearance are "broader."

Of the three prime reasons for shade tree pruning—(a) appearance, (b) safety, and (c) health—safety is the major reason trees near power lines must be periodically trimmed. In this safety category is included the maintenance of power service in addition to the well-being of people and property beneath the wires and trees.

An emphasis on safety pruning does not give reason to ignore the appearance and health of trees being trimmed.

Five Basic Pruning Types

There are five basic operations which line clearance crews must perform in their routine work. 1. Cutting back ("topping") for overhead clearance. 2. Side trimming for adjacent clearance. 3. Undertrimming ("lifting") for clearance beneath limbs. 4. Directional trimming ("trimming through") to provide "windows" for wires through a tree interior. 5. Removal of dead overhang.

Here we shall use the phrase, "cutting back," as a trimming operation, as opposed to the term "topping," which sometimes denotes the same operation. Topping, however, more often implies the frowned-upon practice of drastic removal of a trunk leader and most of a shade tree crown. This operation seriously injures both appearance and health of a shade tree.

Here is a survey of some problems encountered in keeping streetside shade trees clear of utility lines. A result of another *Weeds and Turf* field research project, the article is meant as a refresher for "old pro's" and an introduction for neophytes or crewmen. *Photos are by Weeds and Turf.*

A saw, not a pole pruner, should have been used on this ragged maple. Snipping away rising twigs, the trimmer left many spindly ones dangling from heavy limbs above, some of which should have been selectively removed.

Cutting back is a procedure of selective removal of leaders from the crown of a tree. This prevents contact with energized wires above the tree. The operation is usually done with a pruning hook, hand saw, and sometimes with a chain saw, if the leader is particularly large. When done properly on an individual branch basis, cutting back becomes a highly refined type of tree trimming. It is both the most permanent and most inconspicuous type of pruning.

Severed leaders are drop-crotched (pruned off at a point flush with an adjacent leader) below the intended height of a tree. Cut back leaders are out of sight and are shaded by other smaller twigs which have simply been tip pruned. The full form of the tree is maintained.

Since the advent of the highly versatile aerial bucket lift, many trimming operations can be easily performed from outside the tree instead of inside. Some trimmers, however, when they get outside a tree, seem to forget what they learned about trimming a tree from the inside.

Ill-trimmed trees have all branch and twig ends snipped off at a common level. Unsightly bare wood of pruned branches protrudes through the sparse leaf cover atop a tree. Overall result of such practice is a bowl-shaped or flat-topped tree which does indeed give overhead clearance, but which leaves the tree scalped and in need of repair. Cutting back can be effectively performed with an aerial bucket lift provided trimmers move in close to the crown to drop-crotch low enough.

Side trimming to accommodate wires close to the edge of a tree is delicate work and should be done with ingenuity and artistry. Reasoning behind side trimming is that indentations can be cut into tree crowns and softened by judicious pruning above and below the indentation. This is done when wires are not actually traveling through the tree interior. Side trimming allows trees and wires to exist side by side.

Tree trimmers simply invite trouble when they mistakenly remove a lateral limb as a side "trim" to accommodate wires which would get along perfectly well with light side trimming. Limb removal leaves a "window" from the outer crown to the main trunk. Although this practice may be thought of as an easy way to avoid trimming a particular tree for a few years, disfigured trees along roadsides generate criticisms of utility companies, frequently the tree trimmer's best customers.

Trees with upright habit, such as elms and sycamores, that are tall enough, can have their lower crown lifted so wires can clear beneath the tree. Since these trees normally grow tall, they should not be suppressed beneath wires, rather guided around them. Once undertrimmed, overhead cutting back is no longer needed each year; retrimming is minimized except for dead overhang removal.

Directional pruning is probably the most skillful and most desirable pruning from the standpoint of both trees and wires. When wires are strung through a tree's interior, skilled trimmers can make "windows" through the street trees to give wires free passage. This is desirable along city streets because both trees and wires are accommodated with minimum injury or displacement of either.

The amount of trimming for directional pruning must be conservative and well thought out before cuts are made. Removal of a single branch instead of two smaller twigs may make too large a gap and defeat the whole purpose of trimming through, which is to make the operation as inconspicuous as possible. Trimming through the top of a tree may eventually cause too great a "V" and weaken the main crotch of the tree.

Dead limb overhang removal is usually an undertrimming operation, though sometimes trimmers must prune stagheads high in a crown. Dead limbs must be removed not always because they are touching wires, but because they may break and fall onto wires, thus interrupting power service.

Dead limbs should be pruned (drop-crotched) to a point behind dead wood tissue. Removal of only part of a dead limb is purposeless. When dead wood overhangs energized wires, it must be moved away from wires and lowered by ropes.

One rope can be used if limbs can be crotched so they don't hang over electric wires. When the limb is cut, it will swing away from wires. When a single rope is used, more than one groundman should hold the rope

or else the line should be snubbed (wrapped) around the tree trunk a couple of times to increase the amount of holding resistance. One man can usually control the lowering speed of a snubbed rope.

Attaching a single lowering rope to a dead limb in a position where it will be somewhat balanced can be dangerous for a climber because dead wood is structurally weak. Rope should be tossed over the limb and pulled in with a pole; then a running bowline knot, pulled taut, secures the rope to the limb.

A man in an aerial bucket lift can more easily attach a lowering rope, if such a lift is available. Trimmers on aerial lifts should remember that the whole weight of large limbs should never be tied onto the lift bucket.

If an overhang cannot be swung away from power lines with a single rope, two lowering ropes must be used along with one or two guide lines. One line, the butt, is tied to the thick end of the limb and passed over a sturdy crotch, then to the ground. The second line, or fall line, is attached to the far end of the limb. One or two guide lines are fastened in the middle or on both ends respectively. Climbers must not attempt to hold or control either lowering ropes or guide lines after cuts are made and the limb swings free; this is the groundmen's job.

At the outset of this article we pointed out that line clearance is safety pruning, and that the other two reasons for pruning, appearance and health, cannot be neglected. There is a problem which limits the amount of conscientious work tree trimmers can do; this is contract restriction.

Many Agencies Trim Trees

Problems arise when tree expert companies are contracted to service trees interfering with power lines. Their contracts and permits usually state only that they will clear limbs and branches away from wires. Power line tree trimmers cannot do any extra work requested by property owners even when asked. Once the lines are free, the job is finished.

Most tree companies take the time to make their trimming job as neat as possible, but if trees are on public property it becomes the job of city tree crews, not power company employees, to beautify them. If trees are privately owned, individual residents must purchase private service to have complete pruning.

Therefore, since power line tree crews are not permitted to service whole trees, the jobs they do must be as neat as possible. Tree crews who leave a privately owned tree in need of corrective pruning, when the tree truly did not need pruning at all (were it not beneath power wires), create ill will among the utility's customers.

Private power companies usually receive blanket permits from cities to trim municipal trees when power lines are erected on tree lawns, parkways, or other city property. Where only municipal power lines and municipal trees are involved, an interagency understanding is all that is needed for tree trimmers to perform their work. No extra permit is needed from streetside residents.

Trimmers usually refrain from trimming trees when homeowners complain that they don't want the trees trimmed. Even though the residents have no legal complaint, the trimmers usually pass the trees by and report the location so a city man can call and "keep peace in the family."

When lateral electrical wires extend over private property, however, rights of way must be obtained by a power company or municipality trimming crew from each resident. This is a time-consuming job done to comply with law and preserve power company customer good will.

That more than one crew must work on a tree (in some instances) is unfortunate. But line clearance crews cannot work for two employers at the same time, and wires must be cleared more

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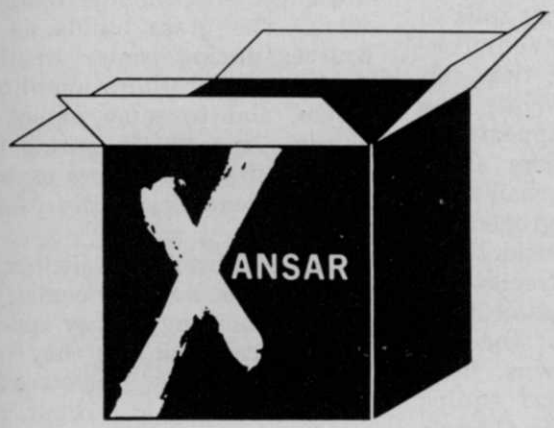

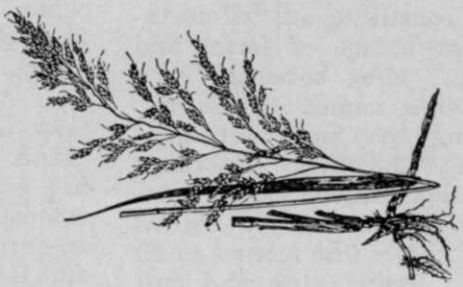

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Turfgrass Portraits II:

Fine Fescues

By DR. ROBERT W. SCHERY

Director, The Lawn Institute

Marysville, Ohio

This is the second in a series of nine articles on basic traits and maintenance procedures for common turfgrasses. Next month author Schery discusses bentgrasses.

FINE fescues, the red fescue group, constitute an "all-northern" assemblage of forms and varieties. Most botanical varieties were named in Europe, including the important commercial "Chewings," *F. rubra commutata.* Hitchcock (*Manual of the Grasses of the United States*) shows fine fescues in all except a few prairie and gulf states. But they are most at home in the more northerly regions, volunteering widely in western Canada. "Meadows, hills, bogs and marshes in the cooler parts of the Northern Hemisphere, extending south— to the San Bernardino Mountains—New Mexico— the Allegheny Mountains and Atlantic coastal marshes to Georgia."

Chewings fescue was for many years cultivated in New Zealand, and imported into the United States. Poor production or shipping conditions during the long boat haul often resulted in inferior seed, and today main source of Chewings is from Oregon, of top quality.

The fine fescues have many remarkable attributes that make them first-rate lawngrasses, especially useful when combined in seed mixtures with Kentucky bluegrass. In the lawn, fine fescues are of delicate texture, dense, dark green. The tightly clustered culms (tillers) bear thin, somewhat wiry basal leaves, which tend to curl (the margins roll in) during dry weather. The loosely fibrous, reddish sheaths are persistent near the crown, a good distinguishing feature.

To a greater or lesser extent these fescues spread by rhizomes, although not so notably as does Kentucky bluegrass, the extent depending partly upon variety and partly upon cultural conditions. Seedheads are never much of a problem on densely seeded lawns regularly mowed.

Except that their lasting qualities are poor in hot climates, fine fescues are exceedingly well adapted. They thrive on everything from peaty, boggy soils to dry, sandy, or rocky environments. As to fertility, they can take it or leave it. While fine fescues have better appearance when fertilized, seldom is it necessary to use more than 2- or 3-lbs. elemental nitgrogen/M/year with them,—considerably less than voracious species demand. In a seed mixture they are good insurance for the less intensively tended lawns. This exceptional hardihood equips fine fescues to survive in difficult locations—sandy, wind-swept spots, for example; or dry, sterile parts of the lawn; and in the shade, in competition with tree roots, where the going is too tough for other grasses.

Obviously, fine fescues are excellent low-maintenance grasses, self-sufficient, recuperative.

Fine fescue seed is of medium size, small enough to be a bargain by the pound (over a half-million seeds to the pound), yet large enough to pack sufficient food for seedling vigor.

In seed mixtures fine fescues make green cover relatively quickly; the need for quick-sprouting impermanent nursegrasses is accordingly diminished.

Fine fescues are similar in appearance to Kentucky bluegrass, these two important species blending well together, profiting from the same general care. Fescue loss, when it occurs, is usually in hot weather, especially if the turf is succulent from generous nitrogen fertilization. But spring leaf spot that so besets bluegrass is not so serious on fescue, a good argument for fine fescue in a bluegrass blend. Nor are the fine fescues touchy about pesticide treatment at recommended rates, lending themselves to selective elimination of pests. Occasionally there may be temporary browning or thinning, with some of the less usual chemicals such as Zytron.

Growth Pattern

Fescues follow essentially the same growth cycle outlined for Kentucky bluegrass in Portrait No. 1 (*W&T*, July, p. 12). Autumn is most favorable for new plantings, and for improving old turfs. The grass builds its resources during cooler weather, thickens by proliferation of new tillers, and to some extent by rhizome spread. In spring this husbanding of resources pays off in a resplendent, tightly packed sward of new shoots.

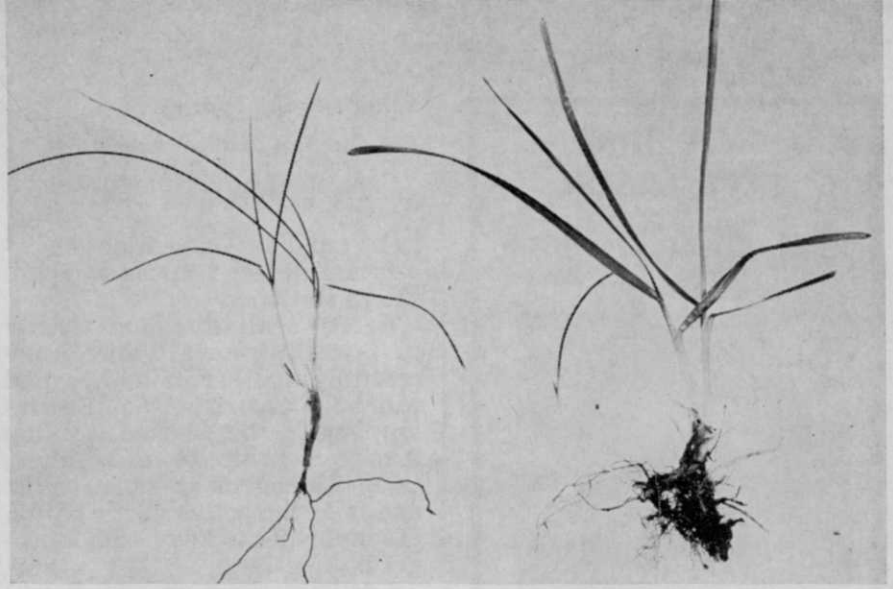
Fine fescues mow a little more difficultly as summer comes, the leaf tips tending to fray and develop "gray hair" as they turn more siliceous. Hot weather decimation may also occur, giving an irregular turf with thriving patches alternating with slumping grass. To lessen disease avoid heavy nitrogen fertility in hot weather, and mow considerately high—1½ inches would be the minimum.

Adaptation and Preferences

Fine fescues can be recommended in just about any area where Kentucky bluegrass survives. They might not be quite so tolerant of the wind-swept plains as is bluegrass, although even in eastern Kansas and Nebraska certain selections behave satisfactorily. Unexpectedly, they have been reported to do reasonably well in difficult coastal plain sites as far south as the Carolinas! But fine fescues are at their best in cooler regions, or at higher elevations. They do

make very attractive temporary winter cover in the South, handled then as an annual.

Maintenance requirements with fine fescues are certainly not onerous. Casual fertilization suffices, and fescues may even resent heavy feeding. A pound or so of elemental nitrogen per M is suggested for autumn, an equivalent amount through spring and summer depending upon soil and climate (avoid hot weather feeding). Irrigation is not vital, except on sand or insofar as is needed to maintain the turf attractively green; fescues sit out drought well, revive when conditions turn favorable. Weeds can be removed safely with the 2,4-D family of chemicals, and fine fescues are reasonably tolerant of crabgrass preventers and crabgrass killers.



A fine fescue plant (left) and a Kentucky bluegrass plant (right) as they appear in typical mowed turf. Note most of the distinguishing features and similarities discussed in the text here and last month, when Dr. Schery examined the bluegrasses.

Propagation

Fescues are propagated by seed. Total disappearance of fine fescue seed in this country nearly matches that of bluegrass, between 20- and 30-million pounds annually. In the last few years about half of this has been imported, chiefly from Canada. Most imported seed is without varietal distinction, marketed as "Creeping Red fescue."

Domestically, a well-managed fine fescue industry has sprung up in the Pacific-Northwest, principally in Oregon. Some Creeping Red fescue is grown, but improved varieties such as Chewings, Illahee, Pennlawn, Rainier and others have been developed. Fields are carefully tended, with weed control, fertilization, hygienic burning, and solicitous harvesting. Seed can usually boast at least 95% purity and 90% germination. Not uncommonly it will be entirely weed-free and over 99% "pure."

Fescue is usually sowed 3 or 4 lbs./M or in seed mixtures (usually with bluegrass) 2-3 lbs./M. The seed handles nicely in modern spreaders, and if the seeding is watered and mulched, fescue plants will be visible in about a week of warm weather. Fine fescue seed may lose germination if not kept dry, especially it it gets hot. For safekeeping storage should not exceed room temperature for a prolonged period.

What to Watch Out For

The usual lawn afflictions bother fine fescue, too. Fortunately, under the "modest living standards" fine fescues generally fall heir to, pests are not apt to be so troublesome as with pampered swards.

Couch lists over 25 diseases that can be found on fine fescues. Of these only summer loss is serious (presumed due chiefly to Helminthosporium). Helminthosporium ("leaf spot") can be at least partially prevented with conventional fungicides such as Actidione-thiram, Captan, Dyrene, Maneb, Tersan OM, Thimer, etc. Biweekly treatments during summer may help hold turf through its most difficult time of the year. But seldom is the disease so serious on moderately fertilized grass as to cause complete loss. Brown patch, Pythium, and snow mold in winter may occasionally cause trouble. Rust is not a problem.

Sod webworms, grubs, and occasionally chinchbugs attack fine fescues. Treatment is conventional,—thorough coverage with an insecticide to which the pest has not developed resistance. Chlorinated hydrocarbons such as chlordane and dieldrin can be soaked into the soil for grub control; in most areas these are still effective against sod webworms, but where not, phosphatics such as Diazinon, or newer insecticides such as Sevin, may have to be used. A switching-around with insecticides is especially necessary with chinchbugs, creatures of well-recognized ability to develop resistance.

Varieties

Varietal distinctions between fine fescues are not easily evident. Now one variety, now another, seems to have slightly better quality. Differences are chiefly physiological, for almost all varieties look quite alike in the lawn. Pennlawn was developed at Pennsylvania State University, from the natural crossing of three disease-resistant selections. It is well thought of in the eastern United States. A Minnesota seedhouse has had especially good luck with Rainier. Chewings and Illahee (an Oregon selection) have been long regarded with favor. Olds and Trinity are other names less frequently encountered. At the Lawn Institute we have been hard put to see much difference between varieties, all domestic ones performing ably when properly tended.

In summary, the fine fescues are a basic component of North American fine turf, especially in seed mixtures for home lawns. For difficult and uncertain conditions they have few peers. Summer thinning, and resentment of low cutting, are the only weaknesses of much concern.

Arborists' Big Job:

Cut Out The "Little" Accidents

(Continued from page 8)

he's taught. On-the-job showoffs usually end up as compensation statistics.

Safety seminars, held weekly or biweekly, have worked successfully in other industries, and can help arborists, too. Seminars should be started by top management to be most effective. Management must enlist and hold the active participation of employees to keep such a program effective.

Lectures don't work. Visual aids and demonstrations help men retain what they're taught. Seminars should combine technology with safety, e.g. "How to use lopping shears safely." One lesson on lopping shears, then a lecture on "Be Safe," will not come across.

Employees can also participate in demonstrations for the benefit of their co-workers. Graphs of past years' accidents compared with current performance will give men a competitive feeling.

Set Proper Example

On the job, field supervisors and foremen have to know and practice safe working habits. They must set examples for newer employees. They should reprimand workers using unsafe methods. Foremen who let minor infractions slip by, open the way for minor accidents—the kind that inevitably cause injury and increase insurance rates.

Tree companies usually work from widely spaced trucks, which may or may not be stored overnight at a main office. Safety posters on an office wall don't help the man in the field. However, posters installed in truck cabs (away from public view) remind men to and from work of the company's safety message. These posters have to be changed regularly so they don't become sour.

Many of the tree experts "safe," easy-to-use tools cause accidents: hand saws, pole saws, power saws, shears, axes, brush hooks, and even gouges. Small checklist labels stuck on exposed parts of these tools will attract attention and remind men to make certain the tool is operable, to see that there are no other men near who could be harmed, or that the operator has no loose sleeves or pants cuffs which could catch in the tool, etc. Checklist instructions are a very helpful learning method.

Both truck posters and tool checklists are meant to supplement safety seminars and shouldn't be substituted for such meetings.

Our last suggestion is Employee Safety Courts. Several men (employees) sit on a "jury," and periodically hear reports of accidents from those involved. They determine the degree of guilt; whether there was negligence or whether the person involved did foresee hazard and take necessary precautions. For instance, a man who dropped a power saw onto his own toe and was injured because he forgot to wear his steel-toe shoes, would be found guilty of negligence; he would receive a designated number of points against him.

Discipline for reaching the maximum number of points is usually decided by management. This court system has worked in other industries and should work for arborists also.

If tree service accident statistics could be separated, the half tabulating those hazardous jobs arborists perform, we believe, would be more respectable. Supervisors have taught their specialists to recognize hazards and work safely with them. Although safety training for aerial workers cannot be neglected or reduced, groundmen have to be shown how to do their jobs properly, too.

Calchem Builds Pilot Plant

A pilot pesticide plant designed by the Ortho Div. of California Chemical Company to accelerate market and process development of its new pesticide products is under construction at Richmond, Calif. Completion is scheduled for January.

According to W. G. Toland, Manager, Research and Development, this intermediate facility between ordinary pilot plant operation and complete commercial installation, will provide a practical study of process techniques and equipment which can be used in the design of full-scale production facilities.

Streetside Tree Pruning

(from page 14)

often than private homeowners are willing to pay for.

Tree crews have a double duty to protect the good will of their contract employer, and, just as important, the good reputation of their own company.

Consider Health of Street Trees

Health of a tree cannot be overlooked even when trimming for safety. All pruning cuts under 1-inch diameter should be made neatly so they will heal rapidly. In the case of limb removal (over 1-inch diameter), flush cuts of laterals heal faster when no stubs or heels protrude. Stubs tend to decay and pave the way for invading insects and fungi. Deep cavity wounds are sometimes caused by stubs left when trees are trimmed.

Limbs are removed with four separate saw cuts. The initial undercut, 12 to 18 inches from the parent limb or trunk, is followed by a jump cut 1 or 2 inches farther out. This procedure removes the bulk of the limb by natural breaking and prevents saw binding. Undercutting keeps the bark from peeling when the cuts are made without lowering ropes. The stub is sawed flush by two cuts, first under then over; this should be made as near the parent limb as possible without sawing the bark of the parent limb. All cuts over 1-inch diameter must be painted over with a wound dressing. Dressing must completely cover the exposed wood but should not be applied onto the live bark.

Heavy-duty, compressed-air pruning hooks used with aerial lifts can sever branches larger than 1 inch very easily. Because these cuts ("shiners") are made with a pruning device does not, however, mean that they need not be painted with wound dressing.

Another point to consider about tree health is internal disease. This consideration is especially important when trimming trees such as the London Plane, *Platanus acerifolia*. The possibility that a tree is diseased with cankerstain organisms should not be overlooked.

Tools can be sterilized in denatured alcohol after each tree is pruned to prevent the spread of internal disease to other trees. A trimmer who prunes a diseased tree (in any season), and then goes on to trim healthy trees, may infect the tree with every saw cut, because of the disease organisms on his saw, pruners, and in his scabbard.

Pruned limbs from diseased trees or disease-suspect trees should be disposed of separately from normal trees. Experts advise that diseased Plane trees, for instance, be burned as near the site of cutting as is feasible.

In summary, tree expert companies under contract to power companies perform what is commonly called safety trimming along home-lined streets. They cannot for the sake of the trees, their customers, or employers, neglect the overall appearance and lasting health of the trees they prune.

These Siberian elms, author Zukel says, were pruned to the same size in April. Trees on the right were sprayed to drip point with MH. This photograph, taken in August, shows degree of growth inhibition.

Slowing Tree and Shrub Growth With Retardant MH-30T

by DR. JOHN W. ZUKEL

Biologist, Naugatuck Chemical Division
United States Rubber Company, Bethany, Connecticut

SIX YEARS ago utility companies spent 125 million dollars a year hand pruning tree growth under transmission lines. The rise in labor costs and addition of new customers has rapidly increased these costs. Pooling resources through the Edison Institute, utility companies have been supporting research since 1958 to reduce hand pruning costs.

A similar hand pruning problem of trees and shrubs exists for cities, parks, and homeowners. No cost estimate is available in this area but the expenditure is considered excessive by cost-conscious maintenance men.

Chemical plant growth inhibition started with Naugatuck's discovery of maleic hydrazide in 1947. To date there have been over a thousand research reports published on various uses of maleic hydrazide (or MH). These include many references to tree and shrub inhibition.

For example, vegetative growth inhibition of peach, cherry, and apple trees was reported from Pennsylvania in 1951 and Michigan found that red maple, American and Chinese elm, and weeping willow were inhibited by MH spraying.

The experiments on shrubs include treatment of a 100-foot pyracantha each year for 13 years. Pruning labor has been markedly reduced and the shrub showed no adverse effect from the treatment.

Our research group started a demonstration program using maleic hydrazide on shade trees under power lines and in city streets in the western states in 1963. This work was done in cooperation with cities and utility companies, such as Pacific Gas and Electric Company in San Francisco, the largest in the West, neighboring Oregon, and Washington.

Some 2000 trees were treated in 1963. These included sycamore, willow, alder, poplar, oak, eucalyptus, mulberry, black walnut, maple, sweet gum, elm, and tamarack.

The first year of commercial use, 1964, was the result of response from the 1963 experiments. This year the demonstrations were extended throughout the United States.

Results

The one application per season to either trees or shrubs controls growth for that season. The inhibiting properties of MH-30T gradually wear off and regrowth occurs.

Methods of Application

The formulation of MH, MH-30T, is diluted 1-1/3 gallons in 100 gallons of water and sprayed to the drip point. The tree is first trimmed to the proper shape and treatment is made when regrowth is out for two to four weeks. The MH is absorbed through the green leaves, then moves to the new growth areas to inhibit further growth.

Best results are obtained when vigorous new growth is sprayed. In spring, treat trees after the leaves have expanded and new growth has started. In areas where new growth follows summer trimming, the spray is applied when the new growth is two to four inches long.

For tree top control under utility lines MH-30T is applied at least halfway down the tree. This procedure prevents development of shoots from the interior of the tree. The same principle holds if side or bottom control is desired. Half the distance within the tree should be sprayed on the side where inhibition is desired.

Inhibition of Shrubs and Ivy

The plants should first be pruned back into the desired shape. After regrowth of 2 to 4 inches has taken place, spray to the drip point with 1-1/3 gallons of MH-30T in 100 gallons of water.

MH-30T can also be used in spring as soon as new leaves have expanded to inhibit further growth.

The following shrubs can be treated: privet, pyracantha, Myrtus, Xylosoma, Viburnum, Eugenia, Pittosporum, Cissus, Hahns ivy, Algerian ivy, honeysuckle, forsythia and icicle plant.