# SPRING IRRIGATION PRECAUTIONS INSURE DESIGN PERFORMANCE

**By Michael Morey,** Irrigation Consultant, Dallas, Texas

With the onset of spring season fast approaching, it is time to start thinking about turning on the irrigation system. The following is a general guide, and in no case should this be construed as specific procedure.

For those of you who do not have a plan of your irrigation system, get one! The person or firm who designed the system should be able to provide you with a copy of the plan. If you do not know who designed the system, contact the contractor that installed the system and ask for the name of the designer or for a copy of the plan. The fee (if any) for this would be minimal ($5.00 to $10.00) and would be a worthwhile investment. An "As Built" plan, which should be provided to you once the installation of the system is completed, will show the location of Drain Valves, Manual Valves, Electric Valves, Sprinkler Heads, Piping, etc., along with dimensions from existing structures such as buildings, walks, curbing, etc.

Once you have a plan, study it and become familiar with the system in regard to location of the Water Supply, Drain Valves, Control Valves, Controller, etc. When you are familiar with the above, you will need to close the Manual Drain Valves (see Fig. 2-2), which should have been left open during the winter. If your system is located in an area of the country where it is common to "winterize" by the use of a large air compressor, you may not have any Drain Valves located on the sprinkler main, although there may be some located near the Supply Valve and Control Valves. If you cannot locate any, do not worry; should any be left open they will be obvious when the water is turned on.

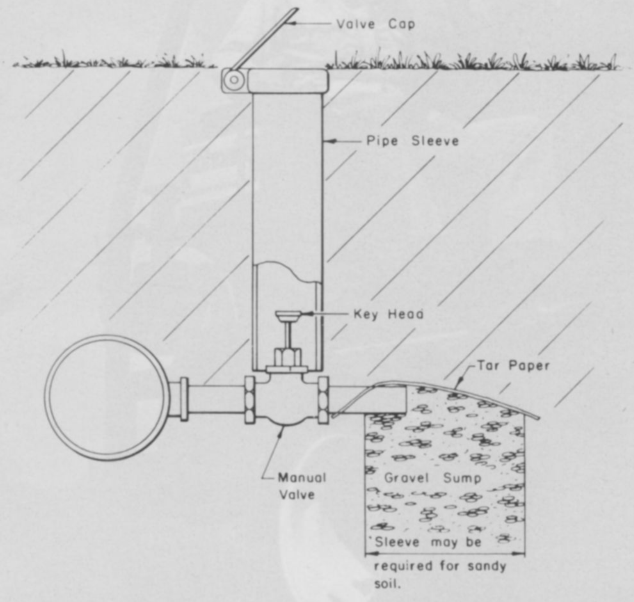


**Figure 2-2** Typical Installation of Manual Drain

After all Drain Valves have been closed, make sure the Controller is off. Now turn the Supply Valve on only enough to allow a small flow of water into the Main Line. If you turn the valve on too fast, it will create a surge of water rushing into an empty main line and can easily cause a rupture in the sprinkler main.

This small flow of water may take quite some time to fill the sprinkler main, but this time used waiting for the line to fill is better spent than time used to repair or replace a ruptured Main Line. While the Main Line is being filled, walk the site and look for any Drain Valves which may have been left open, or for any leaks.

If you find any leaks, immediately turn off the Supply Valve and reopen the Drain Valves to drain the sprinkler main. Repair or replace the affected portion of the sprinkler main and then follow the above procedures to refill the main line.

After the sprinkler main is filled, inspect each drain valve, and using your valve key, open the drain partially to release any trapped air and also to flush any debris from the valve. Should any of the valve sleeves be filled with dirt, gravel, etc., now is a good time to dig them up and clean out the obstructions; if not done now, it will need to be done before the fall season. It is also a good time to install hinged valve caps with locking covers on those sleeves. This will prevent the cap from being lost or sucked into the power mower and also prevent anyone from opening them and dropping debris down the sleeve.

When you are sure that the sprinkler main is not leaking, go to the Controller and turn on the number one (1) controller station. Leave the Supply Valve only partially open and allow the piping in the number one (1) zone to fill until you can see water discharging from the sprinkler heads. Follow the same procedure for the remaining controller stations; do not open the Supply Valve fully until all zone piping has been filled.

If you detect any leaks, repair them and check the repair before backfilling the area. If any zone in which you find a leak supplies water to "gear-drive" sprinkler heads, remove the heads and flush the lines to remove any sand or debris. This sand or debris may have backwashed into the zone piping due to the leak. If this is not done, the sand and/or debris could damage the internal assemblies of the heads.

Once all the zone piping is filled and you have opened the Supply Valve fully, check all zones for proper operation. It is best to flush lines with the Supply Valve fully open. This will provide adequate pressure and flow to completely remove debris before reinstalling any gear-driven heads which you may have removed.

When checking the heads for proper operation, turn a zone on and make a visual inspection:

1. Are all heads discharging approximately the same amount of water?
2. Is the arc of coverage proper? (check plan)
3. Do any nozzles seem to be plugged?
4. Are any heads leaking or broken?
5. Are all heads operating as per plan?

*Continues on page 33*

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If any nozzle seems to be plugged, remove the nozzle and turn the zone on momentarily to flush any debris from the head. Reinstall the nozzle and turn the zone on again to check for proper operation. If there still seems to be a blockage, remove the complete sprinkler head and check for an obstruction in the inlet of the head or in the fitting(s) under the head.

Check the wiper seals on the sprinkler heads (see Fig. 2-3); if they are leaking, replace them. A worn

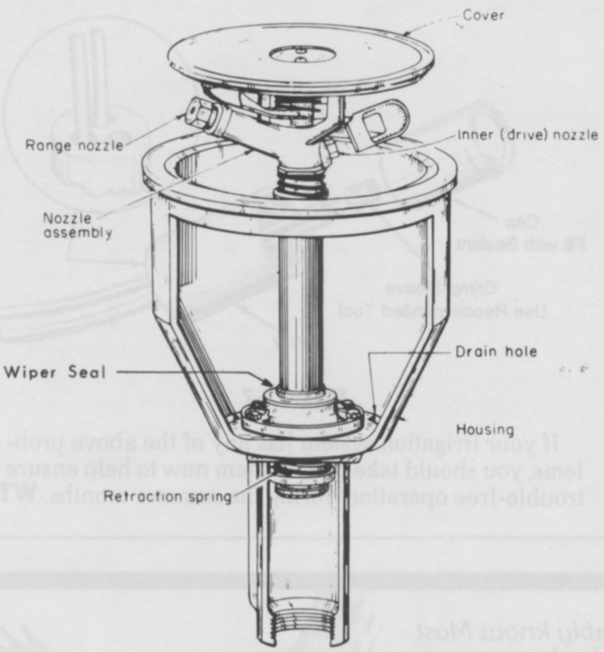



**Figure 2-3**

wiper seal in only one sprinkler head can waste approximately one thousand (1,000) gallons of water per year.

When turning off zones by the use of the controller, take note of the length of time it takes for the valve to shutoff. This time should be from 2-7 seconds, with the normal being 4-5 seconds. If a valve requires 10 seconds or more to close, the orifice(s) in the valve diaphragm and/or the exhaust fitting may be nearly plugged (see Fig. 2-4). If so, locate the valve and turn off the sprinkler main (Supply Valve) and open the

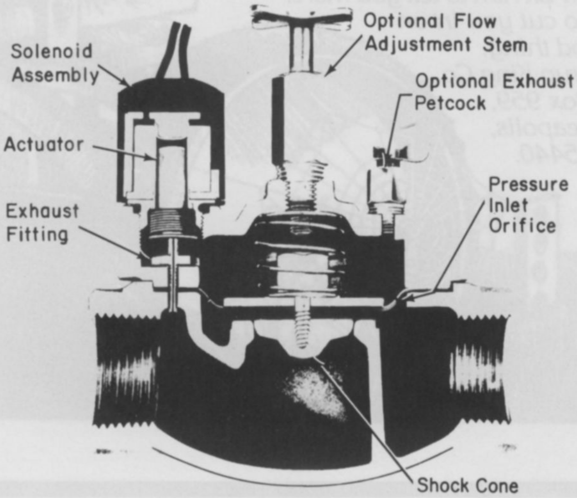



**Figure 2-4**

Drain Valve. NEVER ATTEMPT TO SERVICE A CONTROL VALVE WITHOUT FIRST MAKING SURE THE SPRINKLER MAIN IS OFF AND PRESSURE HAS BEEN RELEASED. Remove the cover bolts from the valve and lift the cover off. Make sure you keep parts in respective order for reinstalling. Check the diaphragm for cracks, replace if worn or cracked, and cleanse in a pail of clean water along with other parts. Remove the solenoid assembly from the valve cover and clean the actuator and spring. Clean the cover and cover bolts last. Reassemble all parts and bolt the cover back on to the valve body. Beware if you have any leftover parts!

After repairing the valve, close the drain valve and turn the Supply Valve on slowly. Operate the zone and recheck the valve-closing speed. Should the valve continue to close slowly, consult the distributor or manufacturer of the valve.

The Control Valves should be installed in valve boxes which are large enough to permit service without earth excavation (see Fig. 2-5). Should you need to excavate the earth to repair a valve, it would be advisable to obtain a valve box of proper size and use it for

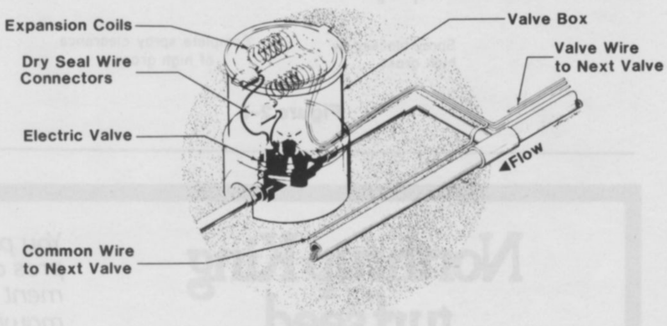



**Figure 2-5**

accessability for any future service. It will also serve as a good visual location of the valve.

If your system incorporates a booster pump, you should disconnect the power to the pump and follow the same procedures for turning on the system and filling the lines. Once the sprinkler main and zone piping is filled, reconnect the power to the pump and check the system for proper operation. This applies only to systems in which the water is supplied by the city main and the booster pump is used to increase the existing pressure.

If your system is supplied water by the use of a pump, follow the same procedures, although you should open the valve on the discharge side of the pump only about ¼ to ½ open and turn on a controller station when filling the lines. Once all piping is filled, open the valve fully and check system for proper operation. CAUTION: make sure the pump is fully primed before attempting to operate; failure to do so can cause pump damage.

Many irrigation systems require service when turned on in the spring. Even the best system available will require some type of service in its years of operation. With the cost of electricity, water, material, and labor increasing every year, this is the best time to get your irrigation system into proper operating condition. You may spend some money now in doing so, but if you wait, it will only cost more.

*Continues on page 34*

The most common causes of improper system operation are as follows:

1. Sprinkler heads not installed at the proper level (see Fig. 2-6)
2. Worn or broken sprinkler heads
3. Improperly installed equipment (valves, heads, controller, pipe, etc.)
4. Valves which are in need of repair or replacement
5. Bad wire connections (see Fig. 2-7 for proper connection)

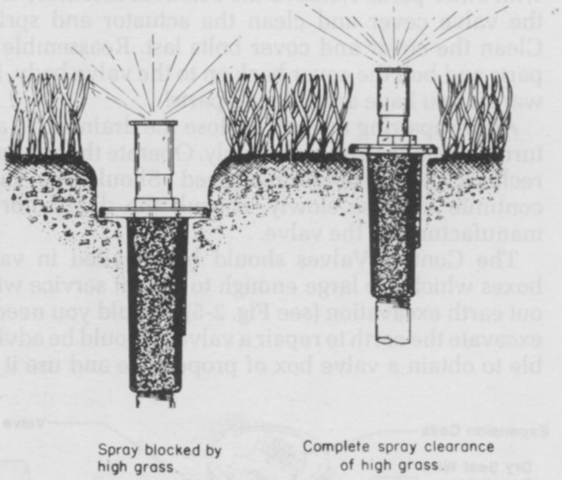



**Figure 2–6**

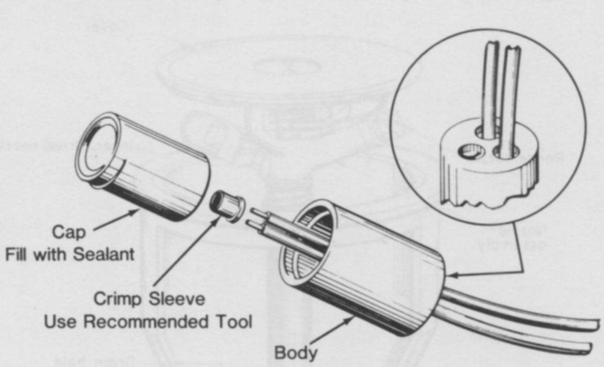



**Figure 2–7**

If your irrigation system has any of the above problems, you should take care of them now to help ensure trouble-free operation during the summer months. **WTT**

# REAGAN'S EPA: BALANCING RULES WITH THE BUDGET

**By James G. Dickinson,** special correspondent, Washington, D.C.

"Balance" has become a favorite word in Washington regulatory circles as the Reagan Administration seeks to change many of the things done or started by the Carter Administration. It's a good word to use, for although it can mean different things to people of different political viewpoints, in the current atmosphere of economic crisis there has been a remarkable fusion of differences to the point where "balance" is seen, generally speaking, in the same light by both Republicans and Democrats.

The people with the longest Washington memories scratch their thinning gray hair these days to remember a time when a President had the benefit of such consensus within the regulatory establishment. Was it Eisenhower, or does it go all the way back to FDR? That itch under everybody's saddle, the Washington bureaucrat, has undergone an astonishing change of demeanor since November 4. Unlike the cynical stereotype of past Administration changes, the average bureaucrat today is not thirsting to teach all these newcomers how Washington works — he's as anxious as the rest of the country to bring about "balance."

The Environmental Protection Agency, regulator of herbicides, pesticides, and fungicides among a bewildering array of toxic and other environmentally sensitive substances and processes, had not even fully completed its first decade of existence when the people expressed their will on November 4. Thus, there are no graybeards at EPA who remember how things were in the agency in Eisenhower's or FDR's time. But many worked in other agencies, and they're girding for what they expect will be an exciting, challenging, and simultaneously frustrating time as regulatory "balance" is swung into position.

The first instrument of this historic process came on February 17, just before Denver conservative Republican Anne M. Gorsuch was nominated to head EPA. On that day, President Reagan signed Executive Order 12291, an extraordinarily detailed and sweeping edict that stopped virtually every substantive pending and proposed regulation dead in its tracks, except those required by national security or court order. Included were some 38 final EPA rules that had either just come into effect or were about to soon become enforceable.

Among those were two dealing with the use of pesticides. Both were permissive rules sought by industry, and are not considered likely to be killed as a result of the review rigors to which they will be subjected under Executive Order 12291. More about them later.

The executive order, immediately remarkable for the high degree of bureaucratic approval it informally received as soon as it was issued, establishes a 25-step "regulatory impact analysis and review" procedure for all affected regulations. This procedure is so intensive that most informed observers agree that its first effect will be to significantly delay the practical onset of any of the affected regulations, and that its second will be to make the going so tough for many rules that agencies will simply just scrap them.

The President's stated rationale for the executive order is "to reduce the burdens of existing and future regulations, increase agency accountability for regulatory actions, provide for presidential oversight of the regulatory process, minimize duplication and conflict of regulations, and insure well-reasoned regulations." Wonderfully, the bureaucrats and rulewriters who have been responsible all along for those very ills are today among the heartiest applauders of that rationale.

Of course, bureaucrats are like regular people in that they have political beliefs too. Some are Republicans of anti-regulatory bent, and some are Democrats with opposite views. Many don't fit either stereotype. But it's both strange and reassuring to hear so many voluntarily declare, as one top regulation-writer of 20 years' standing declared to me, in speaking of Executive Order 12291: "I think it's wonderful, fantastic. We've got to turn the country around, or else we'll all go down the tubes without the Russians firing a single shot."

That bureaucrat, and literally thousands upon thousands of others like him, is already suffering all of the following fallouts from Executive Order 12291: Diminished job satisfaction, heavier workload, more frustration, less office help due to the hiring freeze, and harder personal finances resulting from the spending freeze that curbs pay hikes. Yet, strangely, many — if not most — of these bureaucrats are enjoying themselves more, in a perverse kind of way, than they did when it was they who called the shots; they see themselves as saving the country, and that's a heady feeling.

Look at some of the things Executive Order 12291 requires of each regulation, proposed, pending or final:

- Its potential benefits to society must outweigh its potential costs;
- Its objectives will be so chosen as to maximize net benefits to society;
- Among the alternatives to the rule's objective, that involving the least net cost to society *shall be chosen;*
- The rule's place in an agency's schedule of regulatory priorities must take into account the condition of particular industries affected, the condition of the national economy and other regulatory actions contemplated for the future;
- A special "regulatory impact analysis" must be prepared for and this must be sent to the Office of Management and Budget at least 60 days before it is to be officially proposed, to provide OMB with a chance to advise whether or not it wishes to comment — if it does wish to comment, the rule must be withheld until the comment is received.

These and many other delay-inducing requirements are also required of all "major" rules already in effect. Such rules are defined as those which are likely to result in:

(1) An annual effect on the economy of $100 million or more;

(2) A major increase in costs or prices for consumers,

*Continues on page 36*

**Reagan** *from page 35*

individual industries, federal, state, or local government agencies, or geographic regions; or
(3) Significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets.

The immediate reaction to the executive order, both within government agencies and without, was that it affected virtually everything in the pipeline, and possibly most out of it as well. Certainly, arguments could — and likely would — be made to review everything. The *Federal Register*, that hefty daily tome that publishes all regulations and associated notices, would have to go on a crash diet, cutting down on its average 250-pages-a-day consumption of newsprint. All it would likely publish from now on would be inconsequential procedural notices mandated by law, rules required as a result of explicit court orders — and a succession of notices staying the implementation of already-final rules, extending deadlines for comments on proposed rules, and proposing withdrawal of prior proposals.

When this was written, it was not immediately clear what would be the fate of two relatively noncontentious EPA final rules published in the dying weeks of the Carter Administration. These announced (1) That EPA would, from now on, establish pesticide residue tolerances, when requested, for replacement or rotational crops — rather than establish proscriptions on agricultural practices to insure that products bore zero pesticide residues; and (2) That state government could register, subject to EPA veto, certain pesticide uses and products not specifically included in EPA labeling, to meet special local needs.

The former, being more a statement of policy than the "final rule" it was termed by EPA, is so in harmony with Republican philosophy that Executive Order 12291's impact on it is almost certain to be short-lived. The latter, while still being generally in harmony with Republican thinking — encouraging a degree of state and local autonomy — will likely have to go through all the paces stipulated by the executive order.

One reason for looking carefully at this state registration regulation is the universal reluctance of industry to develop separate labels for each state or local jurisdiction. The rule could, conceivably, result in a plethora of special local and state uses and new products, each with slightly different labeling.

When the rule was proposed in August, 1979, this provision apparently failed to provoke great anxiety. For example, only one firm took EPA to task over it, a solitude that the agency took advantage of in rejecting the objection. "This commenter," EPA said pointedly, "apparently stands alone, even though other members of the pesticide manufacturing industry might benefit economically if the commenter's suggestion were adopted by EPA."

Potential economic benefit, of course, is what Executive Order 12291 is most interested in. EPA will doubtless be thinking long and hard about this before it so lightly dismisses such objections in the future, be they from a lone commenter or not.

Many matters, small and large, are changing in such manner at EPA. President Reagan's choice for Administrator will see to that, starting with her selection of some 24 deputy assistant administrators. She may — and doubtless will — retain many of the incumbents, since industry has not been clamoring for a wholesale cleanout; in addition, most are "career" people rather than political appointees, and as such can only be moved sideways, not fired.

Gorsuch's track record in her home state of Colorado, where she had been both a corporate attorney for Mountain Bell Telephone and an outstanding member of the state legislature, is one of strong decision making and dedication to state rights. Like the other Coloradoans who have been brought to Washington by Mr. Reagan, Gorsuch has critics in the environmental and friends-of-nature camps. News of her nomination was greeted by the Colorado Open Space Council with the observation that "She's hard-working and conscientious, but she's not particularly sympathetic to environmental concerns." In her first two years as a state legislator, the council rated her 33 and 8 respectively on its 100-point scale of environmental consciousness. By 1980, she had rehabilitated herself to 72 by sponsoring automobile inspection and maintenance legislation aimed at controlling Denver's air pollution.

Clean water and clean air will be her main concerns at FDA, she told me, ducking an opportunity to discuss more down-to-earth issues like pesticides, herbicides and fungicides. Had she no experience with such matters? "I didn't say that," Gorsuch replied stiffly.

If she hasn't had such experience, she will soon get it — in spades. The burning issue of the moment — if not the decade — in EPA's Toxic Substances Division is whether to ban outright all uses of 2,4,5-T and Silvex, contaminated by the teratogenic, abortifacient, carcinogenic "unavoidable" chemical Dioxin or TCDD. The contentious herbicide's fate is currently before an administrative law judge of the EPA, and whichever way his decision goes, Gorsuch will come under pressure to exercise her authority to overrule it. She may even come under immediate pressure to stop the judge's hearings — and she has the power to do that, too.

This pressure, whenever it comes, will inevitably call for a delicate value judgment from a woman who prides herself in having the capacity to make "hard decisions." Gorsuch is unlikely, observers say, to be unduly swayed by the teratogenic and abortifacient findings; as a woman who, activists allege, turned her back on the women's movement in Colorado, she may be expected to view the data unemotionally.

Which is to say, in the current parlance of Washington, she will apply "balance" to her deliberations. That should be good news to all but the most single-minded of EPA's many diverse publics.

Indeed, despite the inevitable political skirmishing that's going on over the Reagan budget cut proposals, most of what this new Administration is doing is meeting with general approval. As already stated, the most remarkable aspect of this general approval is the zeal with which harassed and otherwise frequently obstructive bureaucrats have rallied to the cause.

This is not the stuff of newspaper headlines, and television specials. Indeed, the news media — at least in Washington — can sometimes now be seen coyly admitting that it prefers to carp and to criticize, and that, yes, maybe it does overdo it now and again. **WTT**

# THATCH BIOLOGY: BALANCING GROWTH WITH DECOMPOSTION

**By Richard W. Smiley, Ph.D.,** Associate Professor, Plant Pathology, Cornell University, Ithaca, NY

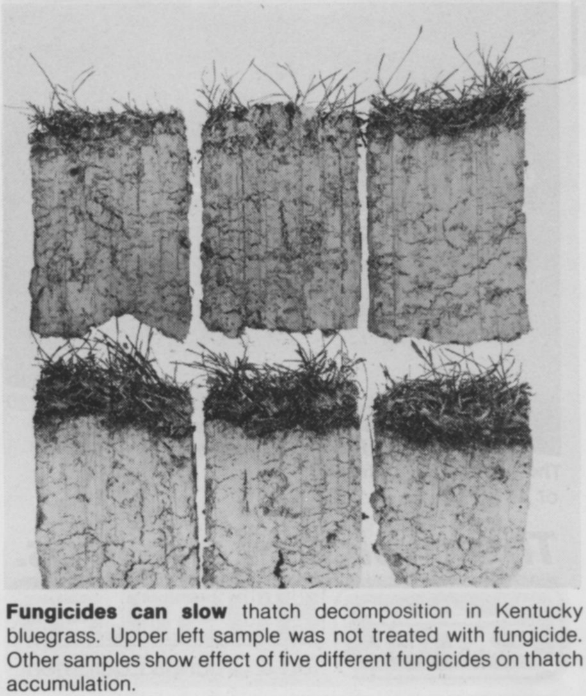
Thatch is an important property of turfgrasses. The causes of thatch are easily listed, but the manner in which these causal factors operate is not well known. This article will concentrate upon recent results of research on thatch accumulation.

Most definitions used to describe thatch agree that thatch is comprised of a layer of dead and living stems (tillers, stolons, and rhizomes) and roots that develop above the soil surface and below the leafy foliage. Leaf clippings are reported to contribute very little to the thatch layer. The leaf clippings generally form a pseudothatch, which is a less-densely packed layer above the thatch. A layer of intermixed soil, stems, and roots has been termed the mat.

Turfgrasses are not unique in possessing such layers; they are also found in grasslands, pastures, forests, and other ecosystems. In grasslands the layers are often designated at the A, Ao, and Aoo horizons, respectively, for the surface soil, mat, and thatch. Thatch is also synonomous with the terms surface litter, compressed litter or humid mulch. Pseudothatch is synonomous with loose litter or fresh mulch.

These comparisons set the stage for a discussion on the causes of thatch. It must be understood clearly that thatch is composed of organic litter, and that its management involves manipulations of biological process which do not differ from those occurring in other ecosystems.

Research conducted in other grasslands is therefore often directly applicable to our understanding of turfgrass thatch. Much of the following discussion is derived from studies of grassland ecology. The results seemingly explain many observed responses of turfgrass thatch to various environmental and management variables.



**Fungicides can slow** thatch decomposition in Kentucky bluegrass. Upper left sample was not treated with fungicide. Other samples show effect of five different fungicides on thatch accumulation.

### Tissue Production vs. Decomposition

Plants produce tissues in cyclical patterns. Cool-season grasses, for instance, typically produce most leaf growth in the spring and autumn, and most root growth in the autumn and winter. The life of each leaf, tiller, rhizome, and root is relatively short, and a continuous cycle of tissue production and death occurs to perpetuate these perennial species. Decomposition of the tissues also depends upon seasonal cycles and the prevailing environmental conditions. Thatch results when the production of tissues proceeds at a rate more rapid than that for decomposition. This balance depends upon a multitude of interacting biological processes.

### Factors Affecting the Balance

The tendency for thatch to accumulate or not depends mostly upon the plant growth rate, the composition of the plant tissues, the amounts and types of pesticides being used, and the fertility, aeration, temperature, and moisture *in* the thatch environment. Each of these factors can be expected to fluctuate widely and independently. The long-term overall balance is therefore more important than conditions at any specific time.

### Plant Growth Rates

Plants which produce the most extensive root and stem systems are likely to become more thatched than those with limited amounts of these slow-to-decompose tissues. Varieties within a species can differ in both the composition and amount of these tissues. All of these variables can affect the tendency for thatch to accumulate. Likewise, all management procedures, including pesticides, which improve turfgrass growth will by definition increase the amount of tissue being produced. Some conditions will increase the rates of production and decomposition, but others will increase production and decrease decomposition. The most important of the factors are discussed below.

### Plant Composition

An appreciation of thatch must include an understanding of the chemistry of plants. Numerous chemicals in plants occur in only small quantities, are easily decomposed by microorganisms, or both. These components contribute little to thatch. Constituents that are very resistant to decomposition processes and are also abundant in plants are the primary compounds found in thatch. Most of these compounds are necessary to provide strength to the grass plant, e.g., they give the plant its superstructure.

Waite and Gorrod (1959) analyzed the compounds of immature and mature ryegrass plants (Table 1). The most persistent components are ash, fats, waxes, phenolic compounds, lignin, hemicelluloses, and cellulose. Ash is the term designating the mineral elements (calcium, potassium, etc.) that are in the tissue. In this example the resistant components (excluding ash) comprised 42% of the young ryegrass plant, and 74% of the older plant. Beard (1976) provided a clearer per-

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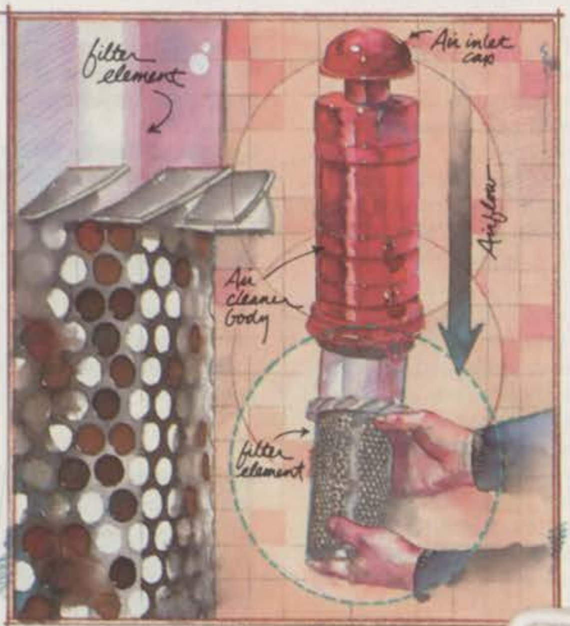
# WE GET DOWN TO THE NITTY-GRITTY.

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**Thatch** *from page 38*

spective of the resistant components in several turfgrass species (Table 2). The table reports the composition of leaves, stems and roots of a bentgrass, a bluegrass, and a fescue. The bentgrass leaves had more hemicellulose than the bluegrass and fescue leaves, and the total of the three components was 11% higher in bentgrass leaves than in bluegrass leaves. In contrast, bentgrass stems contained about 15% less resistant materials than stems of bluegrass and fescue. Bluegrass stems had more hemicellulose than the other grasses, whereas fescue stems had twice as much lignin as the other grasses. No major differences in the compositions of root tissue were reported.

The compositional differences become important when the rates of decomposition of these compounds are compared. Clark and Paul (1970) and Whitehead et al. (1979) have each reported that, under ideal conditions, the time required for a 50% loss (e.g., the 1/2-life) of ryegrass leaf or root weight (excluding water) in soil was 20 weeks (Fig. 1A). At this rate, only about 80% of the original leaf weight will be mineralized (decomposed) to carbon dioxide, mineral elements, and other primary compounds during the first year. Decomposition rates differ for each of the resistant compounds. The half-life period is about two weeks for hemicellulose and cellulose, one year for lignin, 2.5 years for waxes, and 6.5 years for phenolic compounds (Clark and Paul, 1970). These rates are essentially the same in all plant litter (e.g., grass leaves or roots, oak leaves, etc.) in which they occur.

**Table 1.** Compositions of young and mature ryegrass foliage (from Waite and Gorrod, 1959).

| Component | Percent of Dry Water: Young | Percent of Dry Water: Mature |
|---|---|---|
| Fats and Waxes | 3.9 | 1.9 |
| Organic Acids | 3.6 | 2.0 |
| Water Soluble Carbohydrates | 29.5 | 4.6 |
| Phenolic Compounds | 0.4 | 1.1 |
| Pectins | 3.1 | 4.1 |
| Crude Protein | 7.5 | 3.4 |
| Lignin | 3.5 | 11.3 |
| Hemicelluloses | 14.0 | 25.7 |
| Cellulose | 20.2 | 33.8 |
| Acetyl | 0.9 | 2.0 |
| Ash | 7.5 | 4.9 |
| Unidentified | 3.3 | 3.0 |
| Unaccounted for | 3.0 | 2.3 |

**Table 2.** Partial compositions (%) of tissues in creeping bentgrass, Kentucky bluegrass, and red fescue (from Beard, 1976).

| Plant Structure | Plant Species | Hemi-cellulose | Cellulose | Lignin | Cell Wall |
|---|---|---|---|---|---|
| Leaves | Bentgrass | 34 | 19 | 4 | 56 |
| | Bluegrass | 26 | 18 | 2 | 46 |
| | Fescue | 27 | 21 | 3 | 51 |
| Stems | Bentgrass | 30 | 23 | 4 | 57 |
| | Bluegrass | 39 | 28 | 5 | 72 |
| | Fescue | 29 | 35 | 11 | 75 |
| Roots | Bentgrass | 36 | 27 | 14 | 76 |
| | Bluegrass | 34 | 27 | 10 | 71 |
| | Fescue | 34 | 33 | 13 | 80 |

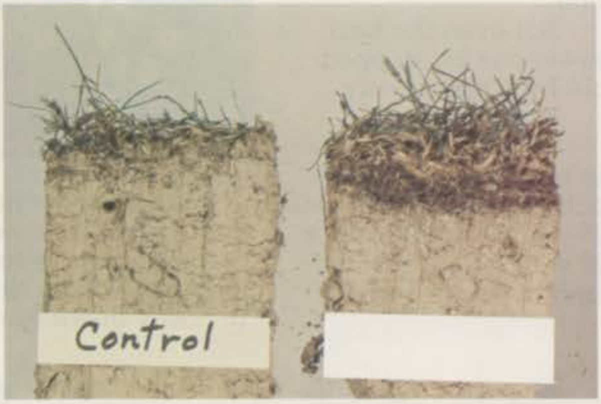
Since most of the major constituents of plants decompose more rapidly than lignin, it is not surprising that lignin is a major component of thatch. It therefore becomes apparent that leaves should decompose much more rapidly than roots, that fescue stems should decompose as slowly as roots, and that stems of bentgrass should decompose almost as rapidly as leaves. The modifying effects of cellulose and hemicellulose presumably reduce the decomposition rate for bluegrass stems (including rhizomes) much more than for bentgrass stems (including stolons).

### Causes of Tissue Decomposition

The decomposition of plant tissue is performed by the microorganisms, microfauna (small animals, including insects), and macrofauna (larger animals) in the soil. The numbers and types of organisms involved are very large, and their interactions are complex. Precise sequences of events apparently differ from one habitat to another.

Individual species of soil microorganisms do not possess all of the enzymes and other characteristics

*Continues on page 42*




**Three-year difference** in thatch accumulation (top) in untreated and fungicide treated Kentucky bluegrass. **Two inches of thatch** in Kentucky bluegrass virtually separating turfgrass roots from the soil.