



as young nymphs on the undersides of branches on spruce or on the lower leaf surface of Douglas fir, the alternate host of the Cooley gall adelgid.

Pine bark adelgid overwinters as eggs, nymphs, and adults in bark cracks and crevices on white pine.

By late winter the trunks of infested pines may be snow-white from huge numbers of adelgids.

Adelgids can be controlled on all hosts any time after spruce galls open in late summer until just prior to bud break the following spring.

Horticultural oil may reduce the overwintering population, but oil may remove the waxy bloom from the needles of spruces and pines, causing them to become unsightly.

Sevin (carbaryl) or lindane can also be used in a thorough-coverage, hydraulic spray, making sure to cover the underside of spruce branches and Douglas fir needles. A wetting agent may be useful to help penetrate the fluffy wax covering that surrounds the insect, especially when treating the pine bark adelgid.

Mites

Spider mites, including spruce spider mite on coniferous evergreens and southern red mites on broadleaf evergreens, suck plant juices and deposit silk and waste material on their hosts, causing foliage to become dull and bronze-colored.

Mites tend to feed in spring and fall but populations usually crash in very hot or very cold weather. They overwinter in the egg stage which is susceptible to control with horticultural oil used at the dormant season rate.

False spider mites are tiny, flat mites which feed and reproduce slowly throughout the year. Most "winter injury" symptoms on Aucuba, azalea, and Japanese hollies are due to false spider mites.

Horticultural oils or other miticides give adequate control of these pests. Treatment is appropriate at any time of the year except in early spring when new, tender growth is emerging.

Aphids

Aphids are small, soft-bodied insects that insert their mouthparts into the phloem of leaves, stems, and roots to suck out sap.

Aphids excrete honeydew, a sweet liquid that coats heavily infested plants. Some species (melon aphid, apple aphid) feed on the most succulent part of the plant. Other species (giant willow aphid, giant bark aphid, *Cinara* aphids) feed on stems. High aphid populations can cause leaves to



Fuller rose beetles notch the leaves of shrubs in the South.

yellow and fall prematurely.

The honeydew they excrete serves as a substrate for a black sooty mold fungus that reduces the aesthetic appeal of the plant and reduces its ability to manufacture food.

Many aphids overwinter as exposed eggs on conifer needles or on stems and buds of other woody plants.

If a damaging aphid population was detected the previous summer or fall, an application of horticultural oil before bud break will reduce the spring aphid population, thereby giving the tree a chance to recover before aphids build up again during the spring and summer.

Soft Scales

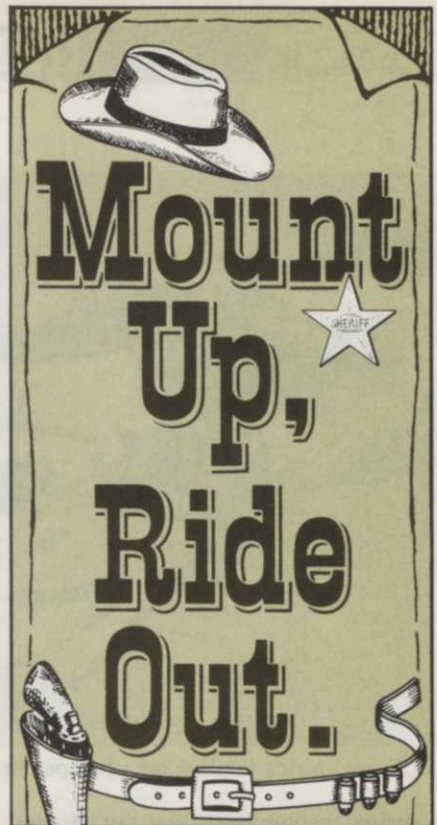
Soft scales are another kind of sucking insect that drain a tree's energy and reduce its ability to manufacture food.

They suck sap from the phloem and produce honeydew. Some (e.g. the tulip tree scale) seriously weaken or kill their hosts.

Heavily infested trees and shrubs often become blackened with sooty molds. Some soft scales overwinter as immature forms (cottony maple, cottony maple leaf, magnolia, Pine tortise, and Fletcher scales) that are somewhat vulnerable to horticultural oils used at the dormant application rate.

Spring (April-late June)

Most insects become active in the



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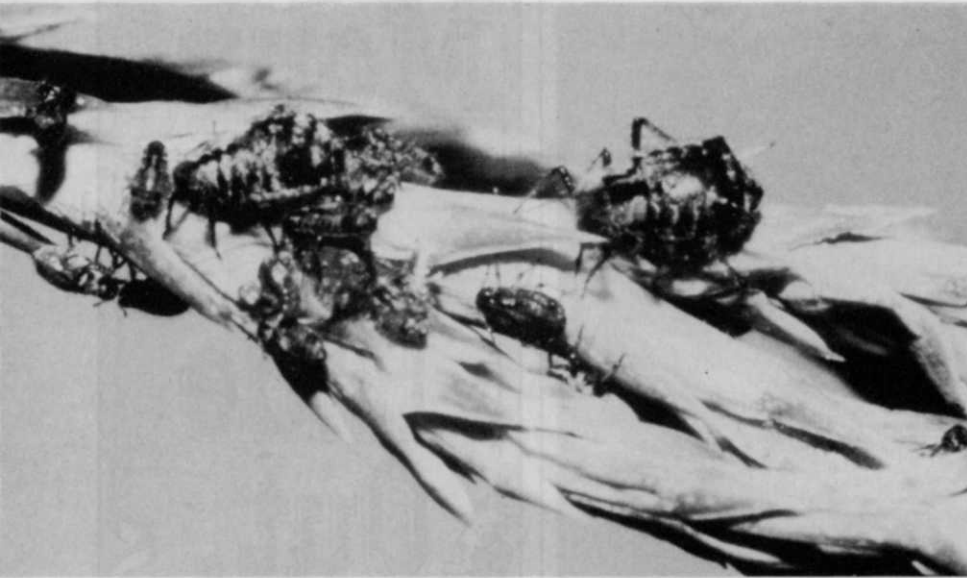
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Cinara aphids feeding on a juniper in the early spring.

spring, responding to warmer weather and resumption of plant growth and development.

Monitoring trees and shrubs for pests during spring is one of the most important tactics in a modern insect control program.

Newly expanding or expanded leaves should be checked for the presence of sucking insects, leafminers, and defoliators.

Tree limbs and trunks should be inspected to determine presence of active borer galleries as early detection will permit time for learning the identity of the pest and determining if a spray program is justified.

Defoliators

Eastern tent caterpillar, fall cankerworm, whitemarked tussock moth, and pine sawflies are among the first defoliators to begin feeding in spring.

The eastern tent caterpillar is obvious and readily detectable because it forms a silken tent in tree crotches, especially flowering fruit and nut trees.

During years of high caterpillar numbers, entire trees may be defoliated. These pests often reach maturity before defoliation is noticed.

The tent caterpillars and their relatives, including mimosa webworm, fall webworm, bagworm, and gypsy moth, are readily controlled with a number of conventional insecticides or with the bacterium, *Bacillus thurengiensis*, commonly known as B.t.

Pine sawflies are often difficult to detect since they blend-in with needles on their hosts. They often reach

maturity before defoliation is noticed.

Sawflies are related to bees and wasps and are highly susceptible to Sevin. Orthene (acephate) is also labeled for this use.

Elm leaf beetle larvae and adults consume foliage. There are two generations each summer. Sevin, Orthene, or Turcam/Dycarb (bendiocarb) can be used when trees leaf-out in spring. A second generation may require a second application in July.

Armored Scales

Armored scales, soft-bodied sucking insects that suck juices from leaves and stems but do not produce honeydew, are named armored scales because after the first stage molts, later stages are covered by cast skins and tough wax.

Consequently, they are vulnerable to contact insecticides only during the crawler and settled first nymph stages.

Armored scales overwinter as eggs (pine needle and oystershell scale), as mated females (euonymus and white peach scales), or in more than one stage (hemlock and tea scales). As indicated, all of them are most easily controlled with crawler sprays.

Armored scales that overwinter as eggs can usually be controlled with a single application of an insecticide, if thorough coverage is achieved. If application timing is not precise, a systemic insecticide like Metasystox-R (oxydemetonmethyl) or Orthene should be used.

Species like euonymus scale require more than one crawler spray, since the first hatching crawlers molt before the last spring genera-

tion eggs are laid.

Three thorough-coverage, hydraulic sprays at 10-to-14 day intervals are needed to provide an adequate level of control.

All armored scales that have more than one generation per year (pine needle, euonymus and white peach scales) should always be controlled during the spring crawler hatch because the hatching period is shorter at that time, so fewer sprays are required to provide control.

Horticultural oils may be effective for armored scale control. Use the summer rate after new plant growth has hardened-off.

Aphids

Aphid populations can explode in a short time, since a new generation can be produced every 10-to-15 days in the North and even faster in the South.

In the North, aphids are often at high population density during summer droughts, or just after a drought period, and should be controlled before they cause premature leaf drop.

In the South, aphid populations are often high in late winter and early spring before lady beetles and other predators become active. However, crape myrtle aphid populations often become damaging later in the summer.

Mistblower applications are excellent against free-living aphids.

Adelgids

Remember, overwintering forms can be controlled by using a hydraulic application of lindane or Sevin, stressing coverage to the underside of branches and leaves before bud break.

After bud break, adelgids on spruce are protected as their galls form. They become vulnerable again in fall after their galls open. Pine bark adelgids can be controlled in spring or summer as long as the pines are not under water stress and after the new growth has begun to harden off.

Leafminers

Birch, boxwood, and holly leafminers are highly specialized insects whose larval stages damage trees and shrubs by destroying tissues within the leaf.

Birch leafminer is a sawfly (closely related to bees and wasps) who emerge as adults in May.

Foliage can be protected by spraying when the adult sawflies are actively mating and feeding on birch trees.

Sevin, malathion, and lindane are effective before eggs are laid within leaf tissue. After egg laying begins or



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INSECT CONTROL GUIDE

INSECTICIDE DIRECTORY

Common Name	Brand Name	Company
acephate	Orthene	Ortho/Chevron
<u>B. t.</u>	Thuricide	Zoecon
	Dipel	Abbott Labs
	SOK Bt	Nor-Am
bendiocarb	Turcam	Nor-Am
carbaryl	Sevin	Union Carbide
chlorpyrifos	Dursban	Dow
diazinon	Diazinon	Ciba Geigy
	Sarolex	Ciba Geigy
dicofol	Kelthane	Rohm & Haas
dicrotophos	Bidrin	Shell
dimethoate	Cygon	American Cyanamid
dioxathion	Deltic	Nor-Am
dymet	Dymet	Mallinckrodt
femobutain-oxide	Vendex	Shell
fenvalerate	Pydrin	Shell
fluvalinate	Mavrik	Zoecon
isofenphos	Oftanol	Mobay
malathion	Malathion	American Cyanamid
methoxychlor	Marlate	Kincaid
morestan	Imidan	Stauffer
oxydemetonmethyl	Metasystox	Mobay
phosmet	Imidan	Stauffer
trichlorfon	Dylox	Mobay
	Proxol	Nor-Am

mines begin to form, a systemic insecticide should be used. Metasystox-R, Orthene, and Cygon (dimethoate) are labeled for this use.

There are several generations per year, but the first two generations seem to be most destructive.

Holly leafminer is a true fly that has only one generation per year. Spring application of Metasystox-R or Orthene after the new plant growth has hardened-off is necessary to achieve control.

Boxwood leafminer is a gall midge which also has one generation per year. A mid-to late-spring application of Cygon will adequately control boxwood leafminer.

Spider Mites

Spider mites such as twospotted spider mite and tumid mite are common and damaging on plants under water stress and during long, hot droughts.

They complete many generations throughout the summer. Kelthane (dicofol), Mavrik (fluvalinate), or an-

other miticide should be used before mites cause foliage to turn bronze. A hydraulic sprayer must be used to maximize coverage, especially on plants with dense foliage, including foundation plantings, conifers, and other evergreens.

Two sprays must be used at a seven-to-10 day interval, since most miticides do not kill eggs. A single application will not be effective against spider mites.

Root Weevils

Root weevils (black vine, strawberry root), can be destructive in both adult and larval stages.

Adults chew notches in leaf margins. Larvae consume small roots and girdle larger roots, sometimes causing death of foundation plants, including rhododendron, azaleas, and yews (taxus).

Spray foliage with Orthene or Turcam/Dycarb in mid-June, followed by repeat applications at three-to-four week intervals until August.

Level of control is directly related

to the degree of coverage, so use a hydraulic sprayer to control root weevils. Drenching soil beneath host plants may help reduce larval populations.

Borers

Clearwing moth borers are common in lilac, ash, dogwood, rhododendron, oak, and flowering cherries. Flatheaded borers (adults are called metallic wood borers) are common in white-barked birches, oaks, and other stressed hardwoods.

Larvae do the damage by feeding beneath bark, disrupting movement of food and water, destroying the cambium (the growth layer of cells), and causing structural weakness. Clearwing presence and flight periods can be monitored with pheromone traps (see insert).

A single, thorough-coverage bark spray of Dursban (chlorpyrifos) or lindane, 10-to-14 days after first male moth capture, will provide season-long control of most clearwing moths.

Three applications of bark/foilage sprays with Turcam/Dycarb, Dursban, or lindane are required to control flatheaded borers.

Summer (July-Sept.)

Defoliators

Mimosa webworm, bagworm, fall webworm, Japanese beetle adults, and second generation elm leaf beetles sometimes become common in early summer.

All of these pests should be controlled when larvae are small to minimize damage and maximize effectiveness of the insecticide. Caterpillars can be controlled with one of the B.t. formulations. Sevin, Orthene, Turcam/Dycarb, and several other common insecticides will also control these pests.

Mistblower application may be cost-effective but may result in unacceptable drift of insecticidal sprays, especially in windy weather.

Japanese beetle adults defoliate many kinds of woody plants and roses in July and August. They are most easily controlled with weekly sprays of Sevin or Turcam/Dycarb.

Mavrik also gives long-term control of Japanese beetle adults. Japanese beetle traps can be used to capture large numbers of beetles, but they do not reduce defoliation or control the beetle population.

Area-wide grub control is the most effective way to reduce numbers of Japanese beetle adults and defoliation they cause.

Second generation elm leaf beetles



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can cause significant defoliation if heavily infested trees are not sprayed. Birch leafminer can be controlled, if trees are sprayed when second or third generation adults are mating and ovipositing.

Scales

Crawlers of several soft scales (Fletcher, cottony maple, cottony maple leaf, pine tortoise, wax and tulip tree) hatch in late June or early July (earlier in the South).

They and settled nymphs are susceptible to scalicides (Sevin, Orthene, diazinon, Dursban, Turcam/Dycarb and Mavrik) in early July. A single, thorough-coverage, hydraulic spray should provide control.

Settled nymphs and other nymphal stages are vulnerable to contact insecticides, because they are not protected by cast skins and wax. Sprays to control soft scales should always be applied after all eggs have hatched to minimize the impact of pesticides on lady beetles and other predaceous insects, to minimize insecticide usage, and to maximize control.

Second generation pine needle scale, euonymus scale, and white peach scale crawlers hatch during July and early August. Two sprays at a 10-day interval may be required to control pine needle scale and white peach scale because crawlers hatch over a three week period.

Summer generation euonymus scale crawlers hatch over a longer period, so three applications at 10-day intervals are required.

Aphids

Aphid populations should be controlled before they secrete copious amounts of honeydew or do irreversible damage to leaves.

If aphids are allowed to build-up in high numbers, plant growth may be distorted and leaves may fall prematurely. Once honeydew and sooty mold are present they may persist long after aphids have been controlled by pesticides or natural enemies. Aphids are vulnerable to contact sprays whenever they are active.

Spider Mites

Spider mites can be controlled whenever they are active by spraying twice with a five-day (South) or 10-day (North) interval.

If trees are receiving repeated applications of Sevin to control other insects, be especially watchful for build-up of spider mites. Sevin selectively kills natural enemies of mites, thereby contributing to increases in spider mite populations.

Woody ornamentals—such as

some euonymus varieties, roses, and bedding plants—are frequently infested by twospotted spider mites and tumid spider mites. These mites are dispersed on air currents and may appear suddenly in large numbers in hot dry weather.

Root Weevils

The second and third applications of black vine weevil adulticides should be applied in July and August.

In the South, Japanese weevils and Fuller rose beetles can be controlled with Orthene as a spray and drench during July. A single spring application will not control black vine weevil or other weevils mentioned earlier.

Area-wide grub control is the most effective way to reduce numbers of Japanese beetle adults...

Borers

White-barked birches determined to be infested by bronze birch borer during the summer can be injected with Inject-A-Cide B (Bidrin) using microinjection procedures developed by the J. J. Mauget Company.

Injection must be done by a trained technician between early July and early August but should not be used as an annual, preventive tactic.

Infested trees should be watered weekly during summer and fall drought and fertilized in the fall after the first hard frost.

The following year, bark/foilage sprays should be implemented as indicated earlier.

The peachtree borer can be controlled with a single application of Dursban or lindane in early July (in the North) or late August (in the South). The second application for control of lesser peach tree borer should also be applied at this time to infested flowering cherries.

Fall (Sept.-Oct.)

Defoliators

Mimosa and fall webworms reach their highest population density and cause most defoliation during late summer and early fall. They should be controlled as soon as first generation larval webs are detected in early summer.

However, both pests are susceptible to larvicides in late August and early September. If B.t. is to be used, it must be applied when larvae are small to achieve an acceptable level of control.

Scales

Magnolia scale and tulip tree scale crawlers are produced in late August and early September. Infested magnolias should be sprayed when goldenrod is in full bloom (early September).

A single, thorough-coverage, hydraulic spray with Orthene or Sevin will provide excellent control. Magnolias and tulip trees may be severely stunted or even killed by heavy infestations of these scales.

Gall Adelgids

Galls on spruce caused by eastern and Cooley spruce gall adelgids turn brown and open in August and September. After galls open, adelgids are vulnerable to contact insecticides. Adelgids on spruce, Douglas fir, and pine remain vulnerable to insecticidal sprays until the following spring when new buds open.

Root Weevils

Attempts to control root weevil larvae should be made in early September and early October. Two drenches with Turcam/Dycarb have been effective against larvae established in soil surrounding roots of field plants.

A single drench with Turcam/Dycarb, Orthene, or Furadan (carbofuran) controls larvae infesting containerized plants. Recent evidence indicates that overwintered larvae may also be susceptible to drenches in early spring.

Closing Thought

We believe that the best way to minimize insect damage is to maintain healthy trees and shrubs. Trees should be matched to sites, watered during the first two years after planting and during summer and fall drought, pruned properly, fertilized in late fall, mulched, and aerated to promote root vitality.

Adherence to these basic horticultural practices will promote tree vitality and improve their ability to withstand attack by most insect pest species.

Throughout this article we have stressed the importance of pest identification, proper timing, and thorough coverage for achieving a high level of insect control.

Coverage and timing are often more important than the insecticide or miticide used. So, make sure of proper pest identification, determine when it is most vulnerable to control, and apply a pesticidal spray thoroughly to only infested trees following label directions. **WT&T**

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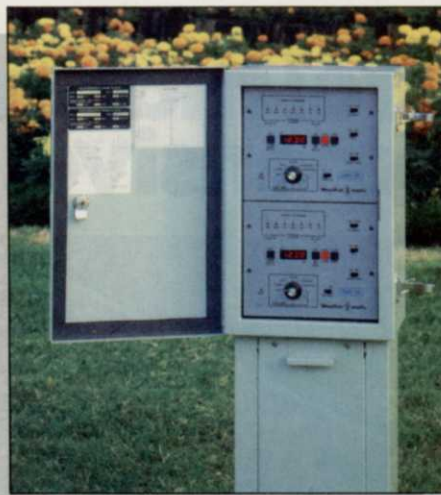


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HIGH-TECH OVERLOAD

Computerization of the irrigation industry is here to stay. Now it's up to the individual companies to educate their clients on the variety of new technology.

by Jerry Roche, editor

Development of new technology...computerized controls, plant stress monitors, more efficient nozzles...this is the future of the irrigation industry as the years wind their way toward the millennium.

Of course, whether the landscape manager is ready for this high-tech overload is another thing.

"I've found that 70 percent of the market doesn't go for computers yet," notes Chuck Hoover of Irri-Trol, Valencia, Calif. "Six, seven, eight years from now, though, people coming out of schools will want to know how they can program their computers."

Adds Don Cooper of Weather-matic, Garland, Texas: "You take the average Joe and put a computer console in front of him and it's going to turn him off. He doesn't understand it. But with proper instruction, the digitals are very easy to use."

Hoover says that when the big changeover from mechanical to digital does come, "it'll come so fast that if people aren't prepared for it, it will go right past them."

So the irrigation industry is ahead of everybody? Maybe, maybe not.

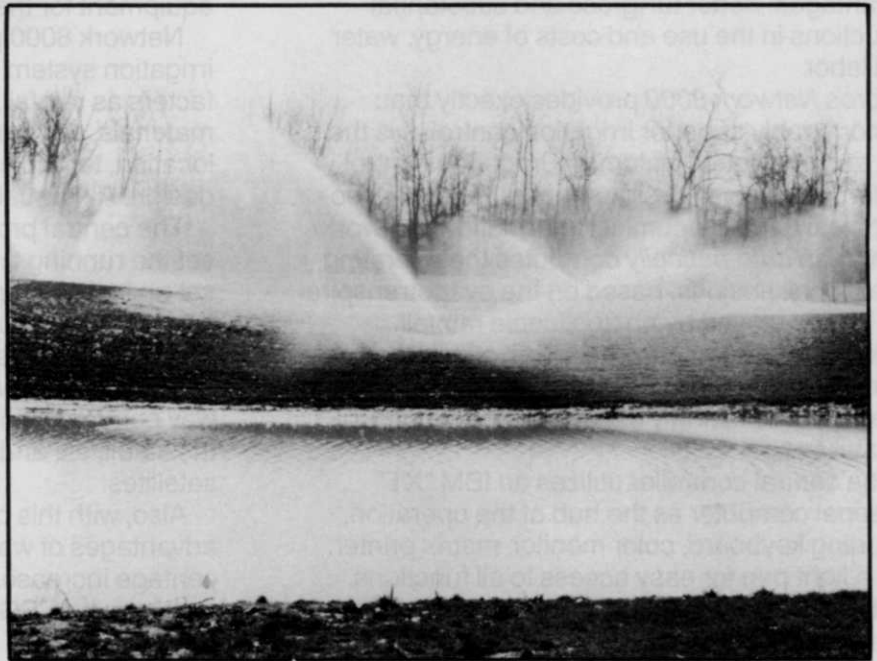
"You could look at it that way," says Dave Davis of Buckner Irrigation, Fresno, Calif. "Or you could look at the new technology as being too late. If it would've been around 20 years ago, we wouldn't have to be so stingy (with water) today."

Also of concern to the industry, then, is conservation of water and energy, each of which has been in short supply at some time during the last 15 years.

Saving water

"I have a personal challenge to all irrigation equipment manufacturers," said Dan Heiny of The Irvine Company, Irvine, Calif., in the August, 1984, issue of WEEDS TREES & TURF. "That is to develop a low-volume pop-type spray head."

Such a system has been developed but cost is still high, notes Gary Panuzzi of Richdel, Carson City, Nev. But they will come down. "It's like a watch you can buy \$3. Everybody will



David Cordillo of Hydro Systems, Warminster, Pa., says there's an inherent evil with throwing water up in the air. Nonetheless, above-ground irrigation remains extremely popular.

be able to afford it."

But low-volume is not the issue, some other manufacturers claim.

"Application rates are," says Rick Robins of Toro Irrigation, Riverside, Calif.

"The main thing is to apply the water in the right spot at a rate slow enough so the soil will absorb it," says Robins.

The key to slow application is the sprinkler head; the key to location is the controller.

"You use a controller that breaks up application times," Robins continues. "It doesn't make any difference whether the controller is mechanical or solid state. Even though the solid state units can make applications of less than one minute in duration, some mechanical clocks have more start times—23 or 24—compared to the four or six of solid state clocks."

One way to save water is with sub-surface irrigation, which is especially effective in convoluted areas and on ornamentals.

"There are inherent evils of throwing water up in the air," says David Cordillo of Hydro Systems, Warminster, Pa., extolling the virtues of his company's sub-surface drip system. "Sub-surface is the irrigation system of the future."

The Golf Course Superintendents Association of America is trying to develop ways to cut water usage in half, a goal that Dr. James Beard of Texas A&M University thinks is attainable.

"The talk is that there's a trend toward controlling water usage," notes Cooper of Weather-matic. "The professional irrigation contractor is adhering to that talk. But we've got some contractors out there that definitely are not professional."

"As a company, we are very cognizant of the water shortage. We as an industry have to recognize that water is a finite resource. If we don't, we're going to be out of work."

Monitoring plants

Efforts are being made to avoid apply-

continued on page 62

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The central programmer will operate any station, set the running time, assign it to any program and set up to three repeats for any station. It can operate up to 800 satellites of 32 stations each, for a total of 25,600 stations.

Toro's new Network 8000 central provides two-way communication: "down-loads" information to the satellites, and "up-loads" information from the satellites.

Also, with this central station you enjoy the advantages of water-budgeting by means of percentage increase/decrease control (by station, by program, by CSG, or the total system), from 1% to 900%.

But this is only the beginning of the story. You have to see it perform to fully appreciate exactly what it can do for you and your irrigation. Call *The Man from Toro* for a no-obligation demonstration.



Key components to Network 8000 are the IBM "XT" personal computer with color monitor and keyboard, operated with handy light pen. Shown in the middle is Toro's Delay & Distribution Unit. And on the right, the IBM matrix printer and stand.

